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Belmont-Redhead local environmental study : final report

NSW DEPT PRIMARY INDUSTRIES



AB019921

Belmont - Redhead



Local Environmental Study

Final Report

Prepared for Lake Macquarie City Council

by

HASELL

January 1996

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NSW DEPARTMENT OF
MINERAL RESOURCES

28 NOV 1996

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EXECUTIVE SUMMARY

This report presents the findings of an environmental study of the site known as Belmont - Redhead owned by BHP in Lake Macquarie City.

The work has been undertaken by Hassell in association with the following sub-consultants:

- . Patterson Britton & Partners;
- . Arup Transportation Planning;
- . Antcliff Ecological Surveys;
- . Mr R. H. Luke; and
- . Navin Officer Archaeological Resource Management.

STUDY AREA

The study area is located between the suburbs of Belmont and Redhead in Lake Macquarie City.

The site is significant in both a regional and local context. It is in a significant location in that it provides an opportunity to link the coast with the existing areas of Belmont and beyond to Lake Macquarie. The site also contains one of the few large remaining wetland areas in Lake Macquarie and occupies around 20% of the coastline in the local government area.

A number of the wetlands are protected under the State Environmental Planning Policy No. 14 (Coastal Wetlands). Other significant aspects of the site include a coastal dune system, the abandoned Redhead Coal Company's Railway, a closed coal mine, various areas where sand mining has been conducted and one active sand mining operation.

METHODOLOGY

The study was conducted in three stages - research, analysis and design. In the first stage, all available information was reviewed to determine the background of the study and the site. Relevant government agencies were consulted to gain their understanding of issues relating to the Belmont-Redhead site and to ascertain which issues needed to be further investigated as part of the study.

The largest component of the initial stage was the conduct of in depth environmental investigations. These covered issues such as traffic and transport, engineering, bushfire hazard analysis, archaeological and historical aspects, water quality, climate, geotechnical, flora and fauna and planning.

In the second stage, the results of the investigations were analysed to determine the key issues and identify any site constraints. Options for the development of the site were identified at this stage and analysed in terms of the constraints previously noted. A planning framework to implement the recommendations was also formulated during this phase.

The final stage of the study involved the drafting of the study reports and the production of maps.

SITE INVESTIGATIONS

Investigations carried out during this study indicated the following:

- Some of the features of the site, particularly the extensive wetland areas, have a high conservation value, despite having been disturbed in some areas.
- Several large portions of the site are severely degraded as a result of extensive sand mining operations over a number of years.
- A major road reservation exists through the site. Advice from the RTA cannot confirm whether or not the motorway ("Belmont Bypass") will ever be built or whether the reservation alignment is likely to be the final road alignment.
- A number of Aboriginal and European heritage items of varying significance have been identified on the site.
- Access to the site from most areas is constrained by natural features particularly the designated SEPP 14 wetlands.
- Dunal areas of the site provide significant topographic relief and are a major visual feature when viewed from the surrounding areas.
- Vegetation species considered to have conservation value, either regionally or at a State level including *Melaleuca quinquinervia*, *M. styphelioides* and *M. linearifolia* occur on the site.
- A buffer of 400m is required around the sewage treatment works adjacent to the southern edge of the site.

DEVELOPMENT PRINCIPLES

A set of "development principles" were devised to guide any future development of the site. The environmental capacity of the site to support urban development was determined through an assessment of the ecological, visual, transport and land management constraints identified through the environmental investigations carried out as part of this study. While there are significant environmental constraints on the site, these also constitute opportunities.

Areas on the site which do not have high conservation value or are not required to act as buffer areas to the environmentally sensitive areas have potential for urban development, provided that development is properly controlled and undertaken in a sensitive manner. The development of options for the site and the assessment of those options has been based on the following planning/development principles devised for the site.

1. Urban development on the site is unlikely to form a "natural" part of the existing Belmont settlement due to constraints on access to the site and the proximity of significant wetlands. Therefore the development should establish its own unique character.
2. Development on the site should maximise the unique opportunities provided by the attributes of the area including the wetlands, historical features and proximity of the coastal landscape.
3. Wildlife corridors, significant vegetation, wetlands and historical features should be developed and actively managed to ensure their integrity and long term viability.

4. Opportunities exist and should be utilised to create a 'model' development which will embrace innovative design and environmentally sustainable development practices, to create an attractive, high quality living, recreational, tourist and educational environment which is in harmony with the natural surroundings.
5. Public access to open spaces and the beach area should be encouraged where appropriate and transport (including pedestrian and cycle) links should be developed accordingly.
6. Water quality on the-site and leaving the site should be of the highest possible quality and water pollution control ponds should be designed to ensure this.
7. Any development of the site should include detailed flora and fauna impact assessment. Under the four potential development strategies it is considered that only development which could affect the wetlands may require a fauna impact statement. Other habitat areas of the site are not considered likely to support endangered fauna populations, though there is a small likelihood the threatened little tern may colonise bare parts of the dune or the nearby beach.

CONCLUSIONS AND RECOMMENDATIONS

This section outlines the conclusion reached by the study team in relation to the suitability of the site for development. Also included is a suggested planning strategy, objectives and recommendations for the development of the site.

Conclusions

Development potential

Based on the investigations carried out as part of this study, it is considered that urban development could be achieved on the Belmont-Redhead site. However, as the site is extremely sensitive in some areas, any urban development on the site should be restricted to locations which will not impact on those sensitive areas.

Given the Belmont-Redhead site's significance, special attributes and coastal location it offers a unique opportunity in the Belmont area and potentially the Hunter, to create an urban area which is environmentally sustainable and which optimises its special characteristics. In order to achieve this, it is recommended that the planning framework in the following section be used as a guide to development on the site.

Planning framework

It is suggested that a planning framework be devised which is able to effectively manage the development of the site. This framework would ideally include a local environmental plan (LEP), development control plan (DCP) and design guidelines.

It is recommended that any LEP prepared for the site be flexible enough to allow a variety of development to occur, including residential, tourist facilities, recreation facilities, and commercial developments such as neighbourhood shops and cafes. It is difficult to comment at this stage what form the ultimate development will take, however it is important that Council set objectives for development on the site and develop (where possible) performance standards to be met before development proceeds. The development principles outlined above could be adapted and expanded to become objectives, and performance measures developed to support them. The existing provisions in the Lake Macquarie LEP 1984 do not provide sufficient flexibility to enable this framework to be developed.

To support the LEP which affects the zoning of the site, a DCP should be prepared. The DCP would encompass urban development principles which would encourage good quality development and ensure that development is in keeping with the special qualities of the site. Issues which should be addressed in the DCP include:

- the relationship of the development with the dunes, the coastal landscape and the ocean;
- providing access to the beach areas without negatively impacting on the fragile environment;
- developing a "sense of community" through the arrangement of components of urban development, such as the street geometry, access to community and commercial facilities and to open space networks;
- landscape design issues;
- access to public transport, particularly the development of a road system which can accommodate public transport; and
- developing the character of the development - for example as a "beach village".

In addition, and where possible, the DCP should address the preservation, management and maintenance of other areas on the site such as the wetlands, dune areas, and if applicable any interpretative centre and associated infrastructure.

Depending on the level of detail covered by the DCP, it is suggested that design guidelines could provide another layer of design detail which would cover specific issues such as site planning, efficiency of the development in terms of street layout and energy efficiency, privacy and public safety, street character, and other site planning principles which create better living environments such as gardens, house layout and overshadowing.

Additional policies and/or plans of management could also be developed for special areas on the site such as the wetlands to ensure they are appropriately developed and managed as a whole system ie including the Jewell's wetlands and Belmont Lagoon.

Suggested planning strategy

The suggested planning strategy is indicative of the development potential of the site, based on the outcomes of the investigations carried out as part of the study and the development principles set out above.

The key features of the recommended strategy are as follows:

1. Wetlands 866, 867 and 861 are linked to form a continuous wetland system which will provide habitat for flora and fauna on the site and around the area.
2. An area of approximately 150ha has urban potential for development, however the final area will be dependant on detailed design. Based on an occupancy rate of 3, this would support a population of around 6750 (15 lots/ha). However, there is also scope within this area for development of a small scale tourist development such as an "eco-tourist" village or boutique hotel development. It is important to ensure that any tourist infrastructure planned is sustainable and does not impact negatively on associated residential development or the natural environment.
3. The main dune along the beach front is protected by an area of around 200m which also provides a wildlife corridor. A walking track can be included along the beach with tracks leading to the crest of the dune in certain areas to provide views of the beach and ocean and the surrounding area. Limited access to the beach should be provided through fenced breaks in the dune which are of sufficient size to allow access but small enough not to impact on the stabilisation of the dune system.
4. Access to the development is via three entry points:
 - south, running along the alignment of the proposed Belmont Bypass;
 - north, via Wommara Avenue; and
 - centrally in the vicinity of Merleview Street.
5. Provision is made for a bypass of the Pacific Highway through the site should one be required in the future, however it would take the form of a "high street" rather than a freeway-type link.
6. Water pollution control ponds are provided in three locations on the site, separate to the SEPP 14 Wetlands to ensure that runoff is properly treated prior to discharge into the designated wetlands. These areas, which include provision for detention storage, total around 10ha.
7. Pedestrian and cycle access is provided along all roads connecting the development with existing settlements on the fringe of the site. A major cycleway is located along the disused railway line linking the historic features. Internal cycle and pedestrian networks are also provided.
8. An interpretive centre is suggested on site to provide a landmark on entrance to the site and information about the wetlands and the other cultural and natural features of the site. A series of boardwalks could be located throughout the wetlands, and viewing platforms are located

along the dune regeneration area to provide views into and information about the wetland areas.

9. A "village green" could be provided in the area to create a focus point on the way through the development to the beach and to create an interactive open space area.

RECOMMENDATIONS

The following recommendations are made with respect to the Belmont-Redhead site. They do not relate specifically to the suggested planning strategy, but generally apply whether or not the recommended strategy is adopted.

Geotechnical considerations

1. Combustible fill from the John Darling Colliery site should be removed and replaced with compacted sand or other fill material to a suitable level if residential/commercial development is proposed. It is recommended that a "compacted earth" raft should be provided to seal the fill site and that this area be used for recreation purposes only.
2. Radioactivity levels in areas proposed for residential use should be tested at the detailed design stage.
3. If the site is left undeveloped, further dispersal of tailings containing monazite from under Slab 2 (refer Figure 35) should be prevented. This can be achieved by raising ground level around the exposed southern edges or by sealing the edges with a stabilising coating.
4. If development is to proceed for residential or other purposes where the occupancy level would exceed several hours per week it is recommended that tailings containing monazite be removed and disposed of at an active beach sand processing site.
5. A buffer zone should be provided around the John Darling Colliery shafts.

Wetlands and vegetation

1. Orthophoto maps illustrating extensions to the SEPP 14 wetlands should be submitted to the Department of Urban Affairs and Planning (Newcastle Office) to assist in their current review.
2. To encourage a better understanding and appreciation of the wetland values, interpretive walks through and beside the wetlands should be established. Shortlands Wetlands Centre should be consulted for advice on establishing this type of facility.
3. Existing problems in the wetlands, particularly wetland 866, need attention. There is weed invasion by both aquatic and terrestrial plant species and stormwater pollution. The implementation of water pollution control ponds at drain entrances should be considered and weed control programs implemented.

4. Runoff into the wetlands from existing urban areas needs to be addressed and a management plan implemented to ensure that further uncontrolled runoff does not occur.
5. Bitou bush and four wheel drive tracks should be removed. The area west of the railway line should be replanted to encourage and facilitate regeneration. NSW Agriculture should be consulted for information on Bitou bush control programs.
6. Parrot's feather should be managed in the reedland open water. Biological control of this species elsewhere in the community should be assessed prior to determining management options.

Water quality

1. Water pollution control ponds should be located offline to increase their effectiveness and efficiency. Where these are located within 40 metres of a natural wetland, an environmental impact statement will be required for their development.
2. Alternative ways of discharging effluent should be investigated, such as recycling for irrigation and/or dual water supply for residential use and allowing infiltration for groundwater recharge.
3. The integration of the system of water pollution control ponds with the Belmont Lagoon system should be investigated.

Coastal/dune issues

1. An area of at least 160m (preferably 200m) measured from the high water mark should be reserved along the coastline to ensure protection from beach erosion.
2. Pedestrian access to the beach should be prohibited in the vicinity of the Third Creek channel.
3. Frontal dunes should be rehabilitated with intensified planting and four-wheel drive access to the beach should be limited to areas outside the site.
4. Walking tracks should be provided from the urban areas behind the dunes to allow improved public access to the beach. These tracks should be at regular intervals and located in areas where there is already disturbance of dune vegetation.
5. A walking track along the beach with restricted access to the crest of the frontal dune should be considered. It would provide excellent views of both the ocean and beach. Where the track accesses the crest of the dune, strategies such as laying sleepers across the track, providing windbreaks and winding the track should be implemented to prevent wind erosion.
6. All tracks through and along the dunes should be fenced to prevent incursion by visitors into the vegetation.

Flora and fauna

1. At least part of the dune area west of the railway line should be retained to provide a juxtaposition of habitat between it and the wetland and maintain a corridor for fauna movement.
2. Passive recreation should be provided in this area with walking tracks and platforms for views over the wetlands. Interpretative signage could be incorporated.
3. Large grassed areas should be avoided within the development as they not only restrict habitat corridors but also encourage aggressive bird species such as the Indian myna and silver gull. Proper design and maintenance of litter control is also important in reducing the proliferation of pest species.
4. Where any development is likely to impact on habitat of endangered (Schedule 12) species, a fauna impact statement will be required.

Transport

1. Consideration should be given to the extension of the local bus service into any residential development on this site. Where possible, bus stops should be within reasonable (400m) distance from residential areas and located in commercial and school precincts.
2. Roads should be designed to allow bus services to use them where appropriate, including bus standing bays and adequate turning areas.
3. Road connections from the site to major arterial roads or the Pacific Highway should be signalised or treated to ensure safe and easy access to the site from both the north and south.
4. Cycleway and pedestrian access should be encouraged along the disused railway line. Cycle access should link any proposed development with the centres of Belmont, Redhead and Jewell's as well as the beach, schools, shops and other neighbourhood facilities. Cycleway access could be provided on lower order streets in the development.

Aboriginal heritage

1. The recommendations of Bonhomme (1994a) should be implemented where necessary. These are:
 - 1 For site 45-7-71, a consent to destroy be applied for with condition of prior collection of artefacts by the Bahtabah Local Aboriginal Land Council.
 - 2 A consent to destroy be applied for the portion of 45-7-130 recorded within BHP lands. A Bahtabah representative should be on site to monitor and collect material.

- 3 Any earth moving activity along the wetland margins should be monitored by a member of the Bahtabah Local Aboriginal Community.
 - 4 A NPWS consent to destroy be applied for over the scatters and isolated artefacts described in this report with condition that the Bahtabah Local Aboriginal Land Council as the opportunity to collect items of interest prior to destruction.
 - 5 If human skeletal material is located during earth moving works all activity at the locations should cease and the Bahtabah Aboriginal Land Council and the NPWS should be contacted.
 - 6 The Bahtabah Local Aboriginal Land Council be asked to participate in the development where it concerns sites and their protection, their interpretation or display of aspects of Aboriginal culture and history. The developer should discuss the possibility of the construction of a keeping place for artefact (sic), if considered appropriate by the Bahtabah Land council, from the area." Bonhomme (1994a)
2. The sites referred to as BSAS-1 and BSAS-2 should be conserved. If disturbance is anticipated in the area of these sites, further investigation and assessment of the heritage value of these sites should be carried out.
 3. An assessment of the archaeological resource in the areas shown on Figure 30 as being zones of archaeological potential should be carried out, if impact to these areas is anticipated.
 4. Representatives of the Bahtabah Local Aboriginal Council should be involved in any decisions relating to the remaining Aboriginal archaeological resource of the Belmont-Redhead area.

European/Industrial heritage

1. The Redhead Coal Company Railway line and it's associated features should be retained.
2. Comprehensive survey and recording of the Redhead Coal Company railway line should be carried out to determine the extent of remains prior to undertaking any development within the study area. This is particularly pertinent in the areas of the railway platforms. The extent of remains associated with Belmont sidings within the study area needs to be verified.
3. The recommendations for reuse identified in the *City of Lake Macquarie Heritage Study* are endorsed. The two railway lines have great potential for interpretation along a network of industrial heritage trails around Lake Macquarie or as a pedestrian/cycleway.
4. If it is not possible to retain the full length of the existing railway easements, sections of it, such as Belmont and Jewell's Platforms , may be retained and interpreted for the public.

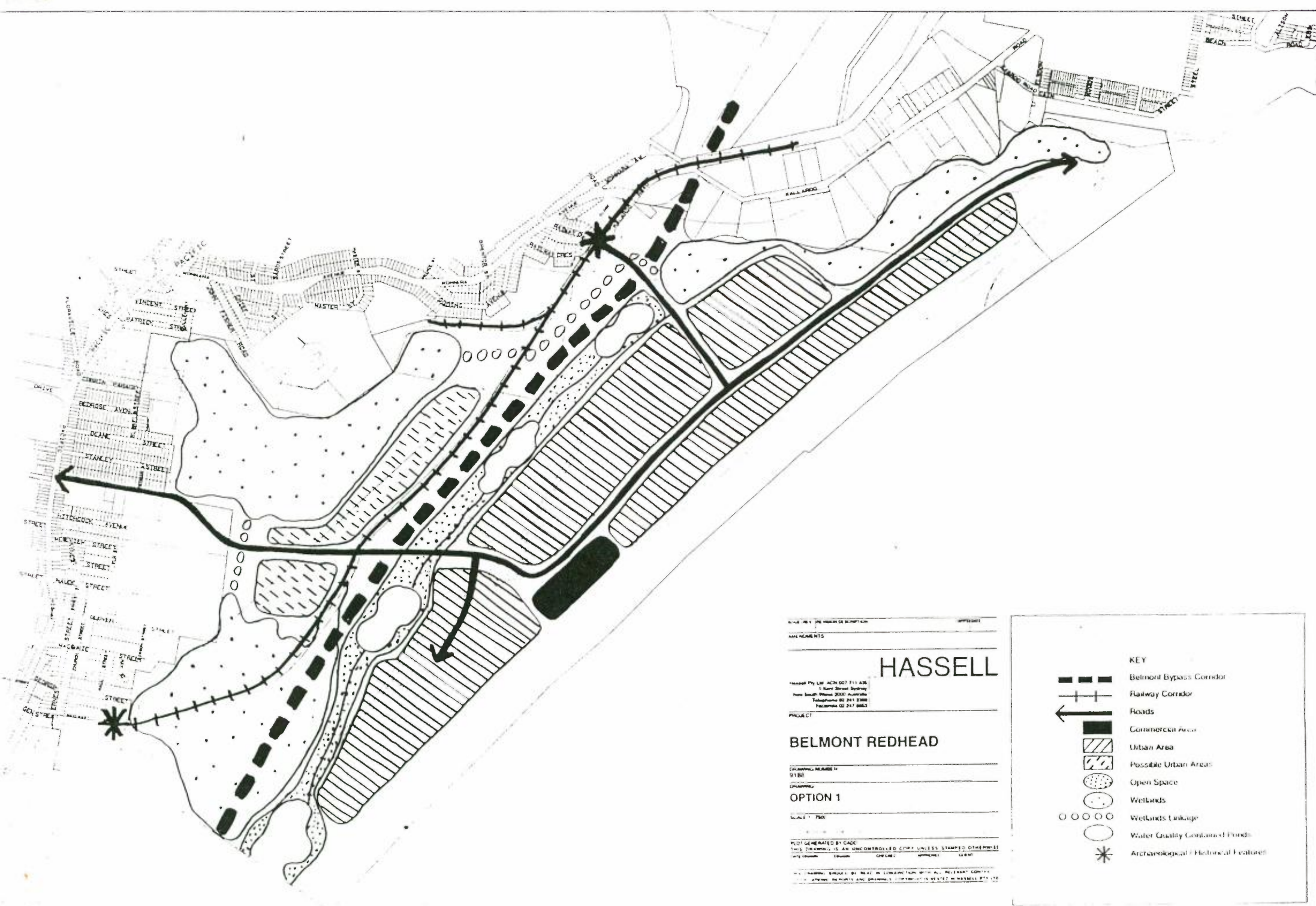
5. Any disturbance or removal of structures, features or deposits associated with either of the railway lines will require an extraction permit from the Heritage Branch, Department of Urban Affairs and Planning.
6. The sand mining structure (BSHS-3) may be removed. It does not require an excavation permit as it is not older than 50 years.

Engineering and other related issues

1. Floor levels of any development adjacent to wetland No 866 should be maintained above 4.4AHD to ensure it is above the 100 year flood level.
2. An integrated pollution control strategy for the site should be implemented, including sediment basins during construction, gross pollutant traps and water pollution control ponds or wetlands.
3. Residential development should not occur close to wetlands to ensure bushfire risk is minimised.

Land use considerations

1. Based on the preferred strategy, the developable areas could yield a potential population of around 6750. In this case, areas should be allocated to allow sufficient space for a school site(s) and at least 2ha of commercial/retail space for neighbourhood centres.
2. Any tourist development on the site should be small scale and in keeping with the character of the area ie. take into account its environmental sensitivity. Tourist development on the site should also be both ecologically and economically sustainable so as not to detract from surrounding development.



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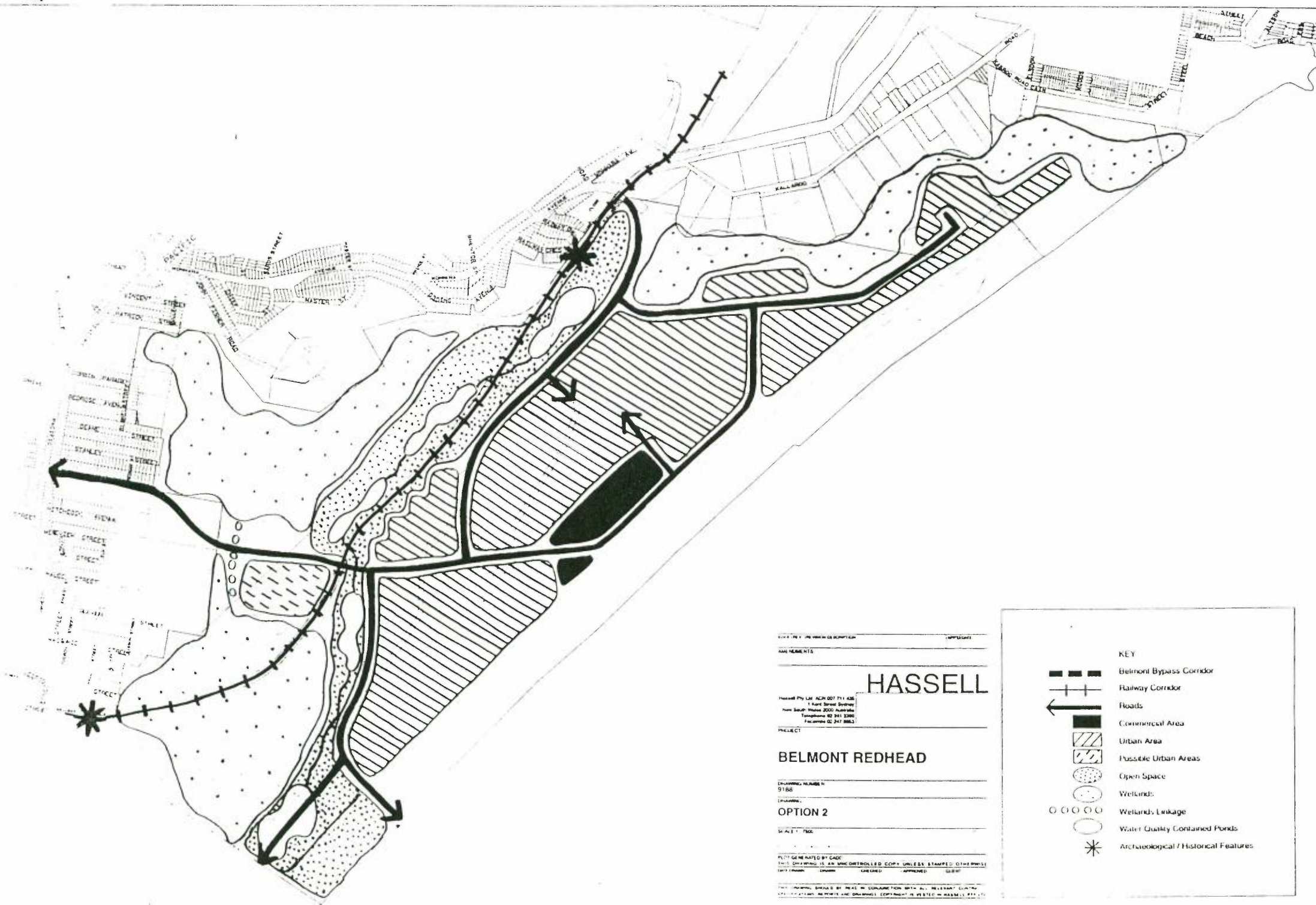
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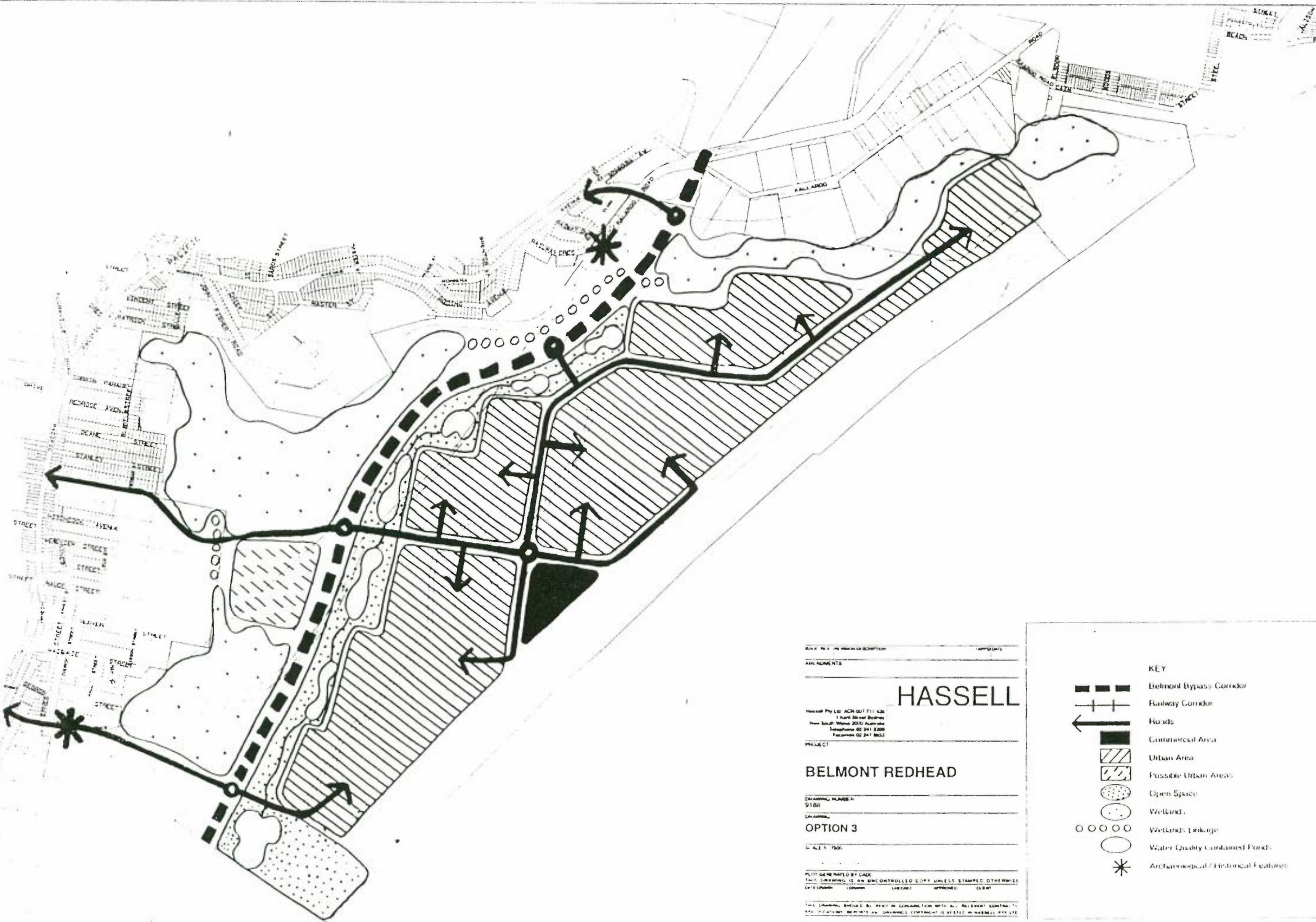
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- Open Space
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- Wetlands Linkage
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- Archaeological / Historical Features



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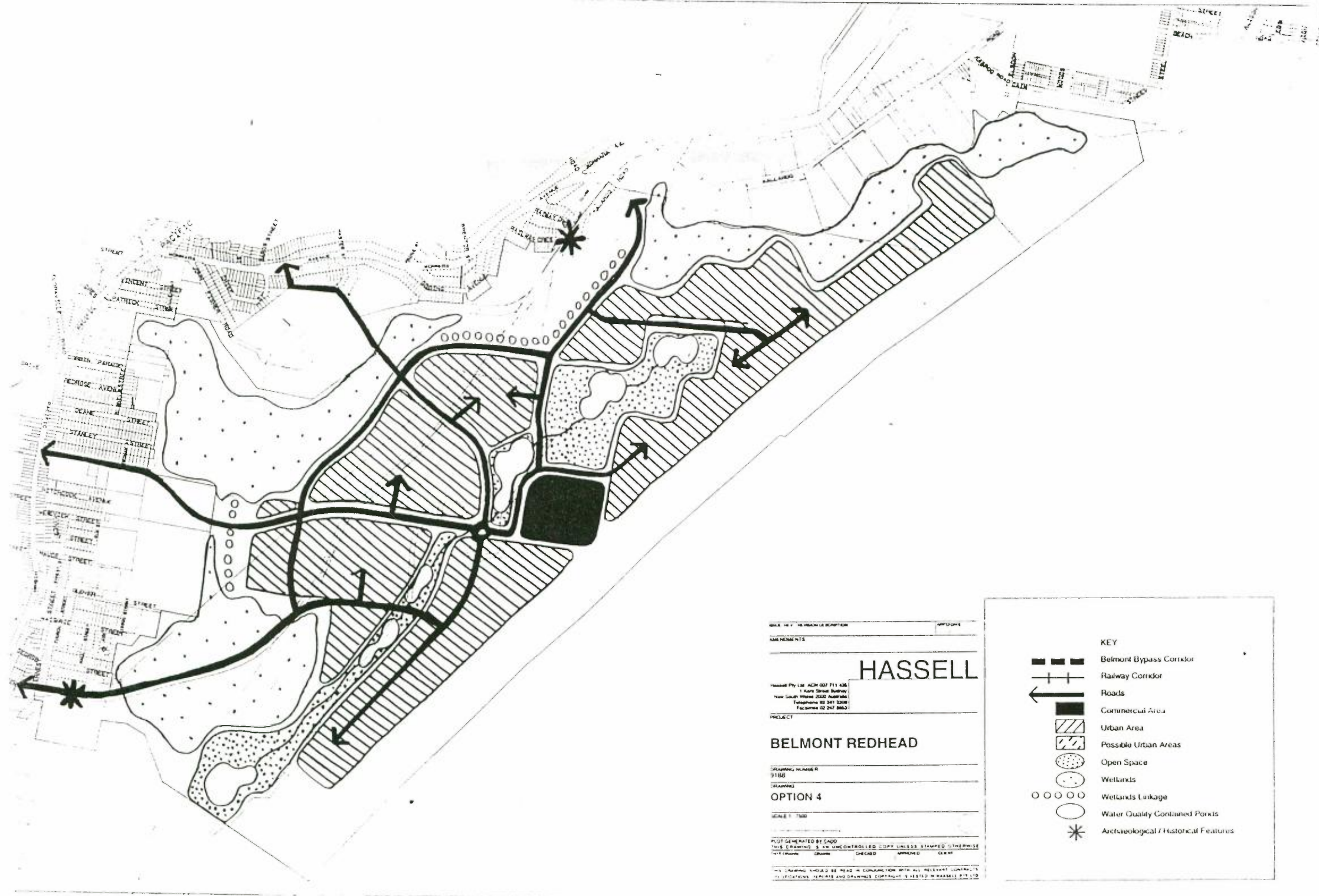


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	Possible Urban Areas
	Open Space
	Wetland
	Wetland Linkage
	Water Quality Contained Ponds
	Archaeological / Historical Features



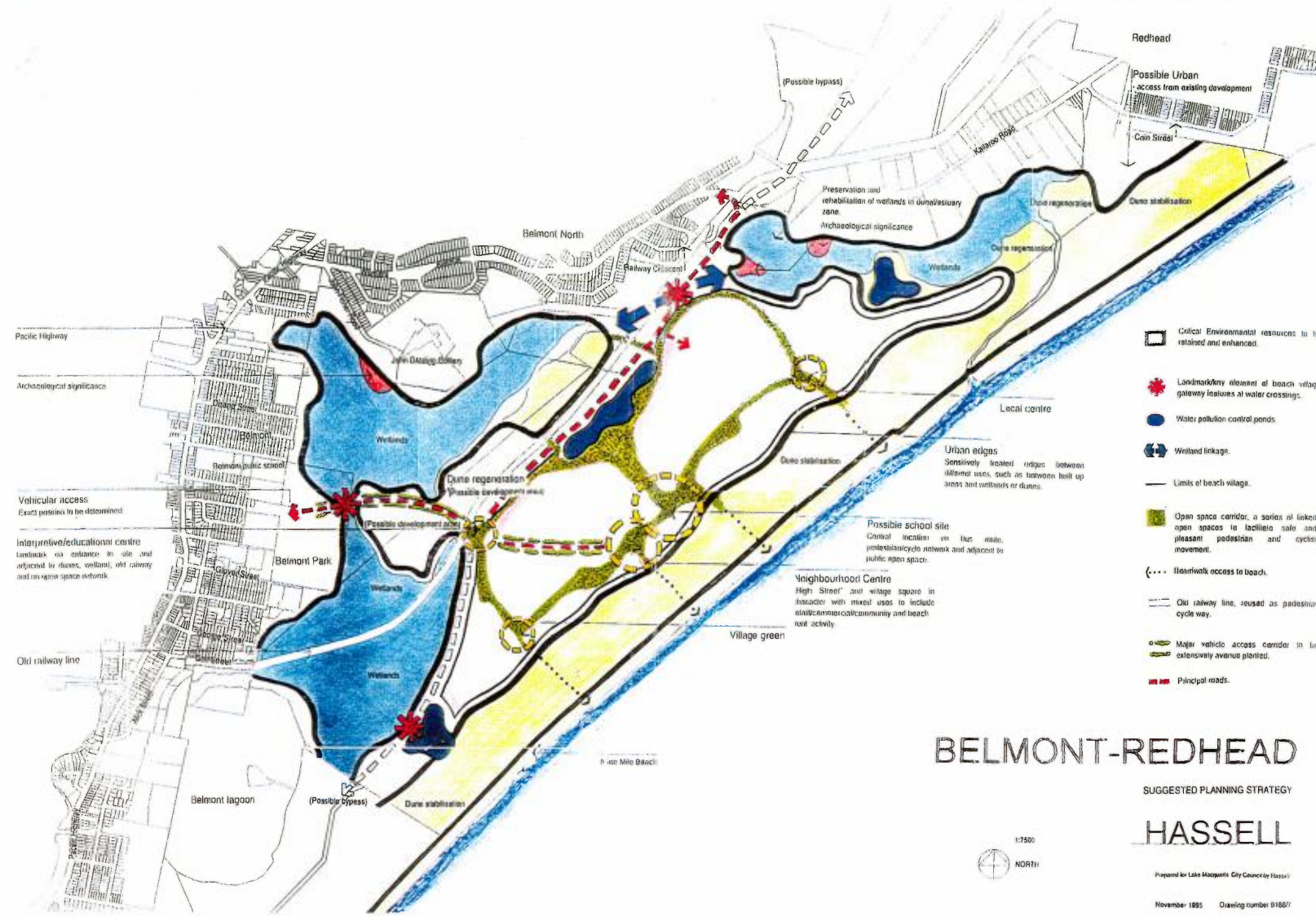
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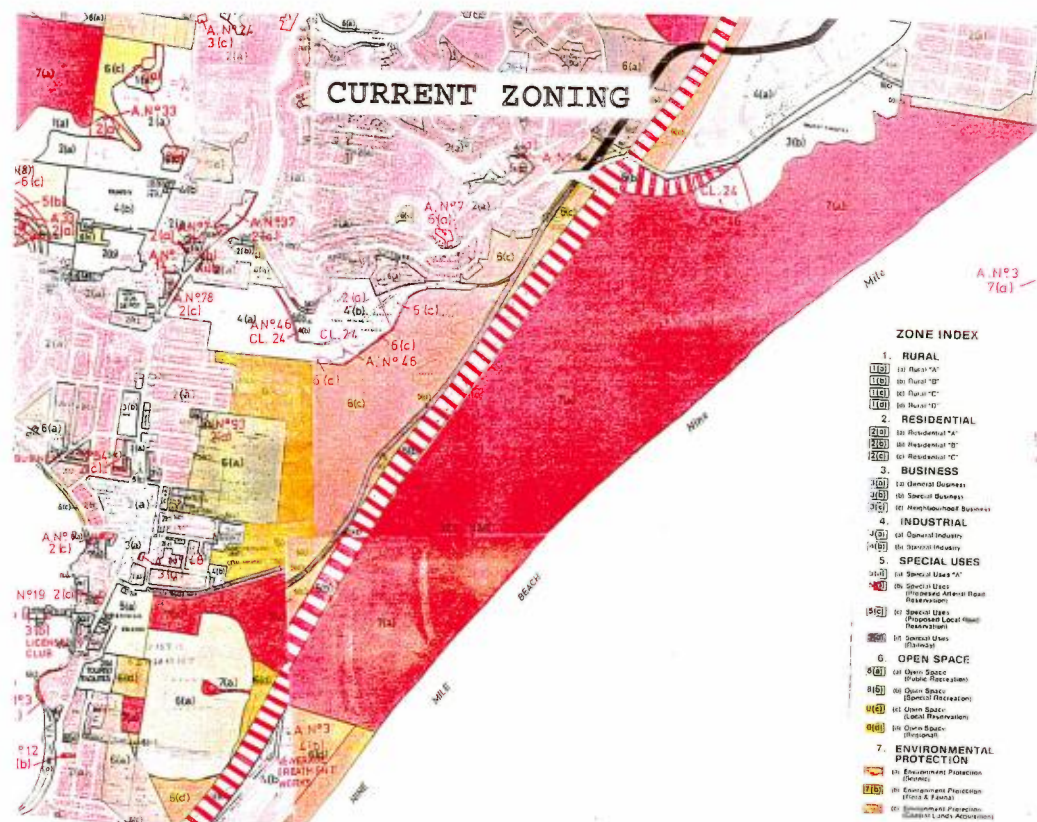
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- Railway Corridor
- Roads
- Commercial Area
- Urban Area
- Possible Urban Areas
- Open Space
- Welllands
- Welllands Linkage
- Water Quality Contained Ponds
- Archaeological / Historical Features

BELMONT REDHEAD LOCAL ENVIRONMENTAL STUDY

COMMENTS ON THE LOCAL ENVIRONMENTAL STUDY ARE WELCOME.



THIS IS A CHANCE TO HAVE YOUR SAY ON THE FUTURE DEVELOPMENT OF THE SITE.



COMMENTS ON THE LOCAL ENVIRONMENTAL STUDY SHOULD BE ADDRESSED TO:

GENERAL MANAGER
LAKE MACQUARIE CITY COUNCIL
BOX 1906
HUNTER REGION MAIL CENTRE, 2310.
ATTENTION: MS LISA GERVASONI.

COMMENTS SHOULD BE RECEIVED BY
25 MARCH 1996

DEVELOPMENT OPTIONS 1 TO 4 ARE AT THE BACK OF THE LOCAL ENVIRONMENTAL STUDY DOCUMENT



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EXECUTIVE SUMMARY

This report presents the findings of an environmental study of the site known as Belmont - Redhead owned by BHP in Lake Macquarie City.

The work has been undertaken by Hassell in association with the following sub-consultants:

- . Patterson Britton & Partners;
- . Arup Transportation Planning;
- . Antcliff Ecological Surveys;
- . Mr R. H. Luke; and
- . Navin Officer Archaeological Resource Management.

STUDY AREA

The study area is located between the suburbs of Belmont and Redhead in Lake Macquarie City.

The site is significant in both a regional and local context. It is in a significant location in that it provides an opportunity to link the coast with the existing areas of Belmont and beyond to Lake Macquarie. The site also contains one of the few large remaining wetland areas in Lake Macquarie and occupies around 20% of the coastline in the local government area.

A number of the wetlands are protected under the State Environmental Planning Policy No. 14 (Coastal Wetlands). Other significant aspects of the site include a coastal dune system, the abandoned Redhead Coal Company's Railway, a closed coal mine, various areas where sand mining has been conducted and one active sand mining operation.

METHODOLOGY

The study was conducted in three stages - research, analysis and design. In the first stage, all available information was reviewed to determine the background of the study and the site. Relevant government agencies were consulted to gain their understanding of issues relating to the Belmont-Redhead site and to ascertain which issues needed to be further investigated as part of the study.

The largest component of the initial stage was the conduct of in depth environmental investigations. These covered issues such as traffic and transport, engineering, bushfire hazard analysis, archaeological and historical aspects, water quality, climate, geotechnical, flora and fauna and planning.

In the second stage, the results of the investigations were analysed to determine the key issues and identify any site constraints. Options for the development of the site were identified at this stage and analysed in terms of the constraints previously noted. A planning framework to implement the recommendations was also formulated during this phase.

The final stage of the study involved the drafting of the study reports and the production of maps.

SITE INVESTIGATIONS

Investigations carried out during this study indicated the following:

- Some of the features of the site, particularly the extensive wetland areas, have a high conservation value, despite having been disturbed in some areas.
- Several large portions of the site are severely degraded as a result of extensive sand mining operations over a number of years.
- A major road reservation exists through the site. Advice from the RTA cannot confirm whether or not the motorway ("Belmont Bypass") will ever be built or whether the reservation alignment is likely to be the final road alignment.
- A number of Aboriginal and European heritage items of varying significance have been identified on the site.
- Access to the site from most areas is constrained by natural features particularly the designated SEPP 14 wetlands.
- Dunal areas of the site provide significant topographic relief and are a major visual feature when viewed from the surrounding areas.
- Vegetation species considered to have conservation value, either regionally or at a State level including *Melaleuca quinquinervia*, *M. styphelioides* and *M. linearifolia* occur on the site.
- A buffer of 400m is required around the sewage treatment works adjacent to the southern edge of the site.

DEVELOPMENT PRINCIPLES

A set of "development principles" were devised to guide any future development of the site. The environmental capacity of the site to support urban development was determined through an assessment of the ecological, visual, transport and land management constraints identified through the environmental investigations carried out as part of this study. While there are significant environmental constraints on the site, these also constitute opportunities.

Areas on the site which do not have high conservation value or are not required to act as buffer areas to the environmentally sensitive areas have potential for urban development, provided that development is properly controlled and undertaken in a sensitive manner. The development of options for the site and the assessment of those options has been based on the following planning/development principles devised for the site.

1. Urban development on the site is unlikely to form a "natural" part of the existing Belmont settlement due to constraints on access to the site and the proximity of significant wetlands. Therefore the development should establish its own unique character.
2. Development on the site should maximise the unique opportunities provided by the attributes of the area including the wetlands, historical features and proximity of the coastal landscape.
3. Wildlife corridors, significant vegetation, wetlands and historical features should be developed and actively managed to ensure their integrity and long term viability.

4. Opportunities exist and should be utilised to create a 'model' development which will embrace innovative design and environmentally sustainable development practices, to create an attractive, high quality living, recreational, tourist and educational environment which is in harmony with the natural surroundings.
5. Public access to open spaces and the beach area should be encouraged where appropriate and transport (including pedestrian and cycle) links should be developed accordingly.
6. Water quality on the site and leaving the site should be of the highest possible quality and water pollution control ponds should be designed to ensure this.
7. Any development of the site should include detailed flora and fauna impact assessment. Under the four potential development strategies it is considered that only development which could affect the wetlands may require a fauna impact statement. Other habitat areas of the site are not considered likely to support endangered fauna populations, though there is a small likelihood the threatened little tern may colonise bare parts of the dune or the nearby beach.

CONCLUSIONS AND RECOMMENDATIONS

This section outlines the conclusion reached by the study team in relation to the suitability of the site for development. Also included is a suggested planning strategy, objectives and recommendations for the development of the site.

Conclusions

Development potential

Based on the investigations carried out as part of this study, it is considered that urban development could be achieved on the Belmont-Redhead site. However, as the site is extremely sensitive in some areas, any urban development on the site should be restricted to locations which will not impact on those sensitive areas.

Given the Belmont-Redhead site's significance, special attributes and coastal location it offers a unique opportunity in the Belmont area and potentially the Hunter, to create an urban area which is environmentally sustainable and which optimises its special characteristics. In order to achieve this, it is recommended that the planning framework in the following section be used as a guide to development on the site.

Planning framework

It is suggested that a planning framework be devised which is able to effectively manage the development of the site. This framework would ideally include a local environmental plan (LEP), development control plan (DCP) and design guidelines.

It is recommended that any LEP prepared for the site be flexible enough to allow a variety of development to occur, including residential, tourist facilities, recreation facilities, and commercial developments such as neighbourhood shops and cafes. It is difficult to comment at this stage what form the ultimate development will take, however it is important that Council set objectives for development on the site and develop (where possible) performance standards to be met before development proceeds. The development principles outlined above could be adapted and expanded to become objectives, and performance measures developed to support them. The existing provisions in the Lake Macquarie LEP 1984 do not provide sufficient flexibility to enable this framework to be developed.

To support the LEP which affects the zoning of the site, a DCP should be prepared. The DCP would encompass urban development principles which would encourage good quality development and ensure that development is in keeping with the special qualities of the site. Issues which should be addressed in the DCP include:

- the relationship of the development with the dunes, the coastal landscape and the ocean;
- providing access to the beach areas without negatively impacting on the fragile environment;
- developing a "sense of community" through the arrangement of components of urban development, such as the street geometry, access to community and commercial facilities and to open space networks;
- landscape design issues;
- access to public transport, particularly the development of a road system which can accommodate public transport; and
- developing the character of the development - for example as a "beach village".

In addition, and where possible, the DCP should address the preservation, management and maintenance of other areas on the site such as the wetlands, dune areas, and if applicable any interpretative centre and associated infrastructure.

Depending on the level of detail covered by the DCP, it is suggested that design guidelines could provide another layer of design detail which would cover specific issues such as site planning, efficiency of the development in terms of street layout and energy efficiency, privacy and public safety, street character, and other site planning principles which create better living environments such as gardens, house layout and overshadowing.

Additional policies and/or plans of management could also be developed for special areas on the site such as the wetlands to ensure they are appropriately developed and managed as a whole system ie including the Jewell's wetlands and Belmont Lagoon.

Suggested planning strategy

The suggested planning strategy is indicative of the development potential of the site, based on the outcomes of the investigations carried out as part of the study and the development principles set out above.

The key features of the recommended strategy are as follows:

1. Wetlands 866, 867 and 861 are linked to form a continuous wetland system which will provide habitat for flora and fauna on the site and around the area.
2. An area of approximately 150ha has urban potential for development, however the final area will be dependant on detailed design. Based on an occupancy rate of 3, this would support a population of around 6750 (15 lots/ha). However, there is also scope within this area for development of a small scale tourist development such as an "eco-tourist" village or boutique hotel development. It is important to ensure that any tourist infrastructure planned is sustainable and does not impact negatively on associated residential development or the natural environment.
3. The main dune along the beach front is protected by an area of around 200m which also provides a wildlife corridor. A walking track can be included along the beach with tracks leading to the crest of the dune in certain areas to provide views of the beach and ocean and the surrounding area. Limited access to the beach should be provided through fenced breaks in the dune which are of sufficient size to allow access but small enough not to impact on the stabilisation of the dune system.
4. Access to the development is via three entry points:
 - south, running along the alignment of the proposed Belmont Bypass;
 - north, via Wommara Avenue; and
 - centrally in the vicinity of Merleview Street.
5. Provision is made for a bypass of the Pacific Highway through the site should one be required in the future, however it would take the form of a "high street" rather than a freeway-type link.
6. Water pollution control ponds are provided in three locations on the site, separate to the SEPP 14 Wetlands to ensure that runoff is properly treated prior to discharge into the designated wetlands. These areas, which include provision for detention storage, total around 10ha.
7. Pedestrian and cycle access is provided along all roads connecting the development with existing settlements on the fringe of the site. A major cycleway is located along the disused railway line linking the historic features. Internal cycle and pedestrian networks are also provided.
8. An interpretive centre is suggested on site to provide a landmark on entrance to the site and information about the wetlands and the other cultural and natural features of the site. A series of boardwalks could be located throughout the wetlands, and viewing platforms are located

along the dune regeneration area to provide views into and information about the wetland areas.

9. A "village green" could be provided in the area to create a focus point on the way through the development to the beach and to create an interactive open space area.

RECOMMENDATIONS

The following recommendations are made with respect to the Belmont-Redhead site. They do not relate specifically to the suggested planning strategy, but generally apply whether or not the recommended strategy is adopted.

Geotechnical considerations

1. Combustible fill from the John Darling Colliery site should be removed and replaced with compacted sand or other fill material to a suitable level if residential/commercial development is proposed. It is recommended that a "compacted earth" raft should be provided to seal the fill site and that this area be used for recreation purposes only.
2. Radioactivity levels in areas proposed for residential use should be tested at the detailed design stage.
3. If the site is left undeveloped, further dispersal of tailings containing monazite from under Slab 2 (refer Figure 35) should be prevented. This can be achieved by raising ground level around the exposed southern edges or by sealing the edges with a stabilising coating.
4. If development is to proceed for residential or other purposes where the occupancy level would exceed several hours per week it is recommended that tailings containing monazite be removed and disposed of at an active beach sand processing site.
5. A buffer zone should be provided around the John Darling Colliery shafts.

Wetlands and vegetation

1. Orthophoto maps illustrating extensions to the SEPP 14 wetlands should be submitted to the Department of Urban Affairs and Planning (Newcastle Office) to assist in their current review.
2. To encourage a better understanding and appreciation of the wetland values, interpretive walks through and beside the wetlands should be established. Shortlands Wetlands Centre should be consulted for advice on establishing this type of facility.
3. Existing problems in the wetlands, particularly wetland 866, need attention. There is weed invasion by both aquatic and terrestrial plant species and stormwater pollution. The implementation of water pollution control ponds at drain entrances should be considered and weed control programs implemented.

4. Runoff into the wetlands from existing urban areas needs to be addressed and a management plan implemented to ensure that further uncontrolled runoff does not occur.
5. Bitou bush and four wheel drive tracks should be removed. The area west of the railway line should be replanted to encourage and facilitate regeneration. NSW Agriculture should be consulted for information on Bitou bush control programs.
6. Parrot's feather should be managed in the reedland open water. Biological control of this species elsewhere in the community should be assessed prior to determining management options.

Water quality

1. Water pollution control ponds should be located offline to increase their effectiveness and efficiency. Where these are located within 40 metres of a natural wetland, an environmental impact statement will be required for their development.
2. Alternative ways of discharging effluent should be investigated, such as recycling for irrigation and/or dual water supply for residential use and allowing infiltration for groundwater recharge.
3. The integration of the system of water pollution control ponds with the Belmont Lagoon system should be investigated.

Coastal/dune issues

1. An area of at least 160m (preferably 200m) measured from the high water mark should be reserved along the coastline to ensure protection from beach erosion.
2. Pedestrian access to the beach should be prohibited in the vicinity of the Third Creek channel.
3. Frontal dunes should be rehabilitated with intensified planting and four-wheel drive access to the beach should be limited to areas outside the site.
4. Walking tracks should be provided from the urban areas behind the dunes to allow improved public access to the beach. These tracks should be at regular intervals and located in areas where there is already disturbance of dune vegetation.
5. A walking track along the beach with restricted access to the crest of the frontal dune should be considered. It would provide excellent views of both the ocean and beach. Where the track accesses the crest of the dune, strategies such as laying sleepers across the track, providing windbreaks and winding the track should be implemented to prevent wind erosion.
6. All tracks through and along the dunes should be fenced to prevent incursion by visitors into the vegetation.

Flora and fauna

1. At least part of the dune area west of the railway line should be retained to provide a juxtaposition of habitat between it and the wetland and maintain a corridor for fauna movement.
2. Passive recreation should be provided in this area with walking tracks and platforms for views over the wetlands. Interpretative signage could be incorporated.
3. Large grassed areas should be avoided within the development as they not only restrict habitat corridors but also encourage aggressive bird species such as the Indian myna and silver gull. Proper design and maintenance of litter control is also important in reducing the proliferation of pest species.
4. Where any development is likely to impact on habitat of endangered (Schedule 12) species, a fauna impact statement will be required.

Transport

1. Consideration should be given to the extension of the local bus service into any residential development on this site. Where possible, bus stops should be within reasonable (400m) distance from residential areas and located in commercial and school precincts.
2. Roads should be designed to allow bus services to use them where appropriate, including bus standing bays and adequate turning areas.
3. Road connections from the site to major arterial roads or the Pacific Highway should be signalised or treated to ensure safe and easy access to the site from both the north and south.
4. Cycleway and pedestrian access should be encouraged along the disused railway line. Cycle access should link any proposed development with the centres of Belmont, Redhead and Jewell's as well as the beach, schools, shops and other neighbourhood facilities. Cycleway access could be provided on lower order streets in the development.

Aboriginal heritage

1. The recommendations of Bonhomme (1994a) should be implemented where necessary. These are:
 - 1 For site 45-7-71, a consent to destroy be applied for with condition of prior collection of artefacts by the Bahtabah Local Aboriginal Land Council.
 - 2 A consent to destroy be applied for the portion of 45-7-130 recorded within BHP lands. A Bahtabah representative should be on site to monitor and collect material.

- 3 Any earth moving activity along the wetland margins should be monitored by a member of the Bahtabah Local Aboriginal Community.
 - 4 A NPWS consent to destroy be applied for over the scatters and isolated artefacts described in this report with condition that the Bahtabah Local Aboriginal Land Council as the opportunity to collect items of interest prior to destruction.
 - 5 If human skeletal material is located during earth moving works all activity at the locations should cease and the Bahtabah Aboriginal Land Council and the NPWS should be contacted.
 - 6 The Bahtabah Local Aboriginal Land Council be asked to participate in the development where it concerns sites and their protection, their interpretation or display of aspects of Aboriginal culture and history. The developer should discuss the possibility of the construction of a keeping place for artefact (sic), if considered appropriate by the Bahtabah Land council, from the area." Bonhomme (1994a)
2. The sites referred to as BSAS-1 and BSAS-2 should be conserved. If disturbance is anticipated in the area of these sites, further investigation and assessment of the heritage value of these sites should be carried out.
 3. An assessment of the archaeological resource in the areas shown on Figure 30 as being zones of archaeological potential should be carried out, if impact to these areas is anticipated.
 4. Representatives of the Bahtabah Local Aboriginal Council should be involved in any decisions relating to the remaining Aboriginal archaeological resource of the Belmont-Redhead area.

European/Industrial heritage

1. The Redhead Coal Company Railway line and it's associated features should be retained.
2. Comprehensive survey and recording of the Redhead Coal Company railway line should be carried out to determine the extent of remains prior to undertaking any development within the study area. This is particularly pertinent in the areas of the railway platforms. The extent of remains associated with Belmont sidings within the study area needs to be verified.
3. The recommendations for reuse identified in the *City of Lake Macquarie Heritage Study* are endorsed. The two railway lines have great potential for interpretation along a network of industrial heritage trails around Lake Macquarie or as a pedestrian/cycleway.
4. If it is not possible to retain the full length of the existing railway easements, sections of it, such as Belmont and Jewell's Platforms , may be retained and interpreted for the public.

5. Any disturbance or removal of structures, features or deposits associated with either of the railway lines will require an extraction permit from the Heritage Branch, Department of Urban Affairs and Planning.
6. The sand mining structure (BSHS-3) may be removed. It does not require an excavation permit as it is not older than 50 years.

Engineering and other related issues

1. Floor levels of any development adjacent to wetland No 866 should be maintained above 4.4AHD to ensure it is above the 100 year flood level.
2. An integrated pollution control strategy for the site should be implemented, including sediment basins during construction, gross pollutant traps and water pollution control ponds or wetlands.
3. Residential development should not occur close to wetlands to ensure bushfire risk is minimised.

Land use considerations

1. Based on the preferred strategy, the developable areas could yield a potential population of around 6750. In this case, areas should be allocated to allow sufficient space for a school site(s) and at least 2ha of commercial/retail space for neighbourhood centres.
2. Any tourist development on the site should be small scale and in keeping with the character of the area ie. take into account its environmental sensitivity. Tourist development on the site should also be both ecologically and economically sustainable so as not to detract from surrounding development.

1

INTRODUCTION

This report presents the findings of an environmental study of the site known as Belmont - Redhead owned by BHP in Lake Macquarie City.

The work has been undertaken by Hassell in association with the following sub-consultants:

- . Patterson Britton & Partners;
- . Arup Transportation Planning;
- . Antcliff Ecological Surveys;
- . Mr R. H. Luke; and
- . Navin Officer Archaeological Resource Management.

1.1 STUDY AREA

The study area is located between the suburbs of Belmont and Redhead in Lake Macquarie City.

The site is significant in both a regional and local context. It is in a significant location in that it provides an opportunity to link the coast with the existing areas of Belmont and beyond to Lake Macquarie. The site also contains one of the few large remaining wetland areas in Lake Macquarie and occupies around 20% of the coastline in the local government area.

A number of the wetlands are protected under the State Environmental Planning Policy No. 14 (Coastal Wetlands). Other significant aspects of the site include a coastal dune system, the abandoned Redhead Coal Company's Railway, a closed coal mine, various areas where sand mining has been conducted and one active sand mining operation. The site's boundaries can be outlined as follows:

- east is bounded by approximately 4.2km of Nine Mile Beach;
- northern extremity dissects Jewells Swamp, south of Kallaroo Road;
- west is bounded by urban development and the Jewells wetland system; and
- southern extremity is bounded by Belmont Lagoon and the Belmont Waste Water Treatment Works.

Refer to Figure 1 for a map of the site's boundaries.

1.2 LAYOUT OF THE REPORT

Section 2 of the report describes the existing natural environment on the Belmont-Redhead site, including the results of investigations undertaken. Section 3 outlines the land use and planning controls which have an impact on the development of the area, including policies and strategies which apply. Section 4 presents an analysis of the housing market in the Belmont and Lake Macquarie area, including the regional and local context of the housing market.



Figure 1

Map of site boundaries

An outline of the issues and constraints applying to the site, including drainage, water quality, bushfire hazard, traffic and environmental concerns is presented in Section 5. Section 6 provides a set of development principles, a range of options for the development of the site and a commentary of each.

Conclusions and recommendations are covered in Section 7 along with a recommended planning strategy for the site.

2

NATURAL ENVIRONMENT

2.1 CLIMATE

2.1.1 Climatic features

The study area is located in the sub-tropical climatic zone. The climatic conditions of the site are similar to those of the City of Newcastle. Records of the climatic conditions for Newcastle have been drawn from the *Development Control Plan Supporting Information* report (Development Planning & Management, 1990). These records are derived from a detailed table of climatic features for Nobby's Signal Station and an Australian Littoral Society report (December, 1977).

2.1.1.1 Temperature

The mean annual minimum temperature is 8.2° C in July and the mean annual maximum temperature is 24.4°C occurring in January. Variation in the mean daily minimum is from 8.2°C in winter to 19.2°C in summer. The variation in mean daily maximum temperature is from 24.4°C in summer to 16.6°C in winter.

2.1.1.2 Wind

The maritime influence on weather conditions results in diurnal variation in wind direction most of the year, excluding winter. Light surface winds are modified by land and sea breezes. Winds from the west and north-west predominate in the morning during autumn, winter and spring. Onshore winds predominate during the afternoons in summer (Patterson Britton, 1988).

The strong winds in winter are usually from the west and north west. Nights are calm for approximately 10% of the year whereas afternoons are seldom calm. The predominant wind speed range is from 10 km/h to 30 km/h for all morning recordings and autumn/winter afternoons. For spring/summer afternoons the predominant range is 20 km/h to 40 km/h.

2.1.1.3 Rain

On average there are 132 days of the year where more than 0.1mm of rainfall is recorded. Average annual rainfall is 1100mm with approximately 11 days per month receiving 95mm of rainfall. Total annual evaporation is in the order of 1000mm.

The period March to June has the highest rainfall (on average) and similarly the greatest number of rain days. November is the driest month.

2.1.1.4 Storms

There are mainly two types of storms experienced in the study area. The first is thunderstorms of relatively short duration occurring about once a month in winter and three or four times a month in summer. Abnormally high rainfalls are often the result

of these thunderstorms. The second type of storm is associated with persistent strong south to north-easterly winds over three to four days which usually cause high wave heights along the coastline and occur four or five times per year.

2.1.1.5 Humidity

The relative humidity averages 74% and is fairly constant throughout the year.

2.1.2 Microclimate

In general, it is expected that the development area would have similar climatic characteristics to the surrounding area. However, the fore dune system will act as a local barrier to onshore winds, which tend to have a cooling affect on local temperatures. Also the exposed sand will tend to 'heat up'. Therefore it is likely that the area behind the dunes will have a slightly higher temperature than areas which are not protected from the onshore wind.

Any impact on the existing microclimate will depend on the type of development proposed. For typical residential development the impact will be insignificant provided that the foredunes are retained and stabilised. With development of the area, the bare sand will be vegetated, therefore the heating affect of the sand will be eliminated, but the area will still be protected by the fore dune system and is therefore likely to have a slightly higher temperature. However, this is expected to be minor.

The foredune system, especially after it has been revegetated and stabilised, will help protect the site from salt laden winds and reduce the effects of wind erosion.

2.1.3 Climate change

It is believed that the build up of greenhouse gases in the atmosphere will produce a warming effect on the climate and a general rise in global sea levels.

As yet, the predictive analytical methods to compute sea level rise are not available, and very preliminary estimates have been produced by extrapolating rises in mean sea level recorded at various tidal monitoring stations. The most authoritative reference is the report of the Intergovernmental Panel on Climate Change (IPCC), released in 1990.

Under the IPCC Business as Usual emissions scenario, high, medium and low scenarios of global sea level rise have been produced to the year 2100. Sea level rises for these scenarios are presented in Table 1 (NSW Public Works, 1993).

Following the precautionary principle advocated by the IPCC, development of an area should not proceed if its design features can not accommodate future sea level rises over an appropriate planning period. This is not the case on the Belmont-Redhead site as development would be located above future sea level rises.

Table 1 Sea level rise scenarios

Planning period (years)	Low (m)	Best estimate (m)	High (m)
50	0.14	0.28	0.44
100	0.30	0.62	1.02

As well as a general increase in mean temperatures, the Greenhouse Effect may cause changes to weather patterns with the potential for increased storminess and rainfall in the study area.

2.1.4 Air quality

Air quality is measured by the Environment Protection Authority on the basis of pollution 'events' related to specific pollutants. As air quality standards for urban air pollutants have not been defined in New South Wales, the EPA uses National Health and Medical Research Council (NH&MRC) Guidelines, World Health Organisation (WHO) long term goals and US Environmental Protection Agency (USEPA) Air Quality Standards.

Air quality monitoring stations are located throughout the Sydney metropolitan area, Newcastle and the Illawarra. Of most relevance to the subject site is data collected at the Newcastle Athletics Field site. Data from other stations at Wallsend and Beresfield are likely to be less relevant. While this data cannot be used to provide exact measurements of air quality at the Belmont-Redhead site, it is indicative of air quality in the area.

Measurements are made of the following pollutants at the Newcastle monitoring site:

- Ozone (O₃);
- Oxides of Nitrogen (NO_x and NO);
- Sulphur dioxide (SO₂);
- Carbon monoxide (CO);
- Particulate matter - suspended matter (Nephelometer); and
- Particulate matter - less than 10µm (PM₁₀).

The following table (Table 2) highlights the pollutants measured, the standard adopted and agency, and the average recorded level at the Newcastle monitoring station.

Based on the published EPA data, no recorded pollution event exceeded the goal level set by the relevant agencies. It is not possible, within the context of this study to calculate how development on the subject site would impact on air pollution levels. It may be assumed that levels of certain pollutants, such as CO, may increase due to additional vehicle movements in the area, however, the level or extent of these increases cannot be defined at this stage.

2.2 PHYSICAL ENVIRONMENT

2.2.1 Topography and drainage

The total area of the Belmont-Redhead site is 520ha. This area comprises part of a larger catchment (Belmont Lagoon catchment) which drains to Belmont Lagoon (refer to Figure 2). The northern portion of the BHP site, outside the Belmont Lagoon catchment, drains to Jewells Swamp.

In the north-western section of the Belmont Catchment (Belmont North), the grades are typically in the order of 5 to 10%. This area drains to the low-lying wetlands within the BHP site and ultimately to Belmont Lagoon.

In the study area, the grades are irregular because of the high disturbance caused by sand mining in the hind dune system. Ground slopes vary from flat (less than 1V:100H) in most areas to very steep in the hind dune area where slopes can be as high as 1V:2H. Surface levels vary from close to mean sea level at the wetlands to around 10 and 20m AHD within the dune area.

The components of the catchment's drainage system which significantly influence the flow paths and rates are outlined below.

1. Five causeways located in the south of the site along the Hunter Water Corporation embankment. Each causeway is 9m wide with an invert level of approximately 0.6m. The causeways are contained in an embankment with a crest level of approximately 2.0m AHD.
2. Two culverts located along the abandoned Redhead Coal Company's Railway embankment. Each culvert has three openings, each about 1.7m wide. One culvert has an invert level of 1.1m while the other has an invert level of 0.5m AHD. The crest level of the railway embankment is approximately 2.1m AHD.
3. A narrow man-made channel conveying runoff from Wetland 866 to Wetland 867 (refer to Figure 2). The level of the channel entrance is 3m AHD, and the channel is contained within the 4m contour line (refer to Figures 2 and 3). The channel has a mild slope of around 0.2%, so that no critical flow control exists at the basin outlet. Flow is controlled by the uniform flow depth in the outlet of the channel (Field, 1981).

The major directions of overland flow on the catchment are presented in Figure 2. Flow velocities in the drainage system for the subject site are expected to be low because of the low grades for the majority of the area, excluding the hind dune system. High infiltration rates resulting from the sandy soils attenuate the runoff volume from most of the site. The low flat areas which have an imported soil top layer would provide higher levels of runoff.

2.2.2 Groundwater

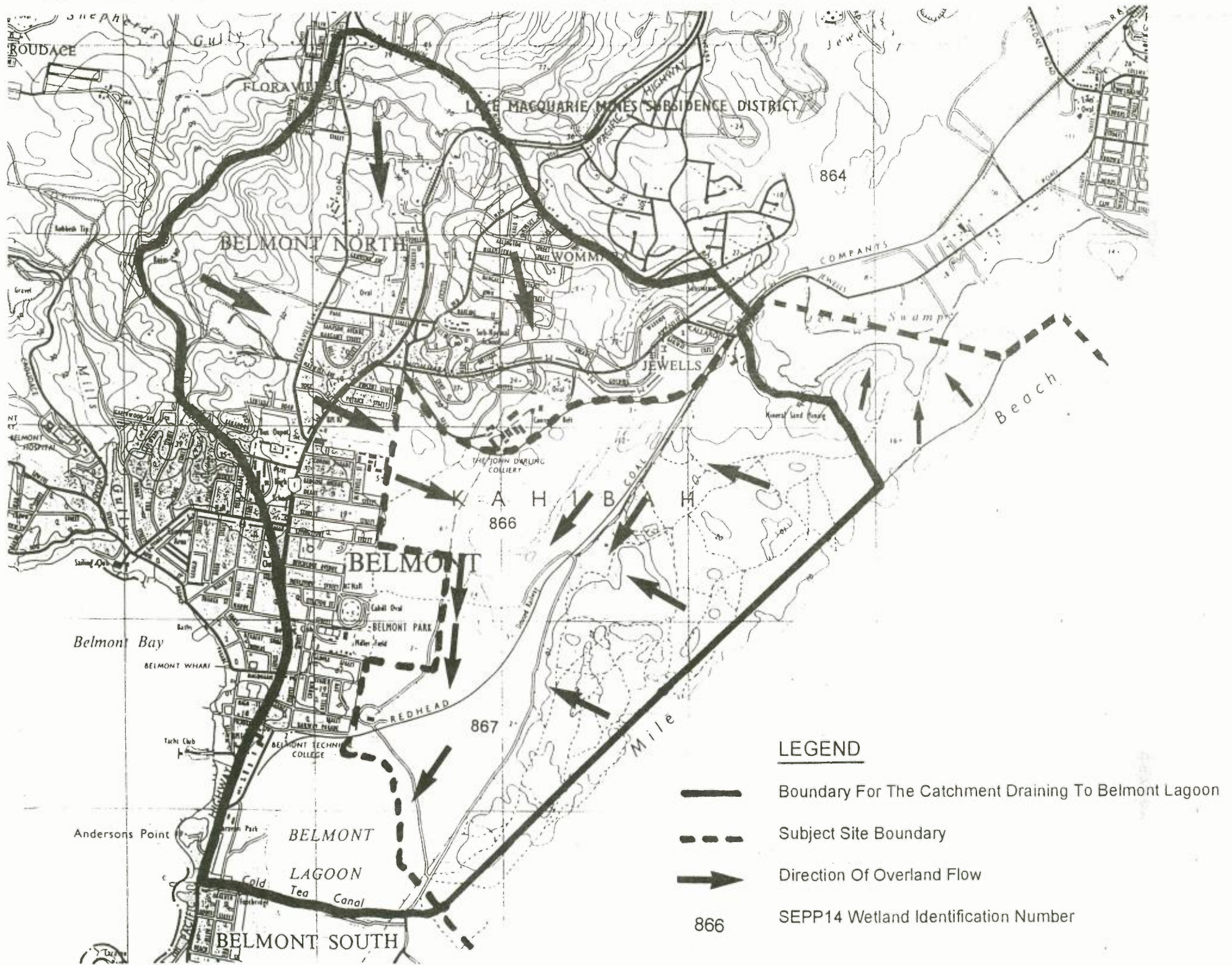
Information on groundwater in areas surrounding the site was obtained from the Department of Water Resources. This consisted of information on 15 bores located

Table 2 Air pollution data

			1/93	2/93	3/93	4/93	5/93	6/93	1/94	2/94	3/94	Average
Ozone (O ₃)*	12pphm (1-hour max)	NHMRC	10.1	6.2	5.2	7.2	3.6	2.4	6.2	4.0	4.6	5.5
Sulphur dioxide* (SO ₂)	25pphm (1-hour max) 12pphm (1-hour max)	NHMRC WHO	0.8	3.1	4.5	5.7	NA	0.8	2.6	2.4	2.7	2.8
Carbon monoxide* (CO)	25pphm (1-hour max) 9pphm (8-hour max)	WHO NHMRC	0.7	0.6	1.3	3.4	6.5	8.2	2.6	3.0	1.4	3.1
Particulate matter -less than 10µm (PM ₁₀)	150µg/m ² (24-hour max)	USEPA	23	23	29	32	35	23	44	34	28	30
Nitrogen dioxide* (NO ₂)	16pphm (1-hour max)	NHRMC	3.2	4.2	5.0	5.4	7.6	5.1	3.4	3.3	NA	4.7

* recorded values are maximum 1-hour values

Figure 2 Catchment drainage



LEGEND





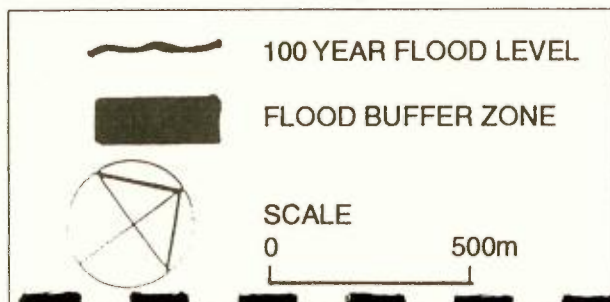
-  Boundary For The Catchment Draining To Belmont Lagoon
-  Subject Site Boundary
-  Direction Of Overland Flow
-  SEPP14 Wetland Identification Number



Figure 3

100 year flood inundation lines



in Redhead (4), Tingira Heights (1) and Belmont South and Marks Point (10) (see Figure 4). Detailed information on water quality was available for 6 of the bores. Information on the depth and thickness of the unconsolidated aquifer was available for 8 of the bores.

2.2.2.1 Depth and thickness of the unconsolidated aquifer

The location of bores for which information on aquifer depth and thickness was available is shown in Figure 5 and more detailed information is provided in Table 3. Four are located south of Belmont Lagoon and four north of Jewells Wetland. Figure 6 illustrates the difference between ground level and the thickness of the aquifer along a transect line through the subject site.

The top of the aquifer ranges from -0.5m AHD to the south of Belmont Lagoon to 4.5m AHD to the north of the site. This suggests that the level of the aquifer below the Belmont-Redhead site is probably between -0.5m AHD and 4.5m.

The thickness of the aquifer to the north and south of the site ranges from 1.5 to 6.4m. To the west of the site at Tingira Heights the aquifer is 1.2m thick. This suggests that beneath the site the aquifer may range from 1.2 to 6.4m thick.

2.2.2.2 Water quality

The location of bores for which water quality information was available is shown in Figure 4. Information on salinity was available for a number of other bores, also shown in Figure 4.

Table 4 provides data on the quality of groundwater. On the basis of information provided, the quality of groundwater in the bores is generally high in terms of guidelines for drinking water quality set by the National Health and Medical Research Council (NH&MRC, 1987).

While not all of the parameters listed in the NH&MRC guidelines have been tested, those that were, are generally within the acceptable range. Bore number GB053172, located at Tingira Heights to the west of the site, appears to have the lowest water quality with high levels of chlorine, total iron, total dissolved solids and sodium.

Information on total dissolved solids (TDS) was provided for 8 of the bores located around the study area. For 6 of these bores, the level of TDS is within the range specified for drinking water (up to 1000mg/L) by the NH&MRC. The highest level of TDS is in GB053172 to the west of the site (3000-7000mg/L).

2.2.3 Geotechnical and geological conditions

Information on the geotechnical characteristics of the site was mainly obtained from the geotechnical investigation report produced by Longworth and McKenzie (L & M). This report is contained in Appendix C of the *John Darling Colliery Redevelopment Study* (PPK et al, 1989).

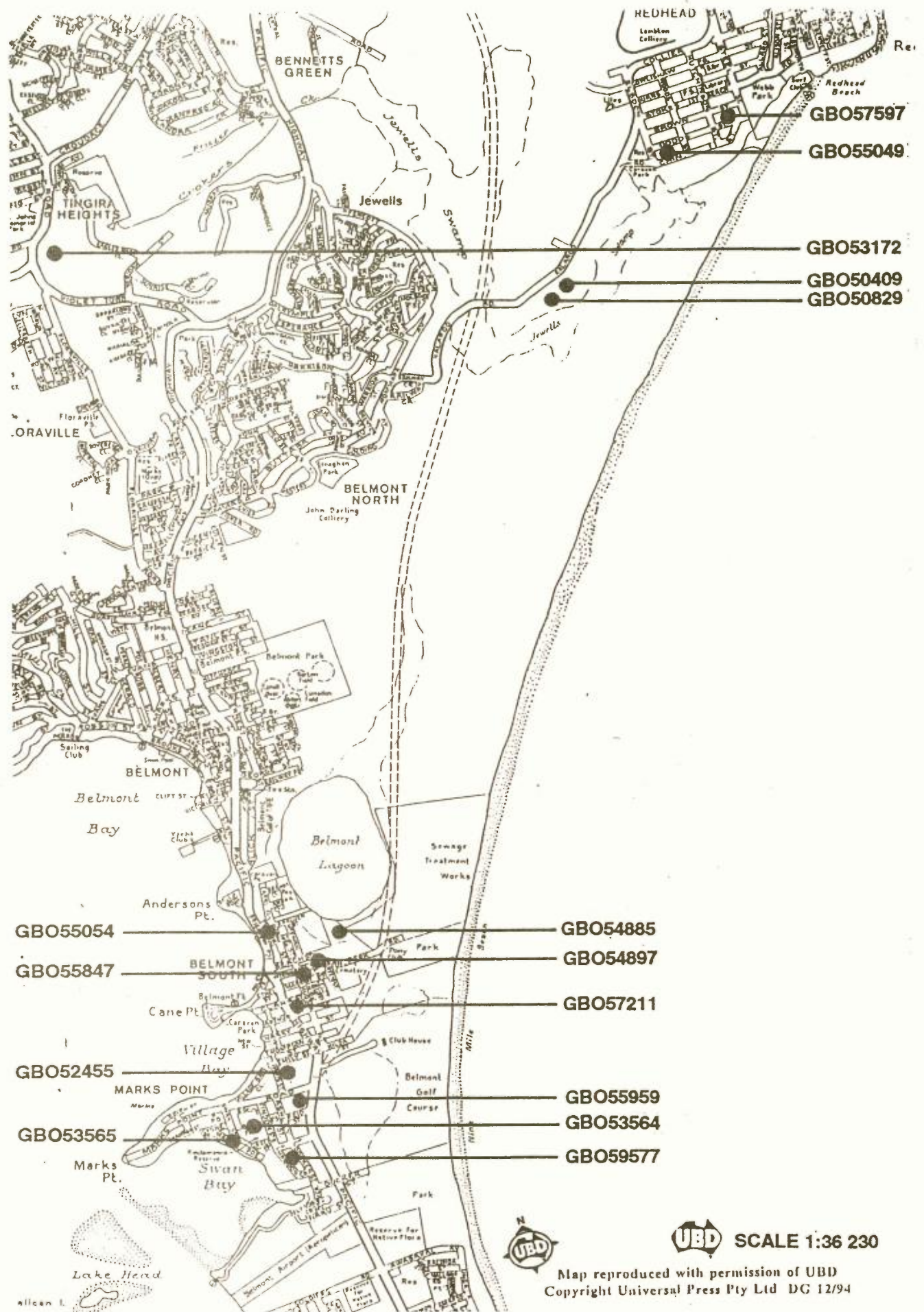


Figure 4 Location of 15 bores

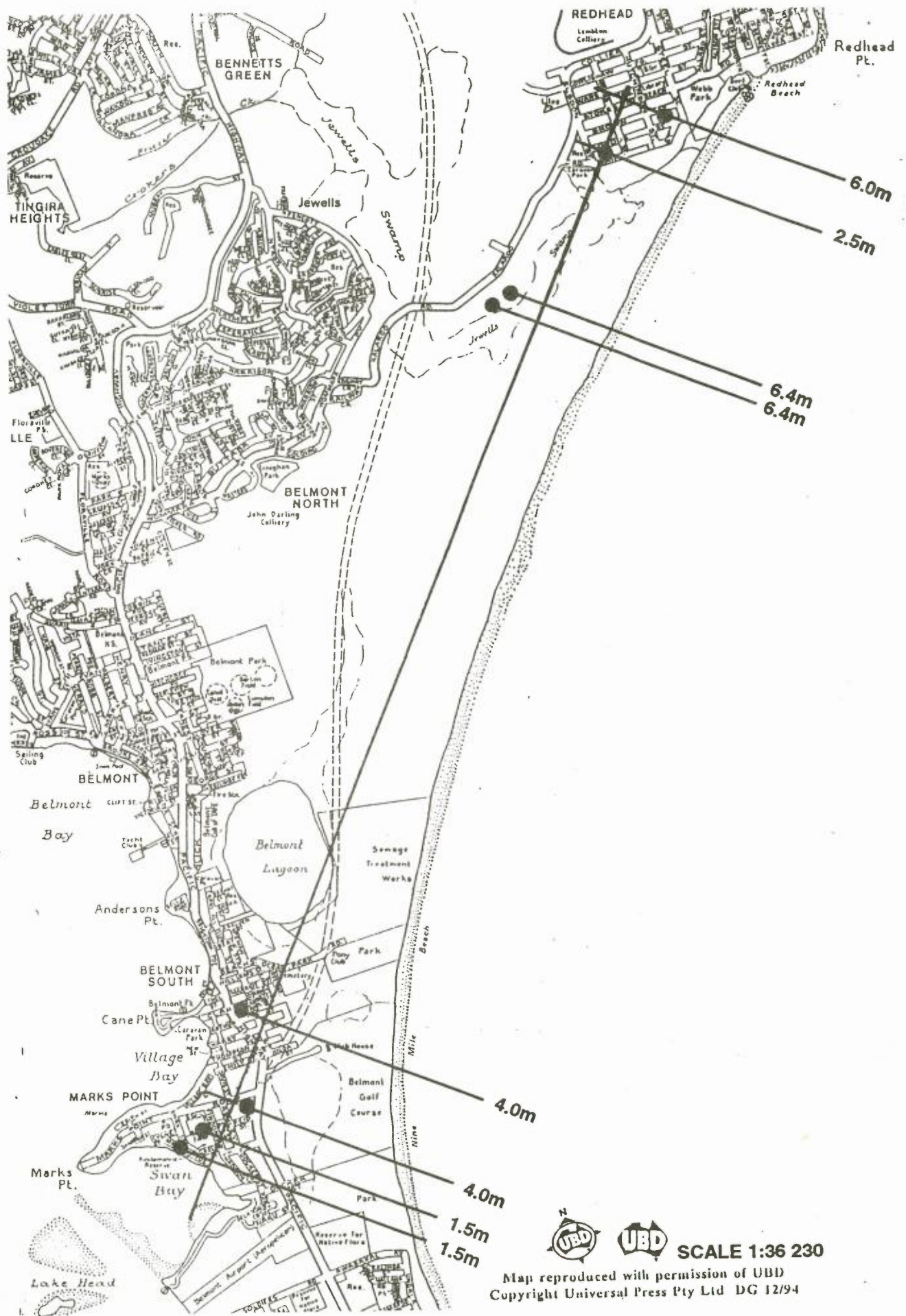


Figure 5 Location of bores and thickness of aquifer close to transect line

Groundwater transect from Swan Bay to Redhead

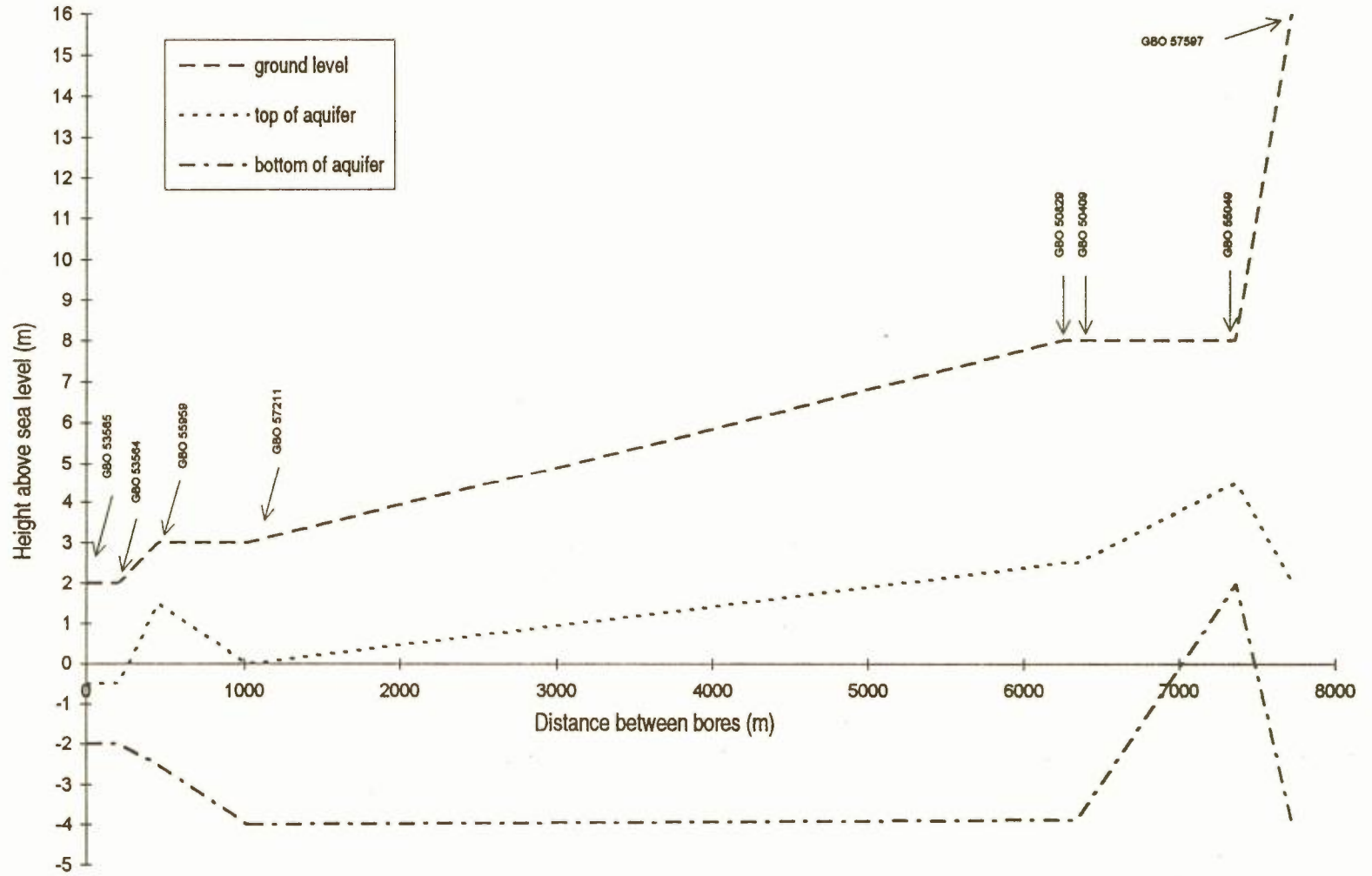


Figure 6

Thickness of aquifer along transect line

Table 3 Ground and aquifer levels relative to mean sea level

	Groundwater bore number							
Height above mean sea level (AHD)	GBO53565	GBO53564	GBO55959	GBO57211	GBO50829	GBO50409	GBO55049	GBO57597
Ground level at bore (m)	2	2	3	3	8	8	8	16
Level of top of aquifer (m)	-0.5	-0.5	1.5	0	2.5	2.5	4.5	2.0
Level of bottom of aquifer (m)	-2.0	-2.0	-2.5	-4.0	-3.9	-3.9	2.0	-4.0
Distance from previous bore (m)	0	204.5	250	568	5227	91	1023	364

Table 4 Water quality data for bores around the study area

Groundwater bore number (from southernmost to northernmost) ¹										
PARAMETER	59577	53565	53564	55959	55049	57597	53172 ²	50829	50409	GUIDELINE VALUE ³
pH	5.5	6.6	6.5	-	7.9	3.8	3.4/4.5	-	-	6.5-8.5
Hardness (mg/L)	-	-	-	-	-	122.0	550	-	-	500
Chloride (mg/L)	-	306.0	307.4	-	80.0	310.0	1645.0/1726.6	-	-	400
Iron (mg/L)	1.0	0.1	0.09	-	-	-	0.5	-	-	0.3
Calcium (mg/L)	-	22.6	22.6	-	70.0	-	3.4	-	-	(75-200) ⁴
Magnesium (mg/L)	-	32.3	32.4	-	-	-	124.6	-	-	(50-150)
Sulfate (mg/L)	-	39.9	40.3	-	-	-	291.1	-	-	400
Fluoride (mg/L)	-	0.6	0.6	-	-	-	-	-	-	0.5-1.7
Nitrate (as N) (mg/L)	-	0	0	-	-	-	-	-	-	10
TDS (mg/L)	1001-3000	501-1000	501-1000	0-500	0-500	-	3001-7000	0-500	0-500	1000
EC (uS/cm)	1000	1272	1260	-	290	1060	4700/5580	-	-	
Potassium (mg/L))	-	10.2	10.2	-	-	-	10.2	-	-	
Boron	-	0	0	-	-	-	0	-	-	
CO ₃ (mg/L)	-	0	0	-	-	-	0	-	-	
HCO ₃ (mg/L)	-	80.5	79.9	-	-	-	0	-	-	
Sodium (mg/L)	-	178.6	180.5	-	-	-	0	-	-	
Reactive SiO ₂ (mg/L)	-	10.3	10.2	-	-	-	950.4	-	-	300

1. All bores are prefixed 'GBO'.

2. First sample taken 25/1/82, second sample taken 26/1/82.

3. NHMRC, 1987.

4. Values in brackets are maximum acceptable and allowable criteria set by the World Health Organisation (Bouwer, 1978).

2.2.3.1 Surface geotechnical characteristics

The coastal area is covered by a 1km wide belt of Quaternary dunal sand deposits. These deposits are fine grained in texture and are very loose and unconsolidated. Exposed areas are susceptible to wind erosion. The dunal sediments reach a maximum height of between 15-20m AHD along a north-south foreshore belt.

The area is underlain by weathered siltstone and carbonaceous shale bedrock of the Newcastle Coal Measures in the Boolaroo SubGroup. The Boolaroo SubGroup extends for a limited depth below the site. The wetlands south of John Darling Collieries pit top area were reported as being underlain by firm silty clay alluvium. The same would be expected for the wetlands located in the subject site. Some filling with mine waste material has occurred in the southern wetlands of the area.

2.2.3.2 Mining operations

The Department of Mineral Resources provided information on past and present activities and the future potential for sand and coal mining in the study area (letter from Department, 1995).

Sand mining

The Department of Mineral Resources advise that the study area contains important construction sand deposits and may also have potential for heavy mineral sand resources. The extent of known sand deposits is shown on Figure 7.

Hymix Industries Pty Ltd currently extract construction sand for the Newcastle-Lake Macquarie building and construction industry from dunal sand deposits largely situated on the eastern side of the existing access road. Hymix estimate that the study area contains at least 5 million tonnes of construction sand with a possible extraction life of 5 to 10 years.

During the 1960s and 1970s part of the study area near Jewells Swamp was mined for heavy minerals by Rutile & Zircon Mines Pty Ltd (RZM). Large abandoned sand quarries are located throughout the study area and dunes have been re-contoured by sand mining operations. The extent of past and present extraction in the study area is shown in Figure 7. RZM has also recently applied for an exploration licence (ELA 24 Singleton) over the majority of the study area shown on Figure 7. The Department advise that RZM is likely to explore the economic potential of tailings left from their previous operation or deeper heavy mineral sand deposits not previously extracted during the original mining.

The Department considers that urban development on areas containing recoverable sand resources should not proceed without prior extraction of the sand.

Coal mining

The subject site is within both John Darling Colliery, owned by BHP Company Ltd, and Lambton Colliery, owned by Oceanic Coal Australia Ltd, shown on Figure 7. The

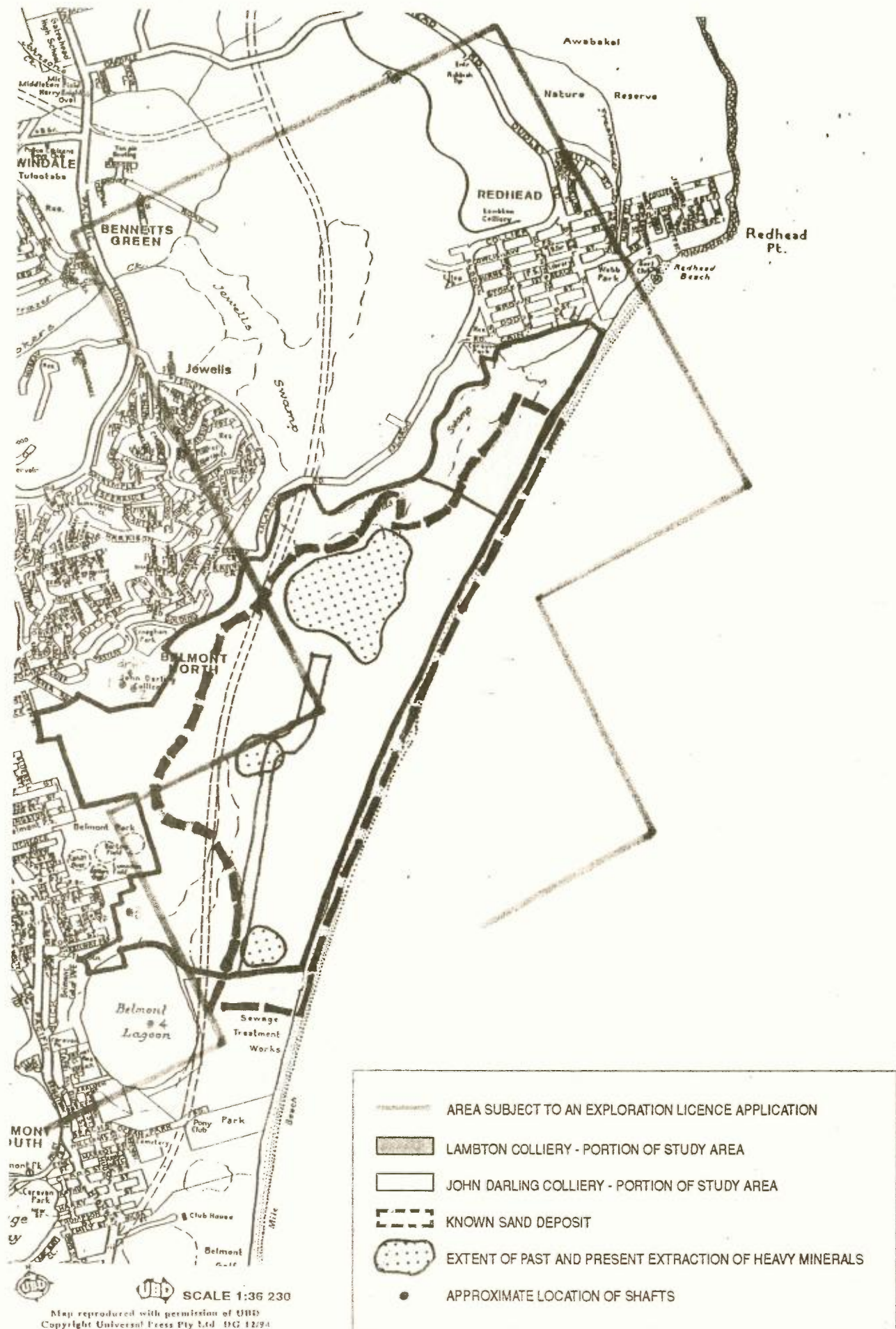


Figure 7 Mining operations

mining leases in the study area have been granted to mine coal only, however, BHP also holds freehold title to the surface over the affected part of its colliery holding.

Coal under the study area has been extensively mined by John Darling Colliery in the now discontinued:

- Victorian Tunnel Seam, at an approximate depth of 200m; and
- Borehole Tunnel Seam, at an approximate depth of 260m.

2.2.3.3 Mine subsidence

The Department of Mineral Resources has indicated that no subsidence is expected in the area.

In their assessment of underground workings in the area, L & M state that:

“Mining for the most part ceased in the area more than 30 years ago and the initial ground subsidence response is expected to have been completed within 18 months after mining. The likelihood of future surface ground movement associated with say the “collapse” of pillar workings is also not considered likely. This assessment is based on the relatively great depth of mining in the area, the high strength of roof rocks, and widths of pillars.

2.2.3.4 Geotechnical assessment of dunal sand deposits

Based on the existing geotechnical conditions of the site, the following constraints will apply to the development (L & M).

1. Major re-contouring will be required because of the presence of very steep pit slopes associated with sand mining.
2. The deposits in their existing state have very unfavourable geotechnical properties for building foundations purposes. These materials are expected to have a low bearing capacity and a high potential for settlement on loading.
3. Compaction of the dunal sands would be required before the construction of light structures and roads. Compaction should meet the requirements of AS 3798-1790 (Australian Standard Guidelines on earthworks for commercial and residential developments). For heavier loaded structures, where thick dunal sediments are present, costly foundations may be required.

2.2.3.5 Fill materials at John Darling Colliery site

The John Darling Colliery site (refer to Figure 8) contains mine waste material which could be subject to spontaneous combustion because of the presence of carbonaceous materials (refer to Section 8.1.2, L & M report) and is not suitable for urban development in its current condition.

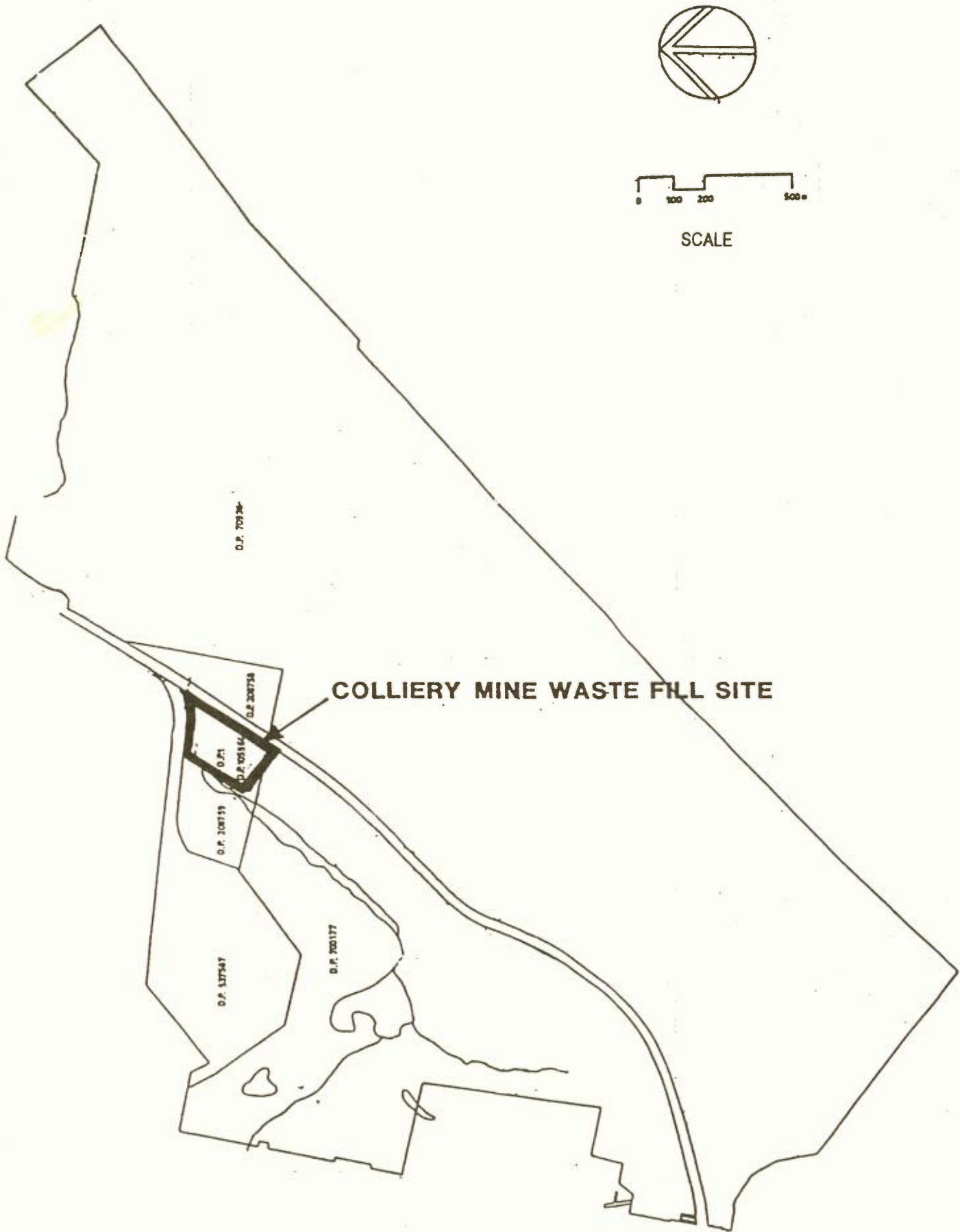


Figure 8

Location of mine waste fill area

If development of this area is proposed, there are two options for the treatment of the combustible fill (L & M).

- removal of fill with subsequent minor site grading and surface compaction treatment; or
- creation of a "compacted earth" raft cover of sufficient thickness to provide suitable conditions for building development.

With the removal of fill, the final site level would be close to the wetlands surface. This would result in high water table levels and site drainage problems, as well as problems associated with the presence of possibly low strength underlying alluvial soils. These problems would not arise if the fill material was replaced with compacted sand or other fill material to a suitable level. The provision of a raft may only be suitable for recreational land uses.

The adopted remediation method would ultimately depend on the final use of the site. Recreational use would require significantly less remediation than residential development.

2.2.3.6 Potential contamination from past surface mining

The Department of Mineral Resources (pers. comm., Chief Inspector of Mines) indicated that in the past "heavy mineral extraction" occurred in the study area. This method of mining adopts physical sorting techniques to isolate and concentrate certain fractions of sand; chemicals are not added in the process. The Department stated that in similar mining operations the naturally occurring radioactive fraction of sand has been observed in tailings waste and that it is likely to be present in the study area. The existence, location and level of radioactivity in the study area is not known.

Levels of radioactivity above the natural background level could be potentially hazardous for residential developments in the study area. While it is not within the scope of this study to do extensive radioactivity testing, information about the potential for radioactive contamination of the site should be obtained during detailed site investigations associated with any residential development.

2.2.3.7 Shafts and drifts and seam gas problems

Four disused ventilation shafts and one drift are known to be located within the site. The approximate location of these are shown on Figure 7. For the John Darling Colliery portion of the subject site (See Figure 8), L & M recommended that the following considerations be given in terms of the shafts and drift:

- prevention or control of seam gas leakage (methane, carbon dioxide, etc) through the shafts and drifts; and
- provision of a buffer zone around the openings (size of the buffer will depend on potential hazard in terms of both geotechnical and gas emission criteria).

2.2.3.8 Services installation

Excavation of trenches for the installation of services would need to satisfy the appropriate Australian Standards with the use of continuous sheeting and bracing for trenches above the water table.

For excavations below the water table, dewatering would be needed in addition to sheeting and bracing in order to prevent quick conditions. Without suitable sheeting and bracing, slopes in loose sand excavated below the water table would need to be less than 10 degrees to the horizontal to ensure stability (BHP Engineering, 1994).

Excavations in sand above the water table are generally stable at slopes of approximately 1V:2H, unless the sand is underlain at shallow depth by soft clay. This may occur along the eastern edge of the wetland area (BHP Engineering, 1994).

2.2.3.9 Acid Sulphate soils

Acid sulphate soils contain iron pyrite and when exposed to air lead to the formation of sulphuric acid and the lowering of the pH values in the soil. Some impacts of these soils include poor plant growth and corrosion of metal and concrete structures.

These soils occur in restricted areas such as low lying parts of coastal floodplains, rivers and creeks and generally, if left below the water table are unlikely to create problems. However, earthworks operations or changes to the groundwater level may result in acid sulphate soils being exposed to the air. Thorough testing is required to identify potential or actual acid soils and if identified, management practices put in place to ensure impacts are minimised.

Actual testing for acid sulphate soils was not carried out as part of this study, however given the site's location on the coast and the previous sand mining activities, testing is recommended if development is to be pursued to ensure appropriate conditions are included in any development consent.

2.3 FLORA

2.3.1 Methodology

To avoid confusion and provide continuity, vegetation community descriptions generally follow those of Winning (1990) in his *Lake Macquarie Natural Areas Study*. The study area was surveyed for plant species by thorough walking transects through representatives of each community. Species not readily identified in the field were collected for identification using standard texts. Checks were made against the reference texts for any nationally or regionally listed rare and vulnerable species (Briggs & Leigh, 1988; Benson, 1986; Winning, 1992). The degree of disturbance to native vegetation was noted with particular attention given to introduced plants.

2.3.2 Plant communities

The natural vegetation of the study area is dominated by a complex of wetland communities and regrowth in the formerly mined areas. For convenience, the wetland complex has been divided into three communities based on structure. These are swamp sclerophyll forest, reedland/open water and scrub/heath. The species composition and structure of these communities reflect the degree of salinity and water logging of the areas in which they occur. Further division based on species composition would also be possible. The distribution of the vegetation communities is illustrated on Figure 17.

2.3.2.1 Swamp sclerophyll forest

This community occurs in the permanently moist/periodically inundated parts of the wetlands and is dominated by *Melaleuca* species. Where the water is fresh low closed forests of *Melaleuca stypheliodes*, *M. linearifolia* and *M. decora* grow to a height of about 8m. Banked areas around SEPP 14 wetland 866 also have growth of forest red gum (*Eucalyptus tereticornis*).

In the Jewells Swamp part of the study area and in those parts of wetlands 866 and 867 where there is some saline influence, taller forests of *Melaleuca quinquinervia* dominate. Co-dominants include swamp mahogany (*Eucalyptus robusta*) and in more saline areas swamp oak (*Casuarina glauca*). Generally there is a thick understorey of swamp fern (*Blechnum indicum*), saw sedge (*Gahnia sieberiana*), batwing fern (*Hypolepsis muelleri*) and bracken (*Pteridium esculentum*) with vines such as snake vine (*Stephania japonica*) also common. The invasive introduced herb *Hydrocotyle bonariensis* is also common.

In the vicinity of the old railway line which runs through wetland 867 there is obvious dieback of large *Melaleuca quinquinervia*. Geoff Winning (pers. comm.) considers that an influx of clay sediments from development within the catchment is contributing to this phenomenon. Other contributing factors could be elevated nutrient levels or ponding of water. Ponding of water may be due to drainage into Belmont Lagoon being impeded by the berm supporting the pipeline to the wastewater treatment works.

2.3.2.2 Reedland/open water

Reedlands dominated by *Phragmites australis* and cumbungi (*Typha orientalis*) occur around the margins of large and deep expanses of water. Other aquatic species such as knotweeds (*Persicaria spp*) and water plantain (*Alisma plantagoaquatica*) occur in open water sections.

Apart from the heavy infestation of the lower parts of Jewells Swamp there is also infestation of water hyacinth along the drainage ditch near Cobbin Parade. This could conceivably spread to other parts of the wetland system. Remedial work to remove parrots feather (*Myriophyllum aquaticum*) is taking place near Leneghan Park.

2.3.2.3 Swamp scrub/heath

This community occurs on sandy soils at the outer edges of swamp sclerophyll forest. Prominent species are prickly tea-tree (*Leptospermum juniperinum*), golden spray (*Viminaria juncea*) and a variety of sedges and rushes which become more dominant as one moves into wetter soil. In some areas *Melaleuca ericifolia* and *M. thymifolia* grow to 1-2m forming a scrub community.

2.3.2.4 Open heath/scrub regrowth

The area between the beach and the existing access road consists of dunes which have been heavily disturbed and transformed by sand mining. The vegetation consists of a mosaic, thick heaths of bitou bush and scrub dominated by coast tea-tree (*Leptospermum laevigatum*) and broom heath (*Monotoca scoparia*). There are also large areas of bare sand, some of which are moving inland, and drowning vegetation. On the upper dunes there are a few isolated stands of saw banksia and coast banksia (*B. serrata* and *B. integrifolia*).

On the formerly mined areas west of the access road there is a greater variety of plant species. Infestations of bitou bush are still common. However, a variety of smaller shrubs particularly peas (eg. *Bossiaea heterophylla* and *Merbelia speciosa*) are scattered among the taller coast tea-tree and broom heath. Groundcover is dominated by lichens and the epacrid *Astoloma pinifolium*. Graminoids are noticeably under-represented.

2.3.2.5 Spotted gum open forest

A small area in the western part of the study area fronting Bluebell Street is dominated by regrowth of spotted gums (*Eucalyptus maculata*) forming a low open forest of 6-10m in height. Also in the canopy are smooth-barked apple (*Angophora costata*) and forest red gum. Beneath this there is a variety of shrubs such as *Acacia myrtifolia* and hop bush (*Dodonaea triquetra*). The groundcover is thick with the growth of blade grass (*Imperata cylindrica*) and kangaroo grass (*Themeda australis*).

2.3.3 Plant species

During the field survey 148 vascular plant species were found, 19 of which are introduced species. With more intensified sampling of the study area, particularly in the open water areas, this species list could be expanded.

None of the species found are listed on the national database of rare and threatened plant species (Briggs & Leigh, 1988) were found. However, the aquatic plant *Zanichellia palustris* has been previously recorded within the study area in a part of wetland 867 (Winning, 1992). This species has particular ecological requirements. It is an annual requiring water bodies in which the substrate is seasonally exposed so it can germinate. It is usually found in saline or brackish water and rarely in fresh water. It probably occurs in wetland 867 as this area would have had a saline influence prior to the construction of the sewerage embankment (Winning pers comm).

Zanichellia palustris is coded 3R+ This code indicates

- the species is found within a geographic range of >100km
- is currently considered rare but not vulnerable or endangered
- and is known to occur naturally outside of Australia

Tetratheca juncea is a locally occurring vulnerable species which usually occurs on ridges but has also been recorded in heath on deep sands (Payne, 1993). Its cryptic habit makes it difficult to find when not flowering. Although there is some likelihood it occurs in the heath west of the main access road, previous disturbance by mining would seem to preclude it from the study area. An opportunity does exist to include it within revegetation schedules.

Due to clearing, isolation and changes in hydrology, swamp mahogany *Eucalyptus robusta* is becoming increasingly rare within the central coast botanical division. This is indicated by its listing as a species of conservation significance within the Sydney region by the National Herbarium (Benson, 1994) and within the Lake Macquarie council area (Lake Macquarie City Council, 1993). There are numerous healthy stands of this species within the study area's swamp sclerophyll forests. It is also an important habitat tree for the endangered squirrel glider (*Petaurus norfolcensis*) which is likely to occur in the study area.

2.3.4 Conservation Significance

In this section the vegetation communities discussed in Section 2.3.2 are graded by conservation significance, quality and regeneration and retention prospects.

2.3.4.1 Wetlands

The conservation significance of wetlands has been recognised by the State government by the implementation of SEPP 14. Three SEPP 14 wetlands occur within the study area. These are the lower parts of Jewells Swamp (no.861), the area east of the old John Darling Colliery (no.866) and the wetland north of Belmont lagoon (no.867).

Although the *Melaleuca quinquenervia* association is considered adequately conserved at state level (J. Benson, 1987) it is not well conserved regionally (D. Benson, 1986; Winning pers comm). The *Melaleuca styphelioides/M.linariifolia* association, which is represented in wetland 866, is considered to be vulnerable and inadequately conserved at a state level (J. Benson, 1987). Winning in his natural areas study of Lake Macquarie (1990) regarded Jewells province (which includes the site) as being of high conservation value due to the large number of significant species and its potential for rehabilitation. Furthermore, the presence of a nationally listed rare plant species (*Zanichellia palustris*) and the regionally significant swamp mahogany within the wetlands further enhances their significance.

2.3.4.2 High quality communities

Swamp sclerophyll forest

Although the *Melaleuca quinquinervia* association is considered adequately conserved at state level (J. Benson, 1987) it is not well conserved regionally (D. Benson, 1986; Winning pers comm). The *Melaleuca styphelioides*/*M. Linearifolia* association, which is represented in wetland 866, is considered to be vulnerable and inadequately conserved at a state level (J. Benson, 1987).

Urban run-off is a major threat to the integrity of this community and is causing the introduction of water hyacinth. Sedimentation ponds or artificial wetlands at entry points would reduce this threat. This community should be retained as it is poorly represented at local and regional levels and is designated by the Department of Urban Affairs and Planning in SEPP 19 (Bushland in Urban Areas).

Swamp scrub/heath

A major part of this community is currently bisected by a 4-wheel drive track. It is an integral part of the wetland system and should be included in the designated wetlands. Weed invasion on the edge of this community can be managed by conventional bush regeneration techniques including the removal by hand of weeds and their propagules, and replanting with locally occurring native species. Any replanting should use plants propagated from local stock.

Spotted gum open forest

There is some weed invasion of this community which can be easily managed in the same way as the swamp scrub/heath. The community comprises a small area that is not otherwise represented on the site and provides a wetland buffer.

2.3.4.3 Medium quality communities

Reedland open water

It has been observed from photographs that this community is probably not as extensive as it was in the past. This may have been caused by ponding and channelling of drainage. Serious infestations of parrot's feather in this community require intensive management. An assessment should be made of the success of biological control for this species elsewhere in the municipality before management options are determined.

Open heath/scrub regrowth - west of railway line

This community has a higher diversity of species than the frontal dunes which have more bare ground. Management requirements include the need for removal of bitou, closing of 4-wheel drive and trail bike tracks and intensified planting.

2.3.4.4 Poor quality communities

Open heath/scrub regrowth - main dune

Many parts of this community are dominated by bitou and exotic grasses; however, there are some good stands of tea tree and banksia in the south of the site. The main management requirement for this community is an intensive regeneration project including stabilisation and reshaping.

2.4 FAUNA

2.4.1 Methodology

2.4.1.1 Birds

Half-hour transects were taken in each habitat type at dawn and dusk. All birds seen or heard were identified and recorded. Incidental sightings were also recorded while undertaking other fieldwork.

Calls of the powerful, barking and masked owls were played on a 50 watt cassette player. This was done at dusk and a period of 20 minutes allowed for responses. This is consistent with the methodology recommended by Kavanagh and Peake (1993).

2.4.1.2 Mammals

Trap lines were placed in three locations over three nights (14-18 March 1995) within the study area resulting in a total of 156 trap nights. 25 small Elliot traps, one medium Elliot trap and one cage trap were laid in swamp sclerophyll forest. The same number of traps were placed in the formerly mined areas. Traps were placed with a 6-8 metre spacing and were baited with a mixture of peanut butter, honey and rolled oats. Traps were not placed in spotted gum open forest or swamp scrub/heath as it was considered these are contiguous with the swamp sclerophyll forest and unlikely to have discrete ground mammal populations.

A search was made for indirect evidence of small to medium sized mammals such as bandicoot holes, droppings etc. A careful search was made for indirect evidence of mammal presence such as droppings, burrows, tracks, diggings and bones. These were identified using the keys and illustrations prepared by Triggs (1984). Fox scats were sent to Barbara Triggs to identify prey items.

Spotlighting was undertaken to detect arboreal (tree dwelling) mammals. The disused railway track and various four-wheel drive tracks were used for this purpose.

2.4.1.3 Reptiles

A reptile search was undertaken throughout the site in fine weather for the period of six hours over three consecutive days. This involved looking under bark, fallen

timber and leaf litter and using a torch to search rock crevices. An assessment was made of the suitability of habitat for reptile occupation.

2.4.1.4 Frogs

Wetland areas were visited at night to detect frog calls audibly and by spotlight. Debris found around these areas was checked during the day for the presence of frogs. Unknown calls were identified using reference tapes (Barker and Grigg, 1983).

2.4.1.5 Species likely to occur

For a species to be listed as "likely to occur", suitable habitat must occur on the site and at least one of the following criteria satisfied:

- species is recorded in the Belmont - Redhead area by previous studies (Travers Morgan, 1992; BHP, 1994);
- birds given a reporting rate of greater than 40% in 'The Atlas of Australian Birds' (Blakers et.al., 1984) for the 1^o block which encompasses the study area; or
- mammals, reptiles or frogs listed as common to abundant in standard reference texts (eg., Cogger, 1993; Strahan, 1991 and Swan, 1990) which include the site within their known distribution and habitat type.

Species which may utilise the site may not have been detected during the survey for the following reasons:

- species was present during the survey but not detected due to inactivity or cryptic habits; and
- species utilises the site at other times of the year, but was not present during the survey due to nomadic or migratory behaviour.

2.4.2 Results of fauna survey

55 species were detected during the field survey. These species and those considered likely to occur in the study area are listed in Appendices B and C.

2.4.2.1 Site Fauna Habitat

A description of the site fauna habitat is provided by the vegetation community descriptions. Specific habitat features that may affect the presence of fauna on the site are listed below:

- tree hollows of a size suitable to provide daytime shelters for bat, possums and gliders and nesting hollows for birds occur in swamp mahoganies and paperbarks in the swamp sclerophyll forest.
- the wide variety of flowering plants and the varied structural composition present in the wetlands and to a lesser extent in the regenerating areas, would provide an important source of food and niches for birds and mammals.
- the large size of the wetlands and their favourable perimeter to surface area ratio mean they can provide habitat for a wide variety of fauna species

- due to past mining and current disturbance by off road vehicles the site's dunes are badly degraded in terms of fauna habitat. They do, however, provide a corridor for movement of species between habitat areas to the north and south
- urban run-off from existing developed areas north and west of the site and weed invasion are contributing to pressures on local fauna populations in the wetlands due to reduction in habitat quality

2.4.2.2 Birds

40 bird species were detected during the field survey. The vast majority of these were detected in the wetlands where a mosaic of open water, thick treed canopy and reedy areas provides niches for many bird species.

In the swamp sclerophyll forest the white-cheeked honeyeater (*Philydonyris nigra*) was by far the most common species. Other common species in the swamp sclerophyll forest were yellow-faced honeyeater (*Lichenostomus chrysops*), grey fantail (*Rhipidura fuliginosa*) and little wattlebird (*Anthochaera chrysoptera*). Dieback in parts of the swamp sclerophyll forest has also provided roosting and nesting habitat for little-pied and great cormorants (*Phalacrocorax melanoleucus* and *P. carbo*).

Common in open water areas fringed by reeds were purple swamphen (*Porphyrio porphyrio*), dusky moorhen (*Gallinula tenebrosa*) and black duck (*Anas superciliosa*). White-breasted woodswallows (*Artamus leucorhynchus*) and cormorants (*Phalacrocorax spp*) are a feature in areas of dead paperbarks.

The diversity and abundance of bird species is far lower in the open heath/scrub regrowth of the former mined areas. This is due to lack of cover and low plant species diversity.

Three bird of prey species were identified gliding over the study area. These were white-bellied sea-eagle, little eagle and whistling kite. The white-bellied sea-eagle is regarded as uncommon at a state level (Morris et al, 1981).

Nocturnal surveys only revealed the presence of a tawny frogmouth at a swamp sclerophyll/scrub regrowth interface. There were no responses to the play back tapes of the three owl species targeted.

42 additional species were listed as likely to occur, including the endangered black bittern (*Dupetor flavicollis*) and the uncommon Lewin's Rail (*Rallus pectoralis*). Intermediate egrets (*Egretta intermedia*) were detected in the study area and both cattle and great egrets are expected to occur. These species are covered by international agreements (Japan - Australia Migratory Bird Agreement and China - Australia Migratory Bird Agreement).

2.4.2.3 Mammals

Four native mammal species were detected during the field survey. Three species were found in swamp sclerophyll forest. These were common ringtail possum (*Pseudechis peregrinus*), grey-headed flying-fox (*Pteropus poliocephalus*) and little

reddish flying-fox (*P. scapulatus*). Flying foxes were in abundance due to the flowering *Melaleuca quinquinervia*. Diggings consistent with those of a bandicoot were common in better quality regrowth areas. These were probably of long-nosed bandicoots (*Perameles nasuta*).

Three introduced mammal species were detected. These were fox (*Vulpes vulpes*), rabbit (*Oryctolagus cuniculus*) and European hare (*Lepus capensis*). These species are all common in the formerly mined area. Foxes also prey on native fauna in the swamp forests.

Trapping failed to yield any captures. However, it is expected that swamp rat (*Rattus lutreolus*) occurs in the swamp sclerophyll forest. The presence of the New Holland mouse in the dunes remains uncertain. In addition to these species a further 14 species are considered likely to occur including the endangered squirrel glider (*Petaurus norfolcensis*) and three endangered insectivorous bats.

2.4.2.4 Reptiles

Only three reptile species were detected during the field survey despite favourable warm weather. These were lace monitor (*Varanus varius*), eastern water skink (*Eulamprus quoyii*) and grass skink (*Lamprophilus delicata*).

A further 20 species were listed as likely to occur including a variety of skinks, dragons and snakes.

2.4.2.5 Frogs

Five frog species were detected in the study area wetlands. These were eastern common froglet (*Crinia signifera*), brown-striped marsh frog (*Limnodynastes peronii*), Keffersteins frog (*Uperoleia laevigata*), green tree frog (*Litoria caerulea*) and eastern dwarf frog (*Lit. fallax*). Eastern common froglet was also detected in damp places in the mined-regrowth area.

A further 9 species, including a variety of ground and tree frogs, are expected to occur. It is not considered likely that the threatened green and golden bell frog (*Litoria aurea*) will occur in the study area due to the abundance of mosquito fish (*Gambusi affinis*) in the wetlands.

2.4.3 Endangered species

The following endangered species are either considered likely to occur within the study area or use it on a regular basis.

1. Black bittern (*Dupertor flavicollis*). This species inhabits shallow, fresh and brackish waters with densely vegetated margins (particularly *Melaleuca* and *Casuarina*) and occasionally mangroves (Morris et al, 1981). They breed in densely vegetated wetlands where nests built in leafy trees overhang water. They feed predominantly on crayfish, fish and insects. Black bittern has been recorded at Belmont Lagoon.

2. Squirrel glider (*Petaurus norfolcensis*). This arboreal mammal feeds on exudates and invertebrates from Acacia and Eucalyptus foliage as well as honeydew, pollen and nectar. It requires hollow-bearing trees for shelter and breeding. It is known to occur near in Jewells wetland near the northern boundary of the study area where swamp mahogany is co-dominant and is very likely to occur in other parts of the site's swamp sclerophyll forest where this important habitat tree occurs (M. Murray pers comm; G. Winning pers comm).
3. Little tern (*Sterna albifrons*). This migratory species nests during spring/summer on unvegetated coastal areas such as sand spits near estuaries. Due to this it is particularly vulnerable to threats such as human disturbance (especially off-road vehicles and fisherman), dogs and tidal inundation. These problems are compounded by its low recruitment rate (Smith, 1990; Garnett [ed], 1993). The species nested in sand dunes at Redhead in 1969 and more recently in a number of locations further north in the Hunter region (Smith, 1990; HBOC, 1993) It was also detected at nearby Swansea in 1991 (Morris & Burton, 1993). It could possibly colonise the site's dunes. However the current popular use of the beach by fishermen in four-wheel drive vehicles would make breeding success highly unlikely.
4. Common bent-wing bat (*Miniopterus schreibersii*). This species forages over forested valleys and roosts in caves, mines, stormwater channels and buildings (Dwyer in Strahan, ed, 1991). Bent-wing bats will fly over 50km from their day-time roosts to feed (Hall, 1990). It is likely to use the wetlands as part of its foraging range while roosting and breeding elsewhere.
5. Little bent-wing bat (*Miniopterus australis*). This species has ecological requirements similar to *M. schreibersii*.
6. Greater broad-nosed bat (*Scoteanax rueppellii*). This species roosts in tree hollows and buildings. It preys on insects and small vertebrates along-tree-lined creeks and the junction of woodland and cleared paddocks. (Richard in Strahan,ed, 1991).

The following significant fauna species were detected or are likely to occur in the study area:

- New Holland mouse - an uncommon species which may occur in mined regrowth areas;
- intermediate egret, cattle egret and great egret - covered by international agreements;
- white-bellied sea-eagle - considered uncommon at a state level; and
- Lewin's Rail - considered uncommon at a state level.

3

BUILT ENVIRONMENT

There are several zonings within the study area and few current uses made of the land. This section describes the present land uses and the uses currently permitted by the existing zonings.

3.1 LAND USES

The only current formal land use on the site is a sand mining pit operated by Hymix Pty Ltd, although there is substantial evidence of previous uses including mine vents and the coal railway. The majority of the site is unused and in a desolate state following substantial sand mining operations over the last four decades. Sand mining operations continue under existing uses rights and are now prohibited under the Lake Macquarie *Local Environmental Plan 1984*.

The area is also used extensively on an informal basis by four wheel drive vehicles and trail bikes and for the dumping of rubbish - particularly old car chassis.

3.2 PLANNING CONTROLS

The study area is subject to several planning instruments. The relevant aspects of these instruments are described below.

3.2.1 Lake Macquarie Local Environmental Plan 1984

The Lake Macquarie Local Environmental Plan (LMLEP) was gazetted on 19 April 1984 and designated particular zonings over the study area. The site is covered by six zonings as follows:

4(a) General Industry

This zone sets land aside for general inoffensive industrial development.

4(b) Special Industry

This zone sets aside land for particular specified types of industrial development - in this case, coal mining.

5(b) Special Uses (Proposed Arterial Road Reservation)

This zone allows for land to be set aside for future main road development - in this case the Belmont Bypass. The Roads and Traffic Authority have indicated that the development of this road is unlikely within their current ten year planning program.

5(d) Special Uses (Railway)

This zone sets land aside for use by the State Rail Authority of New South Wales for railway purposes. This zone covers the Redhead Coal Company Railway and the spur line to the John Darling Colliery. This land is now in the ownership of Lake Macquarie and Newcastle City Councils.

6(c) Open Space (Local Reservation)

This land is set aside for future local public recreation. Owners of land within this zone may require Council to acquire the land (clause 19, LMLEP).

7(a) Environment Protection (Scenic)

This zone sets aside land for the purposes of preserving areas of high landscape quality. Land may be subdivided and a dwelling erected within this zone, but a minimum allotment size of 40 hectares applies. Various uses are permissible with development consent in this zone, including tourist facilities, guest houses, retail plant nurseries, recreation and picnic areas. There is a restriction of one dwelling house per allotment.

The location of these zonings is shown in Figure 9.

3.2.2 Hunter Regional Environmental Plan 1989

The *Hunter Regional Environmental Plan* (NSW Dep. Planning, 1989) (HREP) was gazetted on 8 December 1988. Among its aims are:

- (a) "...to promote the balanced development of the region, the improvement of its urban and rural environments and the orderly and economic development and optimum use of its land and other resources, consistent with conservation of natural and man made features and so as to meet the needs and aspirations of the community;
- (b) to coordinate activities related to development in the region so there is optimum social and economic benefit to the community; and....."

The Plan provides objectives, policies and principles for seven planning activities as follows: social development; economic development; land use and settlement; transport; natural resources; environment protection; and conservation and recreation.

The suggested land use zonings in this report have been framed within the context of the HREP.

3.2.3 State Environmental Planning Policy No.14 - Coastal Wetlands

State Environmental Planning Policy No.14 (SEPP 14) was gazetted on 12 December 1985. The Policy aims to ensure "that coastal wetlands are preserved and protected in the environmental and economic interests of the State" (Circular



Figure 9 Indicative zoning map

B10-1). Maps covering the location and unique numbering of the wetlands form part of the Policy.

SEPP 14 (clause 7(3)) makes developments on land covered by the Policy that involve clearing, draining, filling or constructing a levee designated development under the *Environmental Planning and Assessment Act 1979* (EP&A Act). This development requires preparation of an Environmental Impact Statement.

3.3 OTHER POLICIES/STRATEGIES APPLYING

There are several policies and strategies which apply to the Lake Macquarie area and which potentially impact on the study area. This section provides a summary of these and their likely impacts on the planning for the subject site.

3.3.1 The New South Wales Coast - Government Policy

This policy was released on 9 September 1990 and applies to the coastal areas of New South Wales which lie outside the Sydney metropolitan area, the City of Newcastle and City of Wollongong. The policy defines the applicable area as being one kilometre landward from the low water mark and three nautical miles seaward. It also provides for greater areas to be included where that is considered necessary.

The policy is a prescribed matter under Section 65 of the *Environmental Planning and Assessment Regulation 1994* and therefore must be considered when determining any development application within its jurisdiction. As the entire eastern boundary of the subject site is within the coastal zone its principles must be considered. These include: prohibition of development on frontal dunes, beaches and headlands; protection from overshadowing; determination of applicable setbacks on a case by case basis; and unimpeded public access to foreshore areas.

These will be considered in later sections.

3.3.2 Draft Revised Coastal Policy for NSW

This policy was released in April 1994 by the Coastal Committee of NSW and provided a review of the 1990 policy in the context of growing pressure on the coastal zone. The document presents a draft Strategic Plan which focuses on a series of goals relating to conservation, socio economic issues and implementation of the policy.

Of relevance to the subject site are the objectives relating to goals 1 to 7:

1. To protect, restore and enhance the natural environment
2. To protect and enhance aesthetic qualities
3. To protect and conserve cultural heritage
4. To recognise and accommodate natural processes
5. To provide for ecologically sustainable development and use of resources
6. To provide for appropriate human settlement
7. To provide for appropriate public access.

These goals are incorporated into the strategies developed later in the report.

The draft policy has yet to receive Cabinet endorsement, however, this is likely in the next few months. Changes that are likely to be made to the draft Policy include a wider definition of the coastal zone to include estuaries and a buffer around them and the inclusion of waters up to the tidal limits. The inclusion of the Greater Metropolitan Region is also likely. These changes are unlikely to impact directly on the study area.

3.3.3 Hunter's Coast - Hunter Coastal Urban Settlement Strategy

This strategy, prepared by the NSW Department of Planning in 1994, aims to ensure that urban growth is planned and managed in a manner environmentally and economically acceptable to the community. The strategy projects population growth to around 212,000 by 2016 and identifies areas of land with potential for urban expansion.

It recognises the importance of the environmental constraints on the study area such as wetlands and scenic protection and does not include the site as a potential urban area in its Coastal Urban Settlement Strategy.

To support the implementation of the strategy, a direction under Section 117 of the EP&A Act was made on 20 July 1994 requiring draft local environmental plans being prepared by relevant councils to be consistent with principles of the *Hunter Coastal Urban Settlement Strategy* (NSW Dep. Planning, 1994).

3.3.4 Lower Hunter Housing Market Strategy

This study was undertaken by consultants for the Department of Planning and completed in April 1993. It assesses the region's ability to absorb additional growth without social, environmental and infrastructure costs. It identified North Belmont as having moderate demand for detached housing in the range of \$60,000 to \$70,000 per lot. It also recognised a limited but increasing demand for retirement units in the North Belmont area.

3.3.5 Cities for the 21st Century

This strategy was developed jointly by the major State agencies and represents a "whole of government" approach to integrated urban management. The strategy builds upon the Metropolitan Strategy which was originally released in 1988 and updated subsequently. One of the major differences between this strategy and its predecessors is its recognition of the Greater Metropolitan Region, including the Cities of Newcastle and Wollongong.

It has some relevance to the subject site in that, while it does not make specific statements about the Lake Macquarie area, it recognises the potential growth of the Hunter region generally and the Newcastle area specifically. It also identifies the central business district of Newcastle as an area which will be supported by government in terms of location of employment, marketing and promotion and transport.

3.3.6 Section 94 Contributions Plan

Lake Macquarie City Council's Section 94 Contributions Plan No 1 was adopted on 3 July 1984 and provides the basis for Council's levying of developer contributions for community facilities; open space and recreation; and trunk drainage. Each of these issues is addressed via a strategy which sets out the existing situation, the level of additional needs as a result of that growth. It would be anticipated that any substantial development of the Belmont-Redhead site would impact greatly on the planned levels of growth recorded in the Section 94 Contributions Plan. This would need to be considered in the annual review of the plan, should development proceed.

3.3.7 City of Lake Macquarie Community Profile

This document was prepared by the Lake Macquarie City Council for the Hunter Area Assistance Scheme and provides background information on the local government area to assist in decision making on funding from community based organisations.

It provides social indicators and levels of community services available/required in the future. The profile also acknowledges the population growth in the Lake Macquarie region and where that growth is likely to occur. Growth in the Belmont-Redhead area has not been anticipated in the 1993 profile.

3.4 PLANNING HISTORY

The site was previously zoned under the Northumberland County District Planning Scheme 1960 as:

- Non Urban 'A';
- Industrial 'A';
- Open Space (public parks and recreation);
- Special Uses (Railway) Reservation; and
- County Road Reservation.

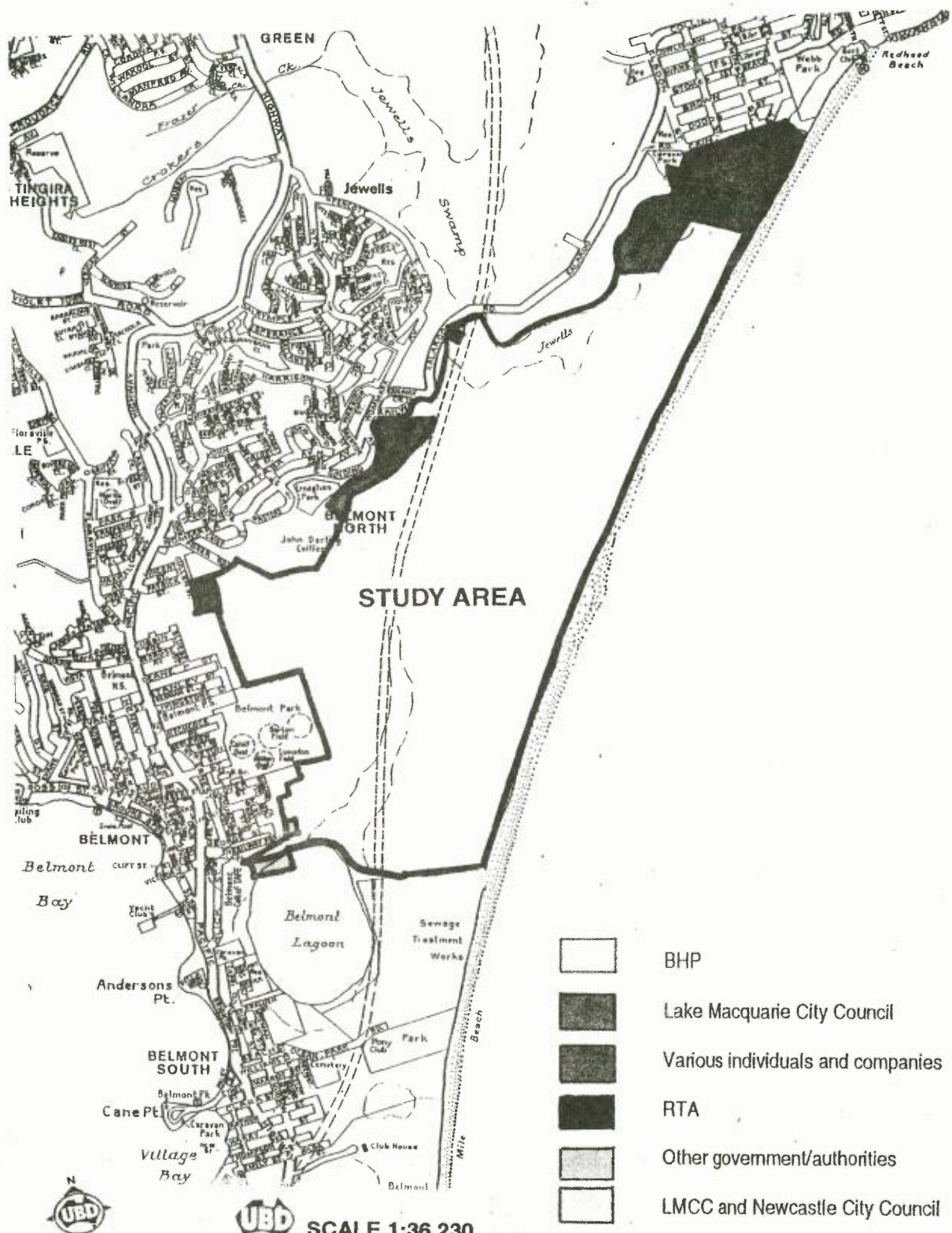
These did not change greatly with the 1984 instrument. A recommendation in the draft 1984 plan to rezone part of the site 6(d) Regional Open Space was not supported by the Department of Planning.

In terms of development proposals, there has been one building application lodged in 1989 for an outbuilding/garage on Lot 23 DP 709388 which was approved. A small subdivision was also approved on BHP land. Since then, there has been no development activity on the site.

A rezoning proposal for the Belmont Sands Resort was put forward in 1989, however this proposal was subsequently withdrawn.

3.5 LAND OWNERSHIP

Figure 10 shows the current land ownership of the Belmont-Redhead site. The largest owner is Broken Hill Proprietary with smaller pockets owned by Lake Macquarie City Council and various individuals and companies.



Map reproduced with permission of UBD
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Figure 10 Land ownership

4

HOUSING MARKET

4.1 REGIONAL CONTEXT

4.1.1 Population growth

Between 1971 and 1991 the total population of the five local Government areas which constitute the Lower Hunter (Cessnock, Maitland, Newcastle, Lake Macquarie and Port Stephens) grew from around 350,000 to around 445,000 people. This represents an average annual rate of increase of around 1.2%.

Research indicates that since 1981 there has been a sharp increase in the rate of movement to the region from Sydney and other parts of New South Wales, (see for example NSW Department of Planning: *Hunter's Coast: Hunter Coastal Urban Settlement Strategy 1994* (p.5-6)). Migration from the former has contributed almost half of the area's population increase, mainly from those who have retired and those not in the workforce. Lifestyle is often the most important reason for moving from Sydney, however significant numbers are also responding to employment prospects.

Within the Lower Hunter a substantial proportion of this growth has been concentrated in the coastal areas. There is every indication that this will continue. The principal reason being that the region is widely considered to offer enhanced lifestyle opportunities. Important also is a pressure for many to seek employment outside Sydney particularly in the Hunter.

Arising from recent investigations by the NSW Department of Planning - *Lower Hunter Housing Market Study*, (1993) and *Hunter Coastal Urban Settlement Strategy*, (1994) - it has been concluded in the strategy for planning the future of the Greater Metropolitan Region of Sydney that substantial potential continues to exist for future growth in the Lower Hunter. Indeed,

“...there do not appear to be major physical or environmental constraints to the (Newcastle) region...” (p59)

accommodating up to an additional 200,000 people. This translates into around 60,000 new dwellings.

Projections (medium level) by the NSW Department of Urban Affairs and Planning indicate that the current population of around 445,000 will grow to around 523,000 by 2011 and 540,000 five years later. At this time the population of the Sydney Region is projected to be approximately 4.36 million people (see NSW Department of Planning; *Non-Metropolitan Population Projections* (1994) and *Metropolitan Population Projections*, (1994).

Within the Lower Hunter it is anticipated that population growth will continue to be heavily concentrated in the coastal areas of Lake Macquarie and Port Stephens; areas where lifestyle aspirations adjacent or nearby to the coast can be readily achieved.

Table 5 Population projections - Lower Hunter Coastal Area

	1991 ERP	2016 Medium	2016 High	Change 1991-2016
Lake Macquarie	169,710	202,600	211,900	32,900-42,200
Newcastle	136,170	144,000	150,600	7,800-14,400
Port Stephens	45,130	79,200	82,900	34,100-37,800
Total Coastal Areas	351,010	425,800	445,400	74,800-94,400

Estimated Resident Population

Source: 1994 Series, by Department of Planning

Of particular note is that within the Lower Hunter approximately 40% of the population is currently accommodated in the Lake Macquarie Local Authority Area. Since 1971 the population here has increased from 122,425 to an estimated 169,710 representing a rise of approximately 38%.

According to the NSW Department of Urban Affairs and Planning, further increases can be expected, though not as rapid. By the year 2016 the population within Lake Macquarie is projected to be between 202,600 and 211,900, reflecting an increase of around 21.0%.

4.1.2 Housing

The regional housing market has now been the subject of extensive investigation. Of these the most relevant is the *Lower Hunter Housing Market Study* prepared by Devine Erby Mazlin (1993). More recent analysis has since been conducted by the NSW Department of Planning in the preparation of the *Hunter Coastal Urban Settlement Strategy* (1994).

The key findings of this and other research which are most relevant to the present study are outlined in the following subsections.

4.1.2.1 Land supply and distribution

Urban land supply in the Lower Hunter is essentially derived from opportunities for more intensive development; and extensions to urban areas identified under the NSW Government's Urban Development Program (UDP). Investigations have revealed that there is a notional total capacity to house approximately 199,000 people.

Within the Lower Hunter over 70.0% of the stock of housing is concentrated in Newcastle and Lake Macquarie. The remaining areas of Cessnock, Maitland and Port Stephens each have around 10.0%.

In terms of potential urban land supply recognised to be capable of accommodating further growth, the vast proportion of opportunities for more intensive development lie in the established areas of Newcastle. Of greater relevance however, is the supply of land identified under the Urban Development Program. These are made up of a comparatively large number of areas, verging on infill opportunities, scattered

throughout the Lower Hunter. It has been estimated that in total these have a capacity of around 24,465 lots.

All of this land is zoned and 2,980 lots are presently subdivided. The remaining land has potential for 21,485 lots, of which 14,870 (65.0%) do not appear to have engineering or other constraints. Approximately 7,136 (33.0%) have some constraints on short term development.

Looking at the distribution of residential land supply, it will be observed that a substantial proportion is located in the coastal areas of Lake Macquarie, Newcastle and Port Stephens. Recent data derived from the Urban Development Program indicates that these areas account for around 70.0% of total supply, and of this approximately half is located in the Lake Macquarie area.

Table 6 Urban development program residential land supply - Lower Hunter Coastal Area: 1993

LGA	Stage of development		
	Subdivided	Zoned	Total
Lake Macquarie	1,230	7,360	8,590
Newcastle	350	3,685	4,040
Port Stephens	945	3,930	4,875

1. Subdivided and vacant 1993

Source: Department of Urban Affairs and Planning, Hunter Coastal Urban - Settlement Strategy 1993.

4.1.2.2 Development activity

Development activity in the Lower Hunter has varied considerably between the constituent local authority areas. In terms of commencements which have occurred in new residential areas identified under the Urban Development Program, between 1986 and 1991 these ranged from 64.7% in Maitland, 49.0% in Lake Macquarie and 39.5% in Port Stephens, down to 26.2% in Newcastle and 11.3% in Cessnock. With the exception of Maitland, it is clear that much of the development activity is focussed on the coastal areas.

Contrasting densities in development are also evident. Analysis of census data indicates that detached housing in Lake Macquarie and Port Stephens, as a proportion of dwelling total/stock represents around 91.5% and 84.1% respectively.

4.2 LOCAL CONTEXT

4.2.1 Population growth

Within Lake Macquarie, as in the wider region, there has and continues to be considerable variation in the pattern of population growth and urban development. Marked increases have occurred in and around Morriset and Toronto where the population rose.

In the intercensal period between 1986 and 1991, the principal focuses of growth were around Morisset and Toronto. These areas respectively, registered increases of 20.8% and 13.0% in both traditional families and retirement housing. Increases were also recorded in the West Wallsend and Windale areas, through to a lesser degree, while Cardiff has maintained its population.

4.2.2 Demographic profile

The most significant feature of the region's demographic profile has been the change in age structure. Over the past decade the broad trend has been towards an ageing of the population. The NSW Department of Urban Affairs and Planning in its recent strategy for planning the future of the Greater Metropolitan Region of Sydney, has projected that this is likely to continue.

Data derived from the 1991 Census indicates that within the Lower Hunter, there will be a decrease in the under 15 age group, a slight increase in the 15-64 age group; and an increase in the 65+ age group over the next fifteen years. Over the next 20 years the population is expected to continue to become older, with marked increases in the number of people over 55 years.

Also evident are changes in household structure. In this respect there has been a decrease in the numbers of traditional nuclear family households and one person households, while conversely, there has been an increase in couples only and "other" categories of households which reflect an increase in the numbers of adult children living at home.

Within Lake Macquarie, the characteristics of the population are broadly similar to those evident within a regional context - except that variations are apparent over smaller areas. In essence, research has found that in areas where there has been relatively rapid growth, the population has been characterised by relatively youthful, affluent and mobile populations. By contrast there are areas, such as Belmont, where the populations have grown only marginally and are typified by being more mature, less affluent and less mobile.

The focus of the current investigation, Belmont-Redhead, is located in an area where there is considerable variation in the demographic profile. The area encompasses the townships and suburbs of Dudley-Redhead, Jewells, Belmont and Belmont South. Comparative data drawn from the 1991 Census on the salient characteristics is presented in the following tables. Of note is that the area is characterised by:

- low but consistent population growth - Dudley-Redhead and Belmont recorded increases of 1.1% and 0.7% respectively and as such represented the principal focuses of growth in area;
- substantial numbers of mature aged people - these were most pronounced in Belmont where some 35.4% of the local population is aged 55 years or more, and the proportion of residents aged 70 years or more is over twice that of the average for Lake Macquarie (16.2%). The proportion of children aged 14 years or less is only 16% compared to 23% for the Local Government Area;
- a low proportion of couples with children in older established areas, most particularly in Jewells and Dudley-Redhead; and

- a predominance of households with a higher socio-economic status in the more recently established urban areas of Dudley-Redhead and Jewells. These areas have experienced rapid population growth since 1971 and are today characterised by relatively youthful (high proportion of school age children) and affluent (average household income of \$39,800 p.a. and \$41,600 p.a. in the respective populations of Dudley-Redhead and Jewells).

In terms of housing, the 1991 Census reveals:

- a high proportion of detached housing in the newer residential areas. This is also evident in Jewells where around 97% of the total stock is detached;
- a high proportion of "other" types of housing in the older residential areas, most particularly in Belmont South and Dudley-Redhead; and
- a relatively low occupancy rate of between 2.26 and 2.75 per dwelling, with the exception of Jewells where the rate is 3.07 persons per dwelling.

4.2.3 Land supply

Against this pattern of population growth, there has been a relatively high level of housing development activity. As at June 1993, the land supply identified under the Urban Development Program had 1230 vacant subdivided residential allotments and a further 7360 potential allotments. Although this is considered by the New South Wales Department of Urban Affairs and Planning to be notionally sufficient to meet land requirements for the next decade, there is concern over the apparent slow take-up of available sites. (Only 27 of 57 sites have commenced development)

Table 7 Demographic profiles

AGE PROFILE	DUDLEY (AREA 2.1)		REDHEAD (AREA 2.2)		BELMONT (AREA 3.1)		BELMONT (AREA 3.2)		TOTAL BELMONT		LAKE MACQUARIE	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
0-4	473	7.3	474	7.4	363	6.0	434	7.3	1744	7.0	11913	7.3
5-9	501	7.8	601	9.3	310	5.1	385	6.5	1797	7.2	12964	8.0
10-14	454	7.0	586	9.1	296	4.9	316	5.3	1652	6.6	12486	7.7
15-24	923	14.3	961	14.9	846	14.0	762	12.8	3492	14.0	23686	14.6
25-39	1443	22.4	1497	23.3	1160	19.2	1271	21.3	5371	21.6	35652	22.0
40-54	1325	20.6	1407	21.9	919	15.2	985	16.5	4636	18.6	30758	19.0
55-69	930	14.4	692	10.7	1157	19.2	1131	19.0	3910	15.7	22103	13.6
70+	392	6.1	220	3.4	980	16.2	683	11.4	2275	9.1	12632	7.8
Total	6441	100.0	6438	100.0	6031	100.0	5967	100.0	24877	100.0	162194	100.0

FAMILY TYPE	DUDLEY (AREA 2.1)		REDHEAD (AREA 2.2)		BELMONT (AREA 3.1)		BELMONT (AREA 3.2)		TOTAL BELMONT		LAKE MACQUARIE	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Single parent/dep offspring only	74	4.1	73	4.1	115	6.8	128	7.6	390	5.6	2840	6.4
Single parent/other	109	6.0	80	4.5	133	7.9	138	8.2	460	6.6	2776	6.2
Couples without offspring	564	31.0	472	26.3	693	41.2	636	37.8	2365	33.9	13575	30.5
Couples/offspring	1007	55.3	1104	61.5	657	39.1	667	39.7	3435	49.2	23528	52.8
Couples with related adults	19	1.0	12	0.7	18	1.1	27	1.6	76	1.1	427	1.0
Couples with dep & related adults	27	1.5	31	1.7	28	1.7	45	2.7	131	1.9	814	1.8
Families with other rel. individuals	20	1.1	24	1.3	37	2.2	41	2.4	122	1.7	589	1.3
Total Families	1820	100.0	1796	100.0	1681	100.0	1682	100.0	6979	100.0	44549	100.0

ECONOMIC INDICATORS	DUDLEY (AREA 2.1)		REDHEAD (AREA 2.2)		BELMONT (AREA 3.1)		BELMONT (AREA 3.2)		TOTAL BELMONT		LAKE MACQUARIE	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Indiv. Income <\$8k pa	1486	29.4	1405	29.5	1789	35.6	1822	37.6	6502	33.0	40324	32.3
Indiv. Income >\$30k pa	965	19.1	938	19.7	544	10.8	503	10.4	2950	15.0	19144	15.3
Total 15+	5046	100.0	4769	100.0	5031	100.0	4850	100.0	19696	100.0	124755	100.0
Ave. Indiv. income	\$18800		\$18900		\$15000		\$14800		\$16900		\$17000	
Hhld income <\$20k pa	571	25.7	370	18.5	967	41.4	1040	43.4	2948	32.9	16224	29.7
Hhld income <\$60k pa	368	16.6	322	16.1	171	7.3	140	5.8	1001	11.2	6585	12.0
Total households	2221	100.0	1996	100.0	2334	100.0	2399	100.0	8950	100.0	54666	100.0
Average Hhld income	\$39800		\$41600		\$28900		\$26600		\$33700		\$35400	

OCCUPATIONAL STATUS	DUDLEY (AREA 2.1)		REDHEAD (AREA 2.2)		BELMONT (AREA 3.1)		BELMONT (AREA 3.2)		TOTAL BELMONT		LAKE MACQUARIE	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Manager/Admin/Professional	920	31.9	743	25.6	421	21.0	375	19.2	2459	25.2	16676	26.2
Clerical	437	15.1	424	14.6	280	13.9	251	12.8	1392	14.3	8979	14.1
Trade	432	15.0	474	16.3	362	18.0	366	18.7	1634	16.7	10982	17.3
Sales/Personal Services	425	14.7	466	16.0	328	16.3	292	14.9	1511	15.5	9286	14.6
Plant & Machinery Op	166	5.7	244	8.4	189	9.4	181	9.2	780	8.0	5071	8.0
Labourers	325	11.3	359	12.4	297	14.8	344	17.6	1325	13.6	8776	13.8
Inad desc/not stated	182	6.3	194	6.7	132	6.6	148	7.6	656	6.7	3790	6.0
Total Employed	2887	100.0	2904	100.0	2009	100.0	1957	100.0	9757	100.0	63560	100.0

DWELLING CHARACTERISTICS	DUDLEY (AREA 2.1)		REDHEAD (AREA 2.2)		BELMONT (AREA 3.1)		BELMONT (AREA 3.2)		TOTAL BELMONT		LAKE MACQUARIE	
	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Dwellings	2242	95.0	2011	96.3	2347	93.0	2411	91.4	9011	93.7	55074	93.1
Occupied private dwellings	119	5.0	78	3.7	178	7.0	226	8.6	601	6.3	4073	6.9
Unoccupied private dwellings	2361	100.0	2089	100.0	2525	100.0	2637	100.0	9612	100.0	59147	100.0
Persons in:												
Private dwellings	6381	98.6	6418	100.0	5643	94.0	5912	99.1	2435	98.0	158176	97.6
Non private dwellings	88	1.4	0	0.0	362	6.0	54	0.9	4	2.0	3853	2.4
Total persons	6469	100.0	6418	100.0	6005	100.0	5966	100.0	2485	100.0	162029	100.0
Dwelling Type												
Separate house	2066	87.5	2015	96.5	1966	77.9	1964	74.5	8011	83.3	53263	90.1
Semi det/Townhouse/Terrace	15	0.6	41	2.0	139	5.5	166	6.3	361	3.8	1839	3.1
Flat or Apartment	39	1.7	21	1.0	238	9.4	244	9.3	542	5.6	2212	3.7
Other	230	9.7	9	0.4	182	7.2	254	9.6	675	7.0	1579	2.7
Not stated	11	0.5	3	0.1	0	0.0	9	0.3	23	0.2	254	0.4
Total Dwellings	2361	100.0	2089	100.0	2525	100.0	2637	100.0	9612	100.0	59147	100.0
Nature of Occupancy												
Owned	1234	55.1	948	47.3	1248	53.3	1222	50.6	4652	51.7	26571	48.2
Being purchased	655	29.2	747	37.3	401	17.1	357	14.8	2160	24.0	15384	27.9
Rented: Housing Auth	17	0.8	81	4.0	114	4.9	211	8.7	423	4.7	3770	6.8
Rented: Other Govt.	3	0.1	7	0.3	9	0.4	9	0.4	28	0.3	193	0.4
Rented: Private/Not stated	244	10.9	147	7.3	451	19.3	513	21.2	1355	15.1	6709	12.2
Other/Not stated	88	3.9	75	3.7	117	5.0	104	4.3	384	4.3	2490	4.5
Total OPD	2241	100.0	2005	100.0	2340	100.0	241	100.0	9002	100.0	55117	100.0

The New South Wales Department of Urban Affairs and Planning suggests that this trend is possibly a reflection of high servicing costs, poor financial viability of smaller subdivisions and difficulties associated with land fragmentation. Looking at the distribution of land supply it will be observed that the only substantial development opportunities are seen to lie immediately parallel to the Sydney Newcastle freeway, a considerable distance from the coast.

This existing supply is centred on the areas surrounding the Edgeworth/Killingworth, Boorugal, Toronto and Morisset.

- Edgeworth/Killingworth

At Edgeworth/Killingworth future potential for urban development has been estimated by the New South Wales Department of Urban Affairs and Planning to be in the region of 10,000 residential allotments. This however, has been the focus of some 14 collieries and as a result is seen to be a constraint on its suitability for urban development. Where potential is seen to exist, it is necessary that liaison occur between the Department of Urban Affairs and Planning, Department of Mineral Resources, Lake Macquarie City Council and mining companies. Such a requirement can be the cause of considerable delay in the development process and in turn erode viability.

- Boorugal
Around Boorugal, the New South Wales Department of Urban Affairs and Planning estimates potential supply of urban land to be approximately 1500 allotments, although a priority for the provision of sewerage by the Hunter Water Corporation, is constrained by underground coalmines. Again, extensive consultation processes are required to confirm the land's suitability for development.
- Toronto
At Toronto a future supply of some 10,000 allotments has been identified, but given the existence of significant coal reserves in this area too, it is anticipated that this potential will not be realised for at least 20 years hence. The area is also isolated from the existing water supply and sewerage networks; a problem compounded by the fact that is considered by the Hunter Water Corporation to be low a priority for future provisioning. Some minor development of approximately 1000 allotments may be achieved after 1995, subject to a resolution of these issues.
- Morisset
Morisset has a potential for the development of around 10,000 allotments. This area however, is remotely located and as a result is considered by the Hunter Water Corporation to have a low servicing priority. In addition, current and future coal mining potential dictates that future development for residential purposes will not be possible for approximately 20 years.
- Other
It is to be noted that the Hunter Regional Environmental Plan (NSW Dept. Planning, 1989) identified a further 11 areas in and around the Westlakes area as potentially suitable for residential development. Subsequent investigation has revealed however, that its relative isolation from existing servicing infrastructure and the existence of past and present coal mining activity has resulted in the conclusion that only limited urban land supply can be provided.

The broad conclusion to be drawn from this brief overview of urban land supply in Lake Macquarie is that it in fact, essentially offers relatively limited potential. First, it is a significant distance from the coast and in turn presents opportunities for only a specific sector of the market. Second, it is heavily constrained by past, present and possible future coal mining activity. Third, much of it is distant from existing servicing infrastructure which is unlikely to be extended in the short to medium term.

The supply of land elsewhere within Lake Macquarie is located essentially in existing urban areas. Research undertaken by APT Peddle Thorp to determine the urban potential of BHP's Belmont property identified several areas where a supply currently existed. These were located at Caves Beach, Valentine, Dudley, Edgeworth, Wallsend and Elemore Vale. In all cases, subdivided fully serviced residential allotments were available in relatively small numbers. These allotments generally ranged in size from 670 to 830 square metres in area, and were of a variable quality.

It was broadly concluded that this supply was capable of meeting only a small percentage of buyer demand.

4.2.4 Development activity

It has been previously indicated that the population of Lake Macquarie has been projected by the New South Wales Department of Urban Affairs and Planning to rise from 169,700 (in 1991) to between 202,600 and 211,900 by 2016. This reflects an increase of around 21.0%.

Based on the pattern of development activity between the intercensal period 1986 and 1991, it is reasonable to assume that the projected growth will continue to have a substantial impact on the demand for urban land. An examination of census data on dwelling commencements indicates that Lake Macquarie has experienced a consistently higher level of activity than that recorded for the region in total.

Table 8 Dwelling commencements: Lake Macquarie and the Lower Hunter (1986-1991)

Area	Year					Total
	1986-87	1987-88	1988-89	1989-90	1990-91	1986-91
Lake Macquarie						
Total Commencements	740	727	972	839	801	4079
UDP Commencements	275	235	470	450	570	2000
Ratio of UDP to Total (%)	40.4	32.3	48.4	53.6	71.2	49.0
Lower Hunter						
Total Commencements	1917	1868	2873	2989	2635	12282
UDP Commencements	530	625	1175	1185	1410	4925
Ratio of UDP to Total (%)	27.6	33.4	40.9	39.6	53.5	40.0

Source: Lower Hunter Housing Market Study, Devine Erby Mazlin, (1993)

Of further relevance is a comparison of dwelling commencement activity with population growth in Lake Macquarie.

Table 9 Comparison of population and dwelling commencements: Lake Macquarie and the Lower Hunter (1981-1991)

Area	Year						Total
	1981-86	1986-87	1987-88	1988-89	1989-90	1990-91	1986-91
Lake Macquarie							
Population Increase	4650	1100	1100	1200	950	1100	5450
Commencements	5340	740	727	972	839	801	4079
Ratio Pop./Comm.	0.87	1.49	1.51	1.23	1.13	1.37	1.34
Lower Hunter (Total)							
Population Increase	12450	3060	2900	3550	3150	3880	16540
Commencements	15291	1917	1853	2873	3032	2635	12310
Ratio Pop./Comm.	0.81	1.60	1.57	1.24	1.04	1.47	1.34

Source: Lower Hunter Housing Market Study, Devine Erby Mazlin, (1993)

Shown above are ratios over time of the two factors. It will be observed that between 1981 and 1986 there was a significantly higher number of dwelling commencements

than the increase in population. This resulted in a ratio of 0.87:1. That is, one dwelling was constructed for over 0.87 persons added to the resident population.

By contrast, during the period 1986 to 1991, the increase in population significantly exceeded the number of dwelling commencements. Over this period the ratio was 1.34:1 suggesting that the population was increasing at a faster rate than the supply of dwellings.

4.2.5 Housing market trends

It is apparent from research that the housing market in the Lower Hunter and more specifically the Lake Macquarie area has over the past three decades become significantly more complex. A number of new submarkets, based on household size, stage of lifecycle, household type and lifestyle have been emerging in the traditional markets for location, price and tenure. Those most prominent are outlined below.

- **First home buyers**
The attraction of an area for first home buyers is heavily dependent on the availability of suitably priced land. The strongest current demand from first home buyers in Lake Macquarie appears to be focussed on the Tingira, Mt Hutton and Boorugal areas.
- **Second home buyers**
It is in areas where there is a higher than average proportion of those aged 30-49 years and where the household income exceeds \$50,000 per annum that there is a likelihood of demand for second homers. In Lake Macquarie the prime markets for second home buyers are located in the Valentine/Eleebana area, in Floraville and in the Cardiff/Speers Point area. Elevated land which provides views of Lake Macquarie and waterfront allotments has and continues to be in strong demand.
- **Investors and renters**
The established markets for investors and renters are traditionally located in the established urban areas of Newcastle and along the coast. In Lake Macquarie these markets are essentially located in and around Belmont.
- **The elderly**
The prime markets for aged persons and retirement housing in Lake Macquarie are focussed on the Charlestown, Belmont, Morisset and Toronto areas. It is in these areas that there are higher than average proportions of people over 55 years old, couples and single person households.

How demand is reflected in the nature of the housing stock constitutes a further feature of the market. Amongst the several types of housing which currently exist, those which dominate in both Lake Macquarie and the wider region include detached housing, multi-unit housing and aged persons accommodation.

- Detached housing
As previously indicated detached housing represents the substantial proportion of all existing stock and is the principal focus of all demand. It was concluded in the *Lower Hunter Housing Market Study* (Devine Erby Mazlin et al, 1993) that there is every likelihood that this will continue, particularly as the Lower Hunter becomes more widely recognised as an alternative to Sydney's outer metropolitan areas for detached housing. The availability of affordable land is clearly a fundamental determinant on the level of demand.
- Multi-unit housing
Within the region and most particularly in the coastal areas of Lake Macquarie and Newcastle there is a growing demand for multi-unit housing. This is primarily in the form of villas and town houses. The ageing of the population and attraction of the Lower Hunter to retirees and second home buyers are the principal causes for the growth in this market sector (see Devine Erby Mazlin *Lower Hunter Housing Market Study* (1993).
- Aged persons units/retirement housing
A population which is growing older is reflected in the increasing demand for retirement housing now evident. This, as previously indicated, is generally in the form of small villa or townhouse complexes. These are generally sought in the coastal and lakeshore areas of Lake Macquarie and within close proximity to major shopping centres.

Research conducted in the *Lower Hunter Housing Market Study* has been summarised in the following table. This data provides a concise insight into the specific segments and characteristics of the residential property market in Lake Macquarie. It is to be noted that these findings are generally consistent with current market conditions identified in recent research conducted by Hassell. This consistency can be generally attributed to the general economic climate.

Table 10 Residential market segments - Lake Macquarie LGA 1992

DISTRICT	SEGMENT	LOCALITY	TYPE	PRICE RANGE (\$'000s)	COMMENTS
Charlestown	Second Home Buyers	Highfields	Detached Housing	\$50-\$70/unit	Moderate Demand 30-40 pa
	Investors	All Areas	Villas/Townhouses	\$110-\$140/unit	Steady Demand
	Aged Persons/Retirement	Charlestown Whitebridge	Villas APUs	\$100-\$120/unit	Increasing Demand
Windale	First Home Buyers	Tingira Heights Mt Hurston	Detached Housing	\$35-\$45/lot	Moderate Demand 30-50 pa
	Second Home Buyers	Valentine Sleebana	Detached Housing Some Multi-Unit	\$65-\$75/lot	Moderate Demand 30-50 pa
	Retirement	Lakeshore Areas	Multi-Units	\$130-\$170/unit	Increasing Demand
Belmont	Second Home Buyers	North Belmont Florville Caves Beach	Detached Housing	\$60-\$70/lot	Moderate Demand
	Retirement	North Belmont	Multi-Unit	\$130-\$150/unit	Limited Demand but Increasing
Cardiff	Second Home Buyers	Spears Point (Lakelands)	Detached Housing	\$50-\$70/lot	Strong Demand 50-100 pa
West Wallsand	First Home Buyers	Argenton Glendale	Detached Housing	\$40-\$45/lot	Moderate Demand
Toronto	First Home Buyers	Booragui Bolton Point	Detached Housing	\$30-\$40/lot	Moderate/Strong Demand 50-70 pa
	Retirement	All Areas	Retirement Villages Multi-Units	\$90-\$130/unit	Demand Increasing
Monssat	Second Home Buyers/Retirement	Brightwaters Bonnelis Bay	Detached Housing	\$70-\$200/lot	Strong Demand for Waterfront Lots
	Retirement	All Areas	Retirement Villages APUs	\$90-\$120/unit	Demand Increasing

Source: *Lower Hunter Housing Market Study* (Devine Erby Mazlin et al, 1993)

4.2.6 Overview

The core finding of the research conducted essentially supports that of the *Lower Hunter Housing Market Study* and the conclusions reached by APT Peddle Thorp. In essence this suggests that there will be a need for additional affordable urban land of reasonable quality. This need can be satisfied by the proposal to release land at Belmont-Redhead.

The substantial research completed in the *Lower Hunter Housing Market Study* has found that shortages of residential land are likely to occur if further suitable land is not released.

Despite consistent production of residential land over the past five years, the combined forces of population growth and the desirability of the Hunter coastal areas have resulted in demand exceeding supply.

This issue will be compounded by the time required in the process of urban land production. The influences of initial planning and later, the development of necessary infrastructure, can be the cause of considerable delay.

The particular attributes which can be offered at Belmont-Redhead are such that demand is likely to arise from those seeking an affordable and attractive residential environment, most particularly families migrating from the more expensive Sydney metropolitan area.

5

ISSUES AND CONSTRAINTS

This section addresses the issues and constraints applicable to the land, identified through the investigations carried out. It also presents some opportunities for the future potential of the area.

5.1 DRAINAGE

5.1.1 Peak runoff rates

The peak runoff rates from the existing and proposed land uses were investigated using the simplistic Rational Method. The stormwater drainage system provided by BHP Engineering (1994) was adopted for this study, with a minor alteration to the boundary of sub-catchment number 6 (refer to Figure 11).

Peak discharges of each sub-catchment for the existing and proposed land uses and various design storm events are presented in Table 11.

The results indicate that the increase in the peak discharges (calculated on a full area basis) are approximately 350%, 120% and 100% for the 1, 50 and 100 year ARI design storms respectively. This result is to be expected, because urbanisation causes a larger peak discharge and reduces the time to the peak at the catchment outlet.

It is a requirement of Lake Macquarie City Council that any development should not increase flood levels in areas outside the site. The increases in discharge, as indicated by the results of the Rational Method calculations, are expected to increase flood levels. Control measures are therefore recommended.

5.1.2 Runoff control

Runoff rates from urban areas can be attenuated with the use of detention basins. Studies on similar catchments have established a typical storage volume requirement in detention basins of approximately 300m³/ha of contributing catchment. The storage volume requirement in each sub-catchment, based on this allowance would be:

Sub-catchment	Volume (m ³)
1	5,200
2	5,400
3	7,000
4	14,100
5	15,600
6	11,500
7	13,100
8	800
9	2,400
10	1,400

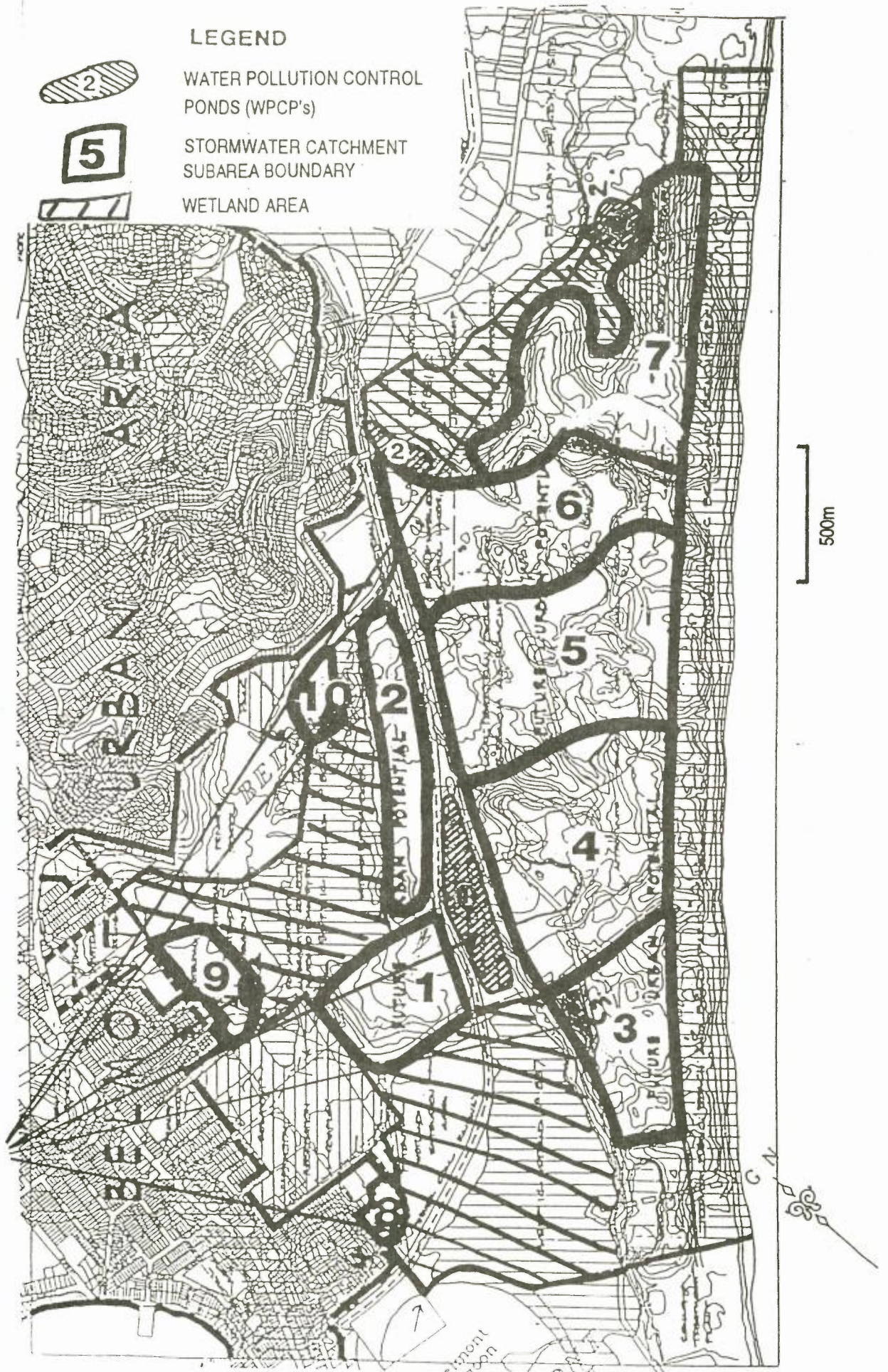


Figure 11

Indicative stormwater drainage system

Table 11 Results of the Rational Method calculations

Subcatchment No.	Area (ha)	Time of concentration (mins)	Design storm intensity (mm/hr)			Peak discharge for the existing landuse (m3/s)			Peak discharge for the proposed landuse (m3/s)			% Increase		
			1:1yr	1:50yr	1:100yr	Q:1yr	Q:50yr	Q:100yr	Q:1yr	Q:50yr	Q:100yr	Q:1yr	Q:50yr	Q:100yr
1	17.17	23	49.08	122.46	135.91	0.52	2.63	3.24	2.34	5.84	6.49	355	122	100
2	17.90	24	49.08	122.46	135.91	0.54	2.63	3.38	2.44	5.84	6.76	355	122	100
3	23.42	26	43.88	109.82	121.93	0.83	2.36	3.97	2.88	5.24	7.94	355	122	100
4	46.90	34	39.88	100.15	111.23	1.14	2.15	7.25	5.20	4.78	14.50	355	122	100
5	51.87	36	36.72	92.44	102.70	1.16	1.99	7.40	5.29	4.41	14.81	355	122	100
6	38.26	32	39.88	100.15	111.23	0.93	2.15	5.92	4.24	4.78	11.83	355	122	100
7	43.78	33	39.88	100.15	111.23	1.07	2.15	6.77	4.85	4.78	13.54	355	122	100
8	2.76	12	64.72	160.12	177.53	0.11	3.44	0.68	0.50	7.64	1.36	355	122	100
9	7.87	17	53.10	132.18	146.66	0.26	2.84	1.60	1.16	6.31	3.21	355	122	100
10	4.78	14	58.15	144.33	160.08	0.17	3.10	1.06	0.77	6.89	2.13	355	122	100

It may be possible to incorporate the necessary detention storage within the water pollution control ponds (refer to Section 5.4).

5.2 FLOODING

5.2.1 Background

In determining design flood levels for small coastal systems, including estuaries, lakes, lagoons and wetlands, it is sound practice to assume that peak tailwater levels and peak flood discharges from the catchment are coincident and caused by the same storm. This procedure has been adopted for the study of the Belmont Lagoon and Jewells Wetland Systems. These are on the southern and northern fringes of the study area respectively. The flooding behaviour of SEPP 14 designated wetland number 866 has been treated separately from these two systems.

5.2.2 Recorded flood events

Lake Macquarie City Council has kept some records of flooding near the Pacific Highway over the past 15 years.

Major floods were recorded over the periods of:

- 26 to 30 April 1988;
- 2 to 5 February 1990; and
- 21 to 22 March 1992.

During these floods the Pacific Highway was not trafficable for several hours.

5.2.3 Lower Jewells Swamp flooding

Flood levels in the lower Jewells Swamp are affected by local runoff and elevated ocean levels at the outlets. The 100 year flood level between Kalaroo Road and the ocean varies from RL 4.2m AHD at the road to RL 3.8m AHD downstream of the culvert adjacent to the Pearce's Sand site. This culvert has now been removed and the above flood levels are applicable to this situation. A 100 year flood level of RL 4.2m AHD has been adopted as the 100 year flood level along the site's boundary with Lower Jewells Swamp (refer to Figure 3).

5.2.4 Belmont Lagoon flooding

The catchment drains to Belmont Lagoon with three controls acting in the swampland to the north of the Lagoon proper. These controls throttle the discharge to Belmont Lagoon so that flood levels are increased in an upstream direction. They are outlined below.

1. The Hunter Water Corporation (HWC) embankment; located immediately north east of the Lagoon. Flow from the swampland upstream of this embankment is retarded until the Lagoon level reaches at least RL 0.6m at which time the control tends to drown.

2. The abandoned Redhead Coal Company's Railway embankment. One effect of this embankment is that it acts as a boundary between 2 distinct drainage paths which drain to SEPP 14 designated wetlands number 866 and 867 as shown in Figure 2.
3. A narrow human-made channel conveying runoff from wetland 866 to wetland 867 (Refer to Figure 2). The channel length is 300m and has a slope of approximately 0.2%. The channel width is approximately 10m.

The highest flood level recorded near the Cold Tea Canal entrance to Lake Macquarie is RL 1.2m AHD, which was recorded in the early 1920s (Lake Macquarie City Council). By allowing for headlosses in Cold Tea Canal and the predicted 100 year sea level rise due to the Greenhouse Effect, the 100 year flood level in Belmont Lagoon is conservatively estimated to be approximately RL 1.9m AHD.

Flood levels above the estimated 100 year tailwater flood level of RL 1.9m AHD could occur because of the headlosses caused by stormwater flow over the (virtually) drowned HWC and Redhead Railway embankments. For the proposed land use and channel, with dimensions described previously, the Rainfall Analysis and Flow Training Simulation Model (RAFTS) estimates the peak flow rate at the downstream end of the channel and just upstream of the Redhead Railway embankment at 127 m³/s.

In order for the railway embankment to pass this runoff, the water depth just upstream of the railway embankment would need to be approximately 2.33m AHD. By conservatively assuming that this depth is uniform, the 100 year flood level to be adopted in the area downstream of the channel exit would be 2.35m AHD. This is slightly higher than the 100 year flood level of 2.0m AHD estimated by Field (1981), who appeared to have used the maximum recorded tidal level as a basis for his study.

Field recommended a flood buffer zone in the area with elevation ranges between 2.0m AHD and 4.0m AHD. The main aim of this flood buffer zone is to accommodate works required to compensate for any changes in the hydrology and hydraulics of the area associated with urbanisation.

The estimated 100 year average recurrence interval (ARI) flood levels for the southern portion of the subject site are presented in Figure 3.

5.2.4.1 Narrow channel

The peak runoff at the channel entrance (refer to Figure 2) was estimated by RAFTS at approximately 139 m³/s for a 100 year 60 minute duration design storm. This is similar to a figure of 145 m³/s estimated by the U.S. Environmental Protection Authority's Stormwater Management Model (Huber & Dickinson, 1988), but lower than the figure of 177m³/s (full-area calculation) predicted by the Rational Method. The proposed land use was found to have an insignificant influence on the peak runoff value at the channel entrance.

5.2.4.2 SEPP14 wetland number 866

RAFTS was used to estimate the 100 year flood level in SEPP14 wetland number 866. This wetland was simulated as a basin and its stage-volume relationship was formulated using topographic information for the subject site. The channel draining the wetland was assumed to have an invert level of 3m AHD at the entrance, a slope of 0.2% and an entrance width of 10m (Field, 1981). Tailwater effects from flooding of Belmont Lagoon were not considered because the 100 year tailwater level, estimated at 2.33m AHD, is below the invert level for the downstream end of the channel.

The 100 year flood level in the wetland was estimated by RAFTS for a range of 100 year ARI design storm durations. A maximum level of 4.33m AHD was found for a storm duration of 60 minutes. If the proposed development is immediately adjacent to the wetland, this will reduce the available storage and a minimum flood level of 4.37m AHD would result for the same storm event. Therefore, it is recommended that the floor levels of the proposed development adjacent to SEPP14 wetland number 866 be maintained above 4.4m AHD.

The ecological characteristics of the wetland system could possibly be improved by widening the channel. This would reduce the 100 year flood level below 4.4m and increase the peak runoff rate at the downstream end of the channel.

The estimated 100 year ARI flood level for the SEPP14 wetland number 866 is presented in Figure 3.

5.3 WATER QUALITY SIMULATION

5.3.1 Background

In order to develop an effective water quality management strategy for the area it is first necessary to have a clear understanding of the water quality management objectives which are to be satisfied. Management objectives may include:

- the proposed landuse should not cause an increase in the average annual pollutant export compared to current levels for existing conditions;
- compliance with ANZECC water quality guidelines in relation to acceptable water quality parameters of receiving waters for existing and/or proposed landuses;
- a combination of the above objectives - no increase in pollutant export and compliance with ANZECC guidelines for receiving water quality.

If the objective was compliance with the ANZECC water quality guidelines it would be necessary to first assess the existing quality of the receiving waters (Belmont Lagoon) and then to look at the impact of the proposed development. Since there are no existing water quality data available for the area it would be necessary to undertake a comprehensive monitoring programme over a period of time to define water quality parameters for the receiving waters. This approach would also involve

more complex modelling to determine the impact of the proposed development on receiving water quality.

For this type of feasibility study it is more common to adopt the first objective where typical pollutant export rates for pre and post development landuses are used to develop an appropriate water quality management strategy.

Appropriate mitigation measures (water pollution control ponds) were initially sized to limit post development pollutant export to existing levels. As it was not economically feasible to achieve this objective a number of alternative options were also examined.

The development of a water quality management strategy for the site is outlined in the following sections. This includes the water quality modelling and a discussion of a number of alternative management options.

5.3.2 Water quality modelling

In order to assess the need to implement physical control measures (such as water pollution control ponds) to protect receiving water quality it is first necessary to analyse existing non-point source pollutant loads within the catchment and to determine the likely impact of changes in landuse on these loads. Numerical models are increasingly being used to estimate existing and future non-point source pollutant loads and to assist in the design of the physical control measures.

Water quality modelling, particularly for urban runoff and wetland behaviour, is very much in the development stage. Limited information is currently available about pollutant export for different catchments and nutrient removal processes which occur within the wetlands. However, in order to quantify the likely nutrient export loads and to size the required wetlands, some form of model is required.

The pollutant export and retention models considered for this study are listed below in increasing order of complexity:

- POLLUTE
- AQUALM
- SWMM

POLLUTE (WP Software, 1989) was adopted for the study as insufficient site specific water quality and streamflow data were available to justify the use of the other, more complex, models. The model and adopted parameters are approximate only (although they are based on the best available data) and will not give definitive results. However, POLLUTE is sufficiently accurate for the purposes of this study and will provide sufficient information to formulate a water quality management strategy for the site. Other models could be used in the future as more data become available for model calibration.

The POLLUTE model was used to:

- simulate the rainfall/runoff process within the catchment based on a modified version of the Boughton water balance model;

- generate non-point source pollutant loadings for the existing and future land use;
- simulate the retention of pollutants within a water pollution control ponds.

The existing and expected pollutant loads for the study area were estimated on an annual basis, for an average rainfall year, based on assumed pollutant export rates for the different landuses. Without site specific data, typical pollutant export rates must be used. Whilst the pollutant export rate values given in the literature are characteristic values for the different landuse types, there is significant variation in these values for a single landuse. For example total phosphorous export for bushland is given as 0.1 +/- 0.1 kg/ha/yr and sewered urban as 1.3 +/- 0.4 kg/ha/yr (CSIRO, 1994). A truly representative export rate could only be obtained from the results of a comprehensive water quality monitoring programme for the area. Although there is considerable uncertainty associated with the published export rates they are considered to be acceptable for the purposes of this study. It will be some time before more accurate data are available.

5.3.3 Rainfall and evaporation data

From an analysis of monthly rainfall records dating from 1962 to 1995 for Nobby's Signal Station (# 061055; Bureau of Meteorology), the rainfall during 1966 was assumed to be representative of the average yearly rainfall for the Belmont-Redhead site. Daily rainfall data from 1966 and monthly average evaporation data were used for simulation in POLLUTE.

5.3.4 Existing land use

5.3.4.1 Catchment area and land use

The land use adopted to represent the existing environment was bushland. The area and location of each subcatchment to be modelled are given in Table 12 and Figure 11 respectively. It should be noted that all subcatchments were modelled for pre and post development conditions however, only those subcatchments east of the Redhead railway line are presented in detail, as these are the areas proposed for future development.

Table 12 Subcatchment areas

Subcatchment No.	Area (ha)
1	17.17
2	17.90
3	23.42
4	46.90
5	51.87
6	38.26
7	43.78
8	2.76
9	7.87
10	4.78

5.3.4.2 Hydrological parameters

The hydrological parameters adopted for the POLLUTE model represent a bush land use with high soil permeability (Water Board, 1993). The adopted model parameters are given in Table 13.

Table 13 Adopted hydrological parameters for a bush land use with high soil permeability

Coefficient	Factor	Coefficient value
Direct runoff coefficients	A	0.15
	B	-0.04
Soil storage coefficients	D	0.70
	E	0.04
	F	0.03
	G	0.10
Max interception storage (mm)	CPM	3.00
Max drainage storage (mm)	DRM	80.00
Max upper storage (mm)	USM	100.00
Drainage storage coefficient	Kt	0.25
Initial interception storage (mm)	CPST	0.00
Initial drainage storage (mm)	DRST	0.00
Initial upper soil storage (mm)	USST	65.00

5.3.4.3 Pollutant export model

For the following equation, which is used to estimate pollutant load per unit area, the pollutant export coefficients for the existing land use are given in Table 14.

$$PE = \alpha R^\beta \text{ (Equation 1.1)}$$

Where:

PE = Pollutant load by mass per unit area

R = daily total runoff (mm)

α = calibrated coefficient

β = calibrated exponent

Table 14 Adopted pollutant export rates for the existing land use

Pollutant constituent	α	β
Suspended solids	20.00	1.00
Total phosphorous	0.03	0.57

The adopted exponent and coefficient values in Table 14 were primarily obtained from information available for the Lake Macquarie Catchment ((Phillips et al, 1989) & (Willing & Partners, 1989)). This included all exponent values and the suspended solids coefficient. However, the total phosphorous coefficient was determined to achieve an adopted export rate of 0.1 kg/ha/yr (CSIRO, 1994).

5.3.4.4 Annual pollutant loads for existing land use

The predicted average annual pollutant loads exported from selected subcatchments in their existing condition are given in Table 15.

Table 15 Existing annual pollutant loads for selected subcatchments

Subcatchment No.	Total phosphorous (kg/yr)	Suspended solids (kg/yr)
3	2.4	2000
4	4.8	3970
5	5.5	4390
6	3.9	3240
7	4.5	3700

5.3.5 Proposed land use

5.3.5.1 Catchment area and land use

The land use adopted to represent the proposed environment was sewered urban. The area and location of each subcatchment to be simulated are given in Table 12 and Figure 11 respectively. Once again, information is only provided for subcatchments east of the Redhead railway line.

5.3.5.2 Hydrological parameters

The hydrological parameters for the POLLUTE model were adopted to represent a sewered urban land use with high soil permeability (Water Board, 1993). The adopted parameters are given in Table 16.

Table 16 Adopted hydrological parameters for a sewered urban land use

Coefficient	Factor	Coefficient value
Direct runoff coefficients	A	0.220
	B	-0.150
Soil storage coefficients	D	0.700
	E	0.005
	F	0.000
	G	0.000
Max interception storage (mm)	CPM	5.000
Max drainage storage (mm)	DRM	30.000
Max upper storage (mm)	USM	55.000
Drainage storage coefficient	Kt	0.150
Initial interception storage (mm)	CPST	0.000
Initial drainage storage (mm)	DRST	0.000
Initial upper soil storage (mm)	USST	40.000

5.3.5.3 Pollutant export model

Pollutant export coefficients for Equation 1.1 for the proposed land use are given in Table 17.

Table 17 Adopted pollutant export rates for the proposed land use

Pollutant constituent	α	β
Suspended solids	200.0	1.0
Total phosphorous	0.4	0.8

The adopted exponent and coefficient values in Table 17 were primarily obtained from information available for the Lake Macquarie Catchment ((Phillips et al, 1989) & (Willing & Partners, 1989)). This included all exponent values and the suspended solids coefficient. However, the total phosphorous coefficient was determined to achieve an adopted export rate of 1.3 kg/ha/yr (CSIRO, 1994).

5.3.5.4 Annual pollutant loads for proposed land use

The predicted average annual pollutant loads exported from selected subcatchments, for the proposed land use, are given in Table 18. Table 18 also indicates the percentage reduction required to reduce total phosphorous (TP) and suspended solids (SS) back to existing levels.

The results show that TP has the greatest change with a predicted percentage reduction of around 92% required to reduce the pollutant loading to existing levels.

The predicted increase in TP is large because the export of this pollutant is very small for the existing land use, as compared with the proposed land use (ie 0.1kg/yr/ha versus 1.3kg/yr/ha). In fact, by assuming a bushland land use for the existing site, which has only portions of bushland and is predominantly disturbed sand, the existing export of TP may be an overestimate.

Table 18 Expected annual pollutant loads for selected subcatchments

Subcatchment No.	Total phosphorous (kg/yr)	Suspended solids (kg/yr)	TP removal fraction required (%)*	SS removal fraction required (%)*
3	32	21,500	92.4	90.7
4	63	42,900	92.4	90.7
5	70	47,400	92.4	90.7
6	52	34,990	92.4	90.7
7	59	40,000	92.4	90.7

* Constant because of constant pollutant loading rate eg for TP, $100 - 0.1/1.3 * 100 = 92.4\%$

5.4 WATER QUALITY MANAGEMENT OPTIONS

Without appropriate controls, the urbanisation of an area, such as the Belmont-Redhead site, has the potential to adversely affect receiving water quality. Additional nutrients, suspended solids and litter must be removed from the stormwater runoff before it discharges into the existing SEPP 14 wetlands. It is therefore recommended that an integrated pollution control strategy be adopted for the site, which includes sediment basins (during construction), gross pollutant traps and WPCPs or wetlands.

Inspections of the subject site and surrounding areas revealed evidence of apparently high nutrient levels in the wetlands on the site. This appeared to be caused to a large extent by the draining of existing urban areas directly into the wetlands. There are currently eight to ten drains discharging into the wetlands without any form of pollution control mechanism. This will have a considerable impact on the ability of on site measures to address the water quality issue.

It is understood that the current requirement of the Environment Protection Authority (EPA) is that the post development pollutant loads should not exceed current levels. If this criteria is adopted for the study area, significant areas of the site will be required for construction of the wetlands. Phosphorous export, which is generally adopted as the principal nutrient for removal in the wetlands, is likely to increase significantly after the site is developed. This does not mean that post development export rates are any higher than for other residential areas. Rather, since the existing land use on the site generates very little phosphorous the percentage increase will be larger than for similar residential developments in existing rural areas.

The design of the stormwater management facility for the proposed land use requires the consideration of two factors:

- the detention storage volume required to attenuate likely increased flood flows caused by urbanisation; and
- WPCPs for the treatment of pollutant constituents contained in runoff from the catchment (including irrigation and stormwater runoff).

5.4.1 Detention storage volume

The detention storage volume requirements are given in Section 5.1.2. The detention storage volume can be incorporated into the WPCP or as a separate detention basin adjacent to the WPCP.

It is recommended that the WPCP be separate to the detention basin. It is recognised that WPCPs generally perform satisfactorily for up to 1 year or 5 year ARI flows (Tooker et al, 1992) if designed in this manner.

5.4.2 Size requirements

POLLUTE was used to determine the TP removal efficiencies of WPCP's of different sizes. The TP removal efficiencies were based on the Lawrence curves (1986).

5.4.2.1 The 92% scenario

To achieve the EPA desired removal rate for TP of 92% (removal efficiency necessary to maintain pre-development phosphorous levels), the WPCPs need to be sized at approximately 26 % of the total area of sub-catchments contributing to the WPCP. The assumed geometry of the WPCPs is shown in Figure 12. The large predicted sizes are due to the long residence times required to achieve the desired removal fraction for TP.

For the geometry given in Figure 12, the volume of each WPCP (excluding the detention storage volume) required to achieve the desired removal fraction for each subcatchment is given in Table 19.

Table 19 WPCP volume and area for each subcatchment (based on a 92% removal fraction)

Contributing subcatchment	Total area of contributing subcatchments (ha)	Area of WPCP (ha)	WPCP volume (excluding detention storage volume) ML
3	23.42	6.1	130
4	46.90	12.2	280
5	51.87	13.5	310
6	38.26	10.0	230
7	43.78	11.4	260

Details of the proposed WPCP system, which has three WPCP's is given in Table 20. The selection of the subcatchments contributing to each WPCP was based on size and runoff constraints. Cost information in the following sections is based on the proposed WPCP system.

Table 20 WPCP volume and area for the proposed water quality control system (based on a 92% removal fraction)

WPCP No.	Contributing subcatchment	Total area of contributing subcatchments (ha)	Area of WPCP (ha)	WPCP volume (excluding detention storage volume) ML
1	5 & 6	90.13	23.5	540
2	3 & 4	70.32	18.3	410
3	7	43.78	11.4	260

The areas of each WPCP required for different TP removal fractions were estimated using POLLUTE. For each TP removal fraction the surface area of each WPCP was observed to be linearly related to the area of the contributing subcatchment. The surface area of the WPCP, expressed as a percentage of the total area of the contributing subcatchments, is plotted against the TP removal fraction in Figure 13.

5.4.2.2 Water pollution control pond costs

Comprehensive cost estimates of WPCPs for the Ingleside Warriewood water cycle management study (Patterson Britton, 1992) were used as a basis for estimating costs of WPCP's for the subject site. The costs are based on the following figures:

1. WPCP including Gross Pollutant Traps & control structures \$40/m²
2. WPCP alone \$20/m²

The total cost of all WPCPs is graphed against the TP removal fraction in Figure 14. Figure 15 shows the cost per dwelling (assuming 1500 lots) versus the TP removal fraction. These costs are based on the figure of \$40/m². The total cost of maintaining pollutant loads at their existing levels (by using the 92% scenario) is \$21M and the cost per dwelling is \$14 000. If the WPCPs were designed to be offline, then the cost of the channel which would be located alongside the WPCP's is estimated to be \$0.4M (@ \$300/m) (this does not include annual maintenance costs).

The results show that relatively large WPCPs would be required to achieve the desired removal rate for TP. This problem is caused by the unique situation of an existing land use which is expected to export negligible TP loads (ie 0.1 kg/yr/ha for bushland), which are difficult to maintain post-development.

The large expense associated with achieving a 92% reduction of TP is likely to compromise the financial viability of the proposed development. Possible options to reduce this expense are considered below.

5.4.3 Possible alternatives

As a means to overcome the cost associated with the 92% scenario, the following alternatives have been investigated:

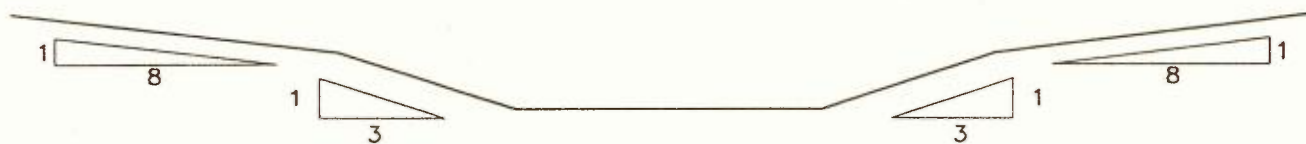


Figure 12 Assumed geometry of WPCPs simulated using POLLUTE

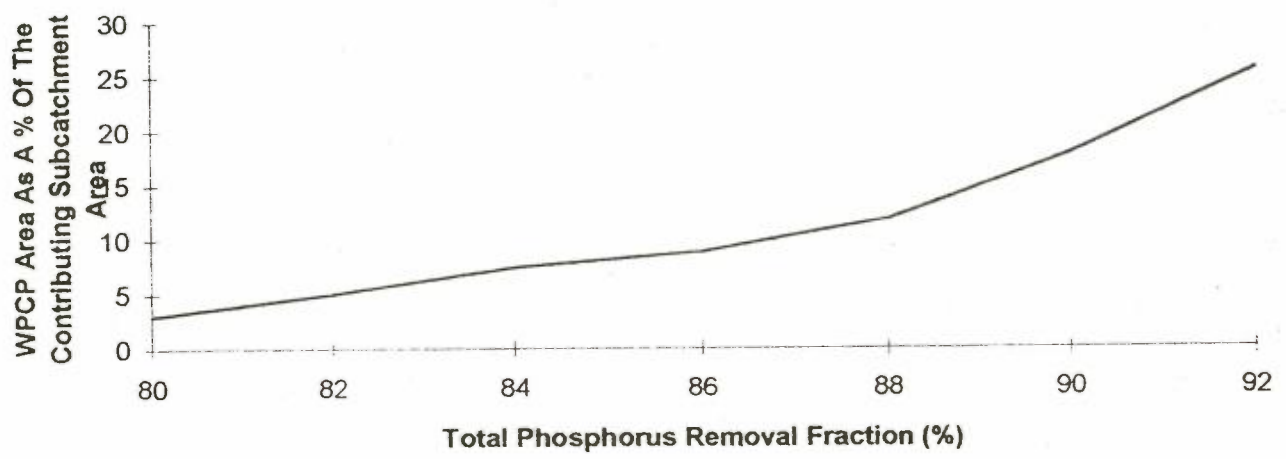


Figure 13 WPCP areas

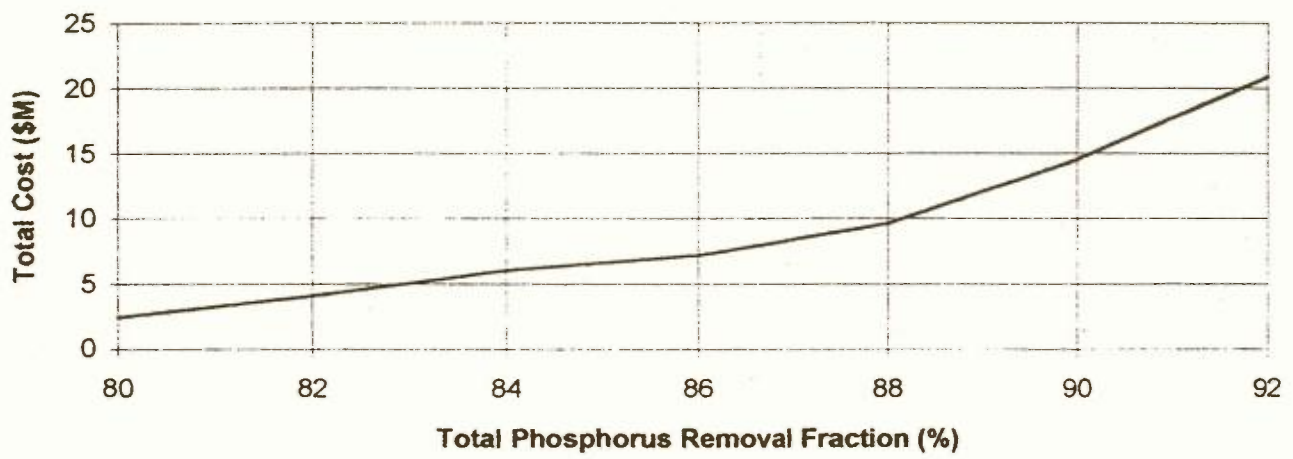


Figure 14 WPCP costs (total cost)

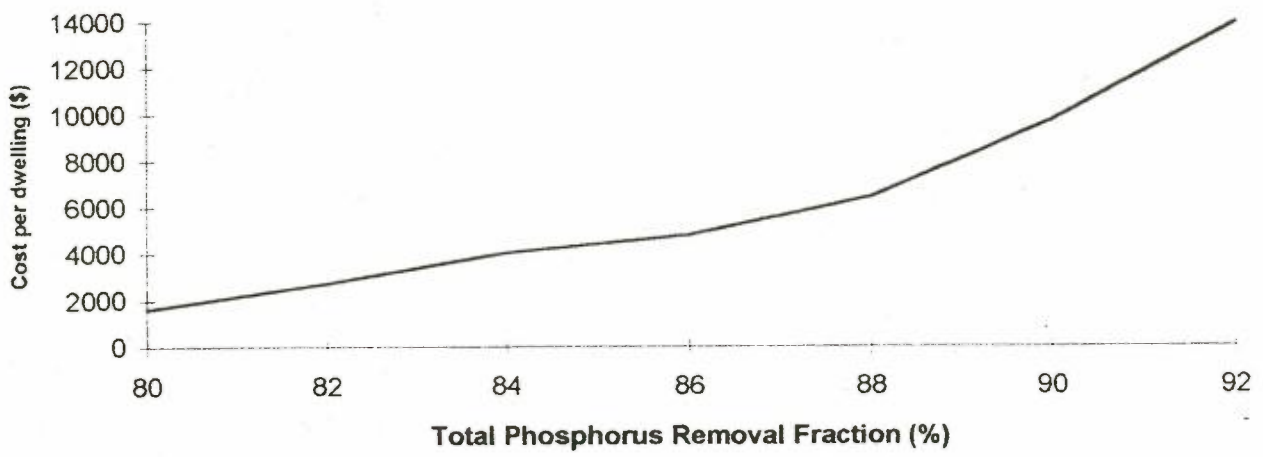


Figure 15 WPCP costs (per dwelling)

1. Adopting management practices to minimise the application of phosphorous for the proposed land use.
2. Adopt a lower removal fraction for the initial stages of development and monitor the resultant export loads (ie 80%).
3. Set the target TP removal fraction below 92% for runoff from the Belmont-Redhead site and provide additional water quality treatment for the adjacent urban area which currently has no water quality control.

5.4.3.1 Alternative 1

In order to reduce costs, a very large reduction in the application of TP would be required. It is very unlikely that this reduction would be sufficient enough to enable a significant reduction in the costs of WPCPs. However, this type of source control should be implemented as a component of the final water quality management strategy.

5.4.3.2 Alternative 2

In studies of other catchments where the existing land use has higher pollutant export loads (eg rural land use, TP export rate = 0.6 kg/ha/yr) TP removal fractions, typically ranging from 70 to 80%, were adopted for a change to an urban land use.

By adopting a design retention time of 0.1 years which corresponds to a TP removal fraction of 80%, the volume and area of the WPCP for each subcatchment is calculated and presented in Table 21.

Table 21 WPCP volume and area for each subcatchment (based on an 80% removal fraction)

Contributing subcatchment	Total area of contributing subcatchments (ha)	Area of WPCP (ha)	WPCP volume (excluding detention storage volume)(ML)
3	23.42	0.8	14
4	46.90	1.5	28
5	51.87	1.6	31
6	38.26	1.2	23
7	43.78	1.4	26

Details of the proposed WPCP system, including cost, are given in Table 22.

Table 22 WPCP volume, area and cost for the proposed water pollution control system (based on \$40/m² & 80% removal fraction)

WPCP No.	Contributing subcatchments	WPCP volume (excluding detention storage volume) (ML)	Area of WPCP (ha)	Cost of each WPCP (\$M)	Detention storage volume (m ³)#	Cost of detention storage if incorporated into WPCP (based on \$7.5/m ²) \$M
1	5 & 6	54	2.8	1.12	27060	0.2
2	3 & 4	42	2.3	0.92	21090	0.15
3	7	26	1.4	0.56	13100	0.1
			TOTAL	2.6	Total	0.45

The depth of the detention storage volume for each WPCP is approximately 1m

The total cost of the WPCPs designed for a removal fraction of 80% is \$2.6M, or \$1700/dwelling. The WPCP area expressed as a percentage of the contributing subcatchment area is approximately 3%.

5.4.3.3 Alternative 3

The third alternative mentioned above, which entails an overall phosphorous reduction of 92%, could be achieved by adopting an 80% reduction for the Belmont-Redhead site with the residual (33kg) taken up elsewhere. As mentioned earlier, another residential area (Belmont) currently drains into the SEPP 14 wetlands, without water quality controls. The residual phosphorous could be removed by construction of a wetland to serve this catchment. For an appropriately sized wetland there should be a net improvement in the overall phosphorous levels. Control of runoff from existing urban areas into the wetlands needs to be addressed by Lake Macquarie City Council.

5.4.4 Catchment details

The Belmont catchment refers to the existing developed area adjacent to the Belmont-Redhead (BHP) site. This area drains into SEPP 14 wetlands within the BHP site.

The Belmont catchment has an urban area of 288.4 ha and bushland area of 256.6 ha. By adopting the same hydrological and pollutant export parameters used for the BHP site an annual runoff volume of 2404 ML and an annual quantity of exported TP of 374.4 kg is estimated for the existing Belmont catchment using POLLUTE.

Preliminary calculations based on an 80% removal fraction adopted for the BHP site gave the following results for the offset WPCP:

- the retention time to achieve the required offset is 1 day; and
- the required area of the WPCP designed to achieve the desired offset of 33 kg, is 0.545 ha.

The cost of a WPCP to treat runoff from the existing urban area is \$220 000 (based on \$40/m²). The total cost, therefore, of all WPCPs including the "offset" WPCP is:

$$\begin{array}{r} \$2.60\text{M (cost of WPCP's for the study area based on an 80\% TP removal fraction)} \\ + \quad \$0.22\text{M (cost of "offset" WPCP)} \\ \hline \$2.8\text{M} \end{array}$$

Greater cost reductions could be achieved by further reducing the TP removal fraction for the Belmont-Redhead site's WPCP's and increasing the removal fraction of the "offset" WPCP. This cost reduction would continue until the costs of the two components were equal. An ideal location for the "offset" WPCP would be at subcatchment 9, shown in Figure 11. Costs associated with addressing the runoff from existing urban areas should be borne by council.

5.4.5 Siltation

Residential development within the study area has the potential to cause increased siltation of the adjacent wetlands and Belmont Lagoon if appropriate controls are not implemented as part of the development process, particularly during the construction/establishment period. The potential for increased siltation as a result of uncontrolled stormwater runoff from urban areas can be seen in wetland areas immediately downstream from existing urban development in Belmont.

Stormwater runoff from urban areas will inevitably carry an increased sediment load. However, with appropriate soils and water management the likelihood of this cause siltation in areas adjacent to the site can be significantly reduced. Appropriate soil and water management would include implementation of an erosion and sediment control plan (including the construction of sediment basins) to cover the construction/establishment period and the construction of gross pollutant traps and water quality control ponds to treat runoff from new urban areas. These controls will enable sediment to be removed from stormwater runoff before it leaves the site and will therefore result in siltation of receiving waters. However, it must be stressed that these controls will only operate effectively if adequately maintained, which means that accumulated sediment will need to be periodically removed.

5.5 GROUNDWATER

Because of the topography and geotechnical characteristics of the site it is likely that the area is currently acting as a groundwater recharge zone. Information available for a number of bores near the site indicates that an unconsolidated aquifer is located several metres below the surface.

Urbanisation of the area will alter the surface runoff regime, which may have an impact on the groundwater system. Firstly, recharge will be reduced since the imperviousness of the site will be increased and surface water will generally be collected and channelled off the site. Also, urbanisation has the potential to alter the level of nutrients and other pollutants in the surface water, which if permitted to infiltrate, may result in pollution of the groundwater.

The impact of urbanisation on groundwater can be minimised by appropriate surface water management. Surface water runoff from the site will be collected and treated in appropriately sized and located water pollution control ponds. The risk of this runoff being polluted with nutrients or other pollutants can also be minimised by appropriate source controls. For example, minimising the application of fertiliser and providing subsurface collection systems for any areas where high rates of fertiliser application are proposed (such as, sporting fields).

If the area is acting as a groundwater recharge zone this can be maintained by allowing infiltration of surface water after it has passed through the water pollution control ponds. However, a more detailed assessment of the site would be required to determine if it is an important groundwater recharge zone.

Effluent from the water pollution control ponds could be used in a number of ways:

- discharged to the SEPP 14 wetland areas;
- used on site to create a number of artificial water features;
- recycled for irrigation and/or dual water supply for residential use; or
- allowed to infiltrate into the groundwater system.

The most appropriate use for the treated surface water runoff should be addressed at the detailed design stage as it will be governed to a large extent by the final use of the site.

5.6 COASTAL ZONE

5.6.1 Coastal impact zone widths

The *Coastal Assessment Report* (NSW Public Works Dept., 1993) for Lake Macquarie City Council provides guidelines for coastal impact zone widths.

The zone widths provided in Table 23 are estimates of the distance that the back beach escarpment may erode to over a 100 year planning period. The current extent of back beach erosion has been adopted as a reference point as it represents the most landward advance of the beach-front under major storm events. This escarpment was created by the last major storm event.

Field assessment, undertaken as part of the study, indicated that the back beach erosion escarpment is approximately 60m west of the high water mark. Therefore, for a 100 year planning period the width of the coastal impact zone taken from the high water mark is approximately 160m. This is slightly less than the level adopted by the Draft Lake Macquarie Coastline Management Strategy (1995), which suggests the coastal impact zone should be 200m.

5.6.2 Coastline hazards

Because of the degraded nature of the Nine Mile Beach dunal system, resulting from extensive sand mining and quarrying, additional hazards to those given above include:

- vegetation degradation and sand drift;
- slope and cliff instability; and
- stormwater erosion

These hazards can be controlled by adopting the methods outlined in the *Coastline Management Manual* (NSW Govt., 1990).

Table 23 Coastal impact zone widths

Planning period (100 yrs)	Distance (m)
1. Beach erosion (the limit of erosion that could be expected during major storms or a series of storms in close succession)	20
2. Long-term shoreline recession @ 0.5m/year (the progressive landward shift of the average long-term position of the coastline)	50
3. Climate change "best estimate" (an estimate of expected shoreline recession due to sea-level rise caused by the Greenhouse Effect)	31
Total (m)	101
Adopted widths (m)	100

5.6.3 Wave runup

Wave runup is the penetration of individual wave fronts through the elevated water surface up the beach face and across the berm. It may run over the foredunes into the swale behind. A wave runup level of RL 7m to 9m AHD has been measured for the Central Coast of NSW.

This level is applicable for the subject site. Wave runup is not expected to pose a problem for the proposed land use provided that the dunes are maintained at their existing levels.

5.6.4 Ocean outlets to Jewells Swamp

There are two ocean outlets to Jewells Swamp called Second and Third Creeks. The original outlet, Second Creek, is the most northern and is located against and controlled by the harder strata of Redhead.

Apart from some encroachment pressure from the coastal dunes and mining disturbance, Second Creek maintained a reasonably consistent pattern until the southern outlet, Third Creek, was constructed in the 1970's. Second Creek exhibits

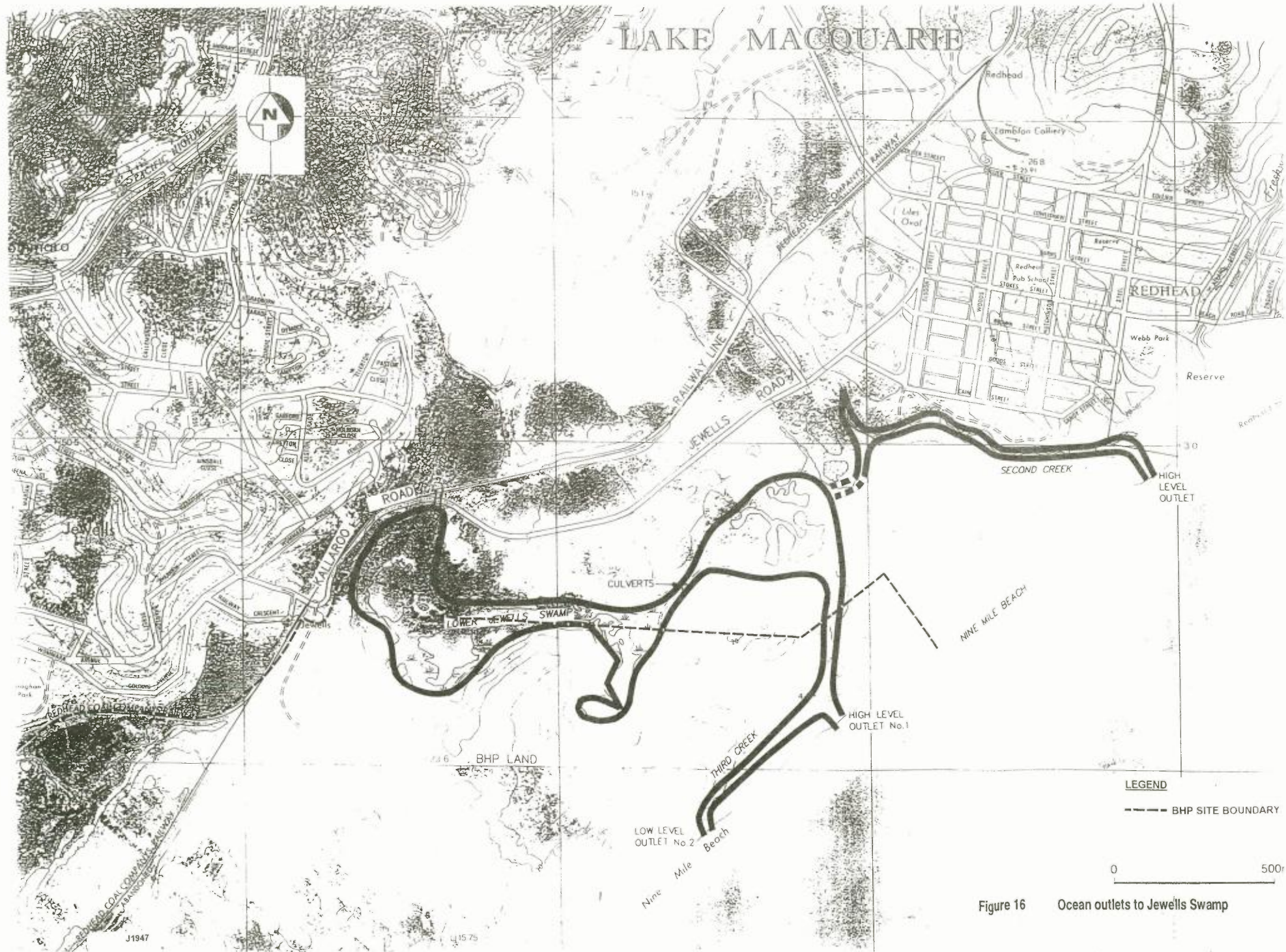


Figure 16 Ocean outlets to Jewell's Swamp

some migratory behaviour but to a lesser extent than Third Creek. Through lack of use it has atrophied and experienced colonisation by vegetation.

The configuration of Third Creek through the dunes has been stable, but its outlet on the beach berm is subject to cycles of migration between the high and low level outlets (refer to Figure 16). This migration appears to occur in a swale between the incipient dune and the foredune with breakthrough occurring at the beachfront adjacent to the northern extremity of the subject site. It is unlikely that breakthrough would occur further to the south-west than that shown on Figure 16. Possible mechanisms which produce movement of the outlet channel towards the south-west were discussed by Patterson Britton in the *Lower Jewells Swamp Flood Study* (Patterson Britton, 1995) However, without a detailed coastal study these mechanisms could not be confirmed.

Flood flows from the back beach area could not penetrate the foredunes and affect the proposed development area because the maximum elevation of the foredunes in their existing state is 10 to 15m. However the channel of Third Creek seaward of the frontal dune would affect pedestrian access to the beach. Therefore, it is recommended that pedestrian access points are not located adjacent to the Third Creek channel.

5.7 FLORA AND FAUNA

5.7.1 Wetlands

A number of opportunities are available to integrate development of the site with conservation of the wetlands. Although the wetlands do place severe constraints on access to the site they are a valuable environmental asset that, in this case, define the limits of development and provide a large buffer between existing residential areas and the site.

Maps showing both the current designated wetland boundaries and suggested extensions to them have been prepared on 1:4000 orthophotomaps. The Department of Planning should be invited to review the boundaries of wetlands 866 and 867 as they are more extensive than currently indicated by mapping. The original mapping of the State's wetlands (which was done under a de facto set of criteria) did not include wet heaths, areas dominated by swamp mahogany or disturbed/modified wetlands even though the ecological and conservation importance of these types is widely recognised. Recent debate regarding SEPP 14 has recognised this inadequacy (viz Winning, 1991; Adam, 1992). Such areas have been included in the suggested extensions to the wetland boundaries as they are an integral part of the wetland system and would be recognised by most authors as wetland types.

Rather than considering the wetlands a constraint to development, opportunities are available to integrate them into the wider community by using them as a recreational and educational resource. To engender a better understanding and appreciation of wetland values interpretive walks through the and beside the wetlands could be established. Preferably, existing tracks would be used. Waterlogged and open water

areas could either be skirted or traversed by boardwalks. Input should be sought from Shortland Wetlands Centre or similar institutions in regard to any such development.

One of the problems associated with the wetlands that needs priority attention is weed control and removal. For example, water hyacinth in the Jewells wetland waterway and a stormwater channel near Cobbin Parade. The success of control measures for this particular weed in the Jewells wetland system should be assessed prior to implementing a programme at this site. Removal of weeds could be addressed by the council in conjunction with the owners by establishing a bush regeneration programme on the site. As evidenced in other local government areas volunteer labour can often make up a large part of such programmes and provide considerable savings.

The major cause of degradation of the wetlands appears to be the influx of urban run-off which is contributing elevated nutrient levels. It is also introducing fine sediments into a wetland system that is on coarse sandy substrates (G. Winning pers comm). To alleviate this and reduce the need for ongoing weed control in the wetlands retention basins need to be installed at points where stormwater is entering the wetlands. A number of informal tracks also occur throughout the wetland areas and are acting as a vector for weed invasion. Rationalisation and formalisation of these tracks is necessary to combat this problem. As these wetlands are of regional and state conservation significance a plan of management to address these threats to their integrity should be promptly prepared whether or not development proceeds on the site.

Another option is to attempt to restore the drainage pattern of the wetland areas to something approaching pre-development conditions. Historical air photos and maps of the site indicate these wetlands were shrubbier in the past and that areas of open water have become larger due the provision of dams for the colliery and sand mine and berms for the railway and sewage lines. This option would require detailed studies in to the likely ecological impacts. Sudden changes in drainage patterns could lead to colonisation by introduced plant species and disrupt fauna populations, particularly frogs.

The area between wetlands 866 and 867 requires major works to establish a viable link between them. Reclamation of the south-western section of wetland 866 was lost by expansion of playing fields and has resulted in the link being restricted to a weed infested ditch. This is an appropriate place to provide road access to the site. Road works, widening of the channel and rehabilitation of the wetland link could be carried out simultaneously. Any bridge constructed would have to be designed to allow movement of fauna between the wetland. A height of 3 metres above the water level would plant growth under the bridge and hence cover for fauna such as small birds, mammals and reptiles. Planting of swamp mahoganies and paperbarks along verges or banks of the access route would encourage and allow movement of arboreal mammals. This is particularly important in maintaining linkages between populations and hence their viability. Such large scale and potentially disruptive project would require an environmental impact statement and possibly a fauna impact statement due to impact on endangered fauna, especially the squirrel glider. The risk of causing further siltation during the works would have to be addressed in detail

The habitat link between the lower section of Jewells wetland and wetland 866 also requires protection and strengthening. Access to the northern part of the site currently occurs through this area and is indicated in three of the four options. Although any access road will form a partial barrier to fauna movement, the link will remain viable particularly if a wetland linkage is established. As major road works in this area could affect the local population of squirrel gliders, a fauna impact assessment and (possibly a fauna impact statement) would be necessary at the development application stage. Ameliorative strategies that should be included in any such works would be the establishment of tall trees by the road to allow movement of gliders between Jewells wetland and possible habitat areas in wetlands 866 and 867.

Currently, a mound supports the sewage line between Railway Parade and the treatment works to the south of the site. Only a few narrow drainage swales connect the wetland and the lagoon and these are suffering sedimentation. In conjunction with Hunter Water, the possibility of converting this mound to a series of cradles should be investigated. Such a conversion would allow improved mixing of water between Belmont Lagoon and wetland 867 and facilitate fauna movement between these areas. However, a careful assessment of the degree of adaptation that the vegetation has already undergone would have to be made before causing substantial changes to hydrology.

As the rare aquatic plant *Zanichellia palustris* requires seasonal exposure of its substrate, changes which make water permanent in its habitat would affect its local status. The species could therefore be affected by increased run-off from the developable areas which may negate this seasonal change.

Sustainable management of the wetlands would best be achieved through a specific plan of management based on the provisions of State Environmental Planning Policy No 19 - Bushland in Urban Areas (clause 8). Such a management plan would involve the setting up of a wetland catchment committee involving the local community, local conservation groups, schools, etc. Active management would include:

- a weed control program and periodic assessment of its success;
- monitoring of water quality to assess and address the main sources of pollution;
- developing a strategy aimed at educating residents of the catchment of the effect everyday activities can have on the wetlands eg the use of fertilisers, pesticides, herbicides, increased run-off from hard surfaces, domestic pet faeces etc.;
- ongoing monitoring of fauna and flora, particularly endangered species. This could be achieved by inviting universities or TAFEs to participate;
- ongoing assessment of bushfire risk and need for "ecological" burns;
- setting up of a nursery based on local plant stock. Involvement of groups such as the Society for Growing Australian Plants (SGAP) and local schools would be useful in this regard.

5.7.2 Dune area west of old railway line

This area has rehabilitated better than the frontal dune with greater a diversity of plant species and structure. This could be further assisted with intensified planting of locally occurring native species, removal of bitou and rationalisation of tracks (it is currently being degraded by trail bikes). At least part of this area (say of 100m width)

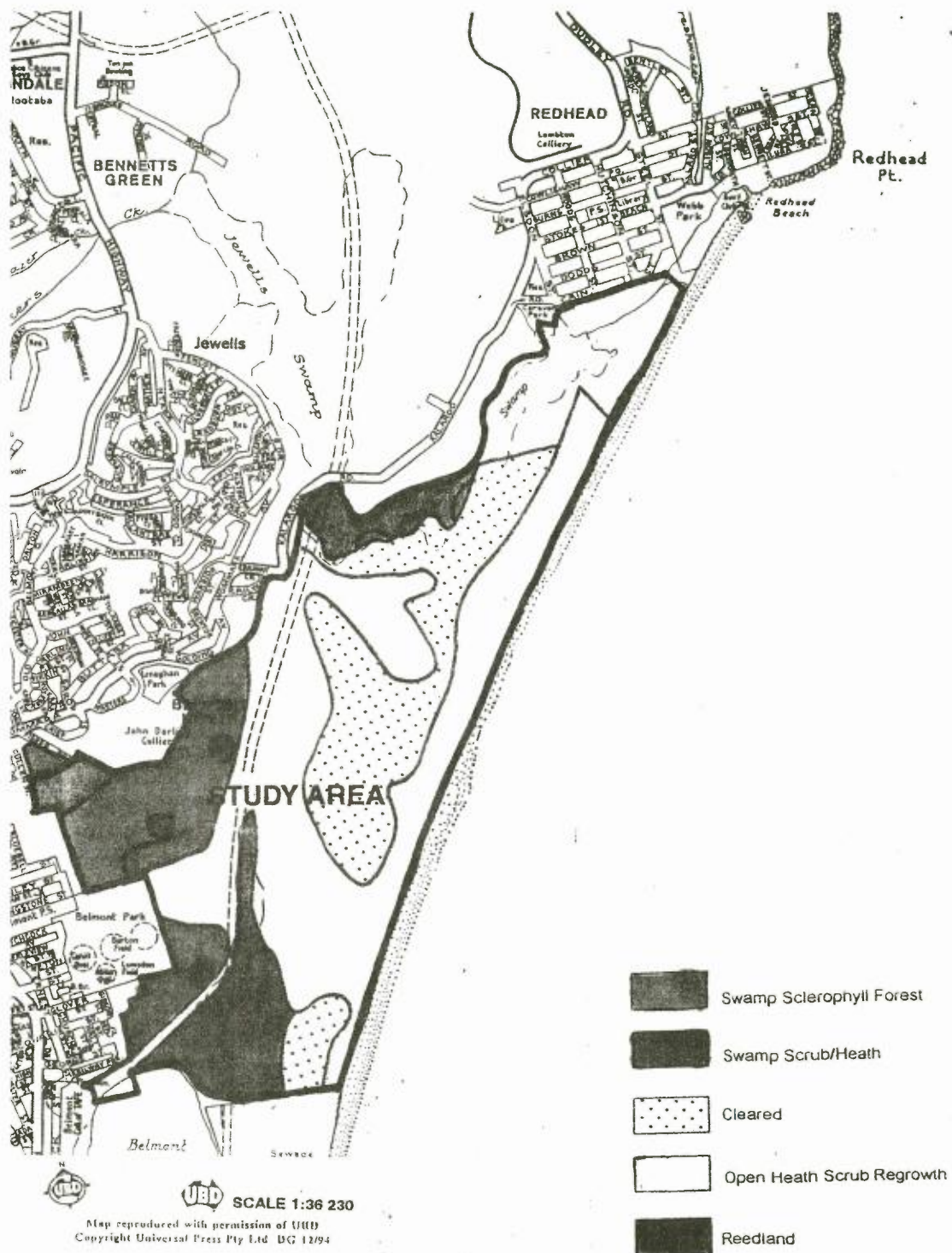


Figure 17 Study area vegetation

should be retained to provide a juxtaposition of habitat between it and the wetland and maintain a corridor for fauna movement.

Passive recreation could be provided in this area with provision of walking tracks. Platforms with views over the wetlands to the west could be included and used for interpretive purposes.

5.7.3 Frontal dunes

The current mine sites and formerly mined areas are considered the most suitable for any residential or commercial development. This is because these areas are substantially modified and exhibit low levels of biological diversity compared to other habitat areas on site. A 160m width landward from the high water mark has been included in all options and will allow movement of fauna between habitat areas north and south of the site. Such a width is necessary as these dunes are generally in poor condition due to past disturbance and have little structural or floristic diversity.

There is an opportunity to rehabilitate these dunes with intensified planting and removal/rationalising of four-wheel drive access. In the north of the site there is major movement of some dunes landward and this poses a threat to the Jewells wetland. Reshaping of these dunes is necessary to arrest this phenomenon.

Removal of bitou bush from the retained 160m buffer is also a major priority. Three strategies are available for the control of bitou:

1. biological control. State and federal agencies are currently carrying out trials on the efficacy of using various types of insects to control bitou
2. winter spraying with low concentrations of Roundup. This has been done successfully on the north coast (Bob Frederick, NPWS Grafton, pers comm).
3. manual removal. This has successfully been carried out by "dune care groups" on the north coast. Concurrent with removal of the weed is the collection of propagation material from native species for rehabilitative planting.

The best approach to controlling the weed would probably be an integration of the above methods. NSW Agriculture should be consulted prior to the establishment of any control programme for general guidance.

Provision of walking tracks from commercial or residential areas behind the dunes would allow improved public access to the beach. As these tracks would only be a few metres wide this would not compromise the functioning of the 160m buffer zone as a corridor for fauna movement. Access should be concentrated at already heavily disturbed areas such as blowouts and/or along 4-wheel drive tracks. The necessity for revegetation of the dunes and success of any rehabilitation then would be obvious to beach users. A walking track along the crest of the dunes would provide excellent views of both the ocean and beach to the east and the wetlands and Lake Macquarie to the west. Thick vegetative cover close to tracks can result in "tunnelling" of wind. To prevent wind erosion of tracks strategies such as laying sleepers crossways to the path, providing windbreaks and winding tracks should be used. All tracks would need to be fenced to prevent incursion by visitors into the vegetation.

5.7.4 Water pollution control ponds and open space

Development of the site for residential and/or commercial purposes will result in a profusion of non-porous surfaces (roads, paving, rooves) and elevated nutrient levels in run-off due to fertilised garden areas, dog faeces etc. Ideally, water pollution control ponds should be planned to have the capacity to retain large amounts of run-off and function to keep nutrient and sediment loads entering wetlands as close as possible to existing levels. In relation to the ecology of the site this is their primary function. In addition to this, they also add to habitat values for both flora and fauna and they can enhance or create habitat corridors. In options 2 and 3 the chain of water pollution control ponds and surrounding open space provide a buffer between development and the wetlands and effectively broaden the corridor between the wetlands.

Any open space areas should avoid the use of large expanses of grass as such habitats are of little value to most fauna and only encourage the colonisation by common and aggressive species such as the Indian myna, silver gull and white ibis. The presence of such species and lack of suitable habitat would result in a poor fauna assemblage and restrict movement through the site. Rather, if open space is to be used for activities such as picnicking or games areas, a mosaic of grassy and shrubby areas should be planned. Proper design and maintenance of litter control is also important in stopping the profusion of pest species.

5.8 BUSHFIRE HAZARD

5.8.1 Background

On the basis of Figure 17 the following area estimates can be made about the composition of the subject site.

- cleared land, 33%;
- regrowth areas, 42%; and
- wetland, 25%.

Approximately 75% of the site has been disturbed by industrial operations. This mainly includes mining for minerals contained in beach sands and the removal of sand used for building.

5.8.2 Risk assessment

5.8.2.1 Mineral sands area

The mineral sands area has been re-formed into small dunes and planted with vegetation such as acacias and bitou bush. There is insufficient fuel continuity to support a bushfire in this area.

5.8.2.2 Building sand mining areas

In the building sand mining areas, various roads or tracks and collection areas of up to 1ha have been gravelled. There is also a network of smaller tracks and many high dunes have formed.

Regeneration of these areas, (with plants such as acacias, bitou bush and grasses) occurs mainly in disconnected patches. There are also small remnants of coastal scrub; such as, thickets of tea-tree (up to 3m high) and scattered, narrow bands of reeds.

The continuity of fuel in these areas is not sufficient to support a bush fire, even of a small size.

Closure of the gaps between vegetation is likely to be a slow process. Hence, it is unlikely that fires will cause any concern under existing land use conditions for at least the next ten years.

5.8.2.3 Wetlands

Wetlands are found in three disconnected locations. Near the northern boundary a reed bed or swamp area of approximately 10 hectares adjoins the site boundary. In a central position, adjoining the western boundary of the property, an area estimated at 40ha is made up partly of reed beds but mainly of a combination of trees such as tea tree, a scrub layer and surface vegetation of grasses, reeds and rushes. A similar combination is found in an area near the southern boundary estimated at 60ha.

All of the wetland areas contain some dead vegetation but fires are not likely to cause concern except after lengthy spells of hot, dry weather. However, as winds associated with critical fire behaviour come mainly from the north west, west or south west, fires in these three areas are likely to be driven towards bare ground or relatively bare ground rather than towards developed areas lying to the west.

5.8.3 Bushfire protection activities

If the area is left as it is and allowed to regenerate, it would probably take at least 20 years before fuel continuity would be sufficient to support a fire of any consequence.

If some portions are developed for housing it is unlikely, for various reasons, that peripheral houses would be erected very close to any wetland. Isolating houses in this way from the small risk of fire that exists at the site should minimise bushfire hazards.

Bush fire control activities on the site would probably only need to be confined to small operations relevant to protecting the two main areas of wetland.

5.9 INFRASTRUCTURE

5.9.1 Background

Patterson Britton has had discussions with the authorities responsible for the supply of utilities and infrastructure at Belmont, including:

- Lake Macquarie City Council (flooding/stormwater);
- Hunter Water Corporation (water/sewer);
- Orion Electricity (power); and
- AGL Gas Company (natural gas).

The primary aim of these discussions was to confirm the information supplied by BHP Engineering (1994) and to identify any other issues which may not have been covered previously.

General discussions and advice in respect of services infrastructure were based on a potential yield in the range of 1400 to 1500 residential lots with an equivalent population of 4000 to 5000 persons. Additional information was subsequently requested regarding spare capacity and cost of service installation. The authorities generally confirmed that the information given by APT Peddle Thorp was correct.

All future design and construction of subdivision and infrastructure works will be in accordance with the guidelines set out in the Lake Macquarie City Council Subdivision Code.

5.9.2 Water

The Hunter Water Corporation (HWC) advise that the existing water supply infrastructure for the study area consists of water mains (200mm and 375mm diameter) located within the Pacific Highway road reserve. The 200mm diameter main is on the western side of the roadway and the 375mm diameter main on the eastern side.

The existing residential areas of Wommara and Belmont, to the east of the highway and adjacent to the study area, have smaller distribution mains (100mm) in certain streets. These smaller mains do not have the capacity to service the proposed development, which means that the water supply will have to be taken from the larger mains at some point along the highway.

The water supply for the area is stored at the Belmont No. 1 and No. 2 reservoirs, whose location is shown on Figure 18. The Swansea No. 1 and No. 2 reservoirs located to the south of Swansea near Caves Beach act as a backup supply to the Belmont reservoirs. The supply to all of these reservoirs is provided from three sources which are:

- Grahamstown Dam, north of Raymond Terrace, with a current capacity of 131,000 ML;
- Chichester Dam, north of Dungog, with a current capacity of 21,000 ML; and
- The Tomago Sand Beds.



Figure 18 Existing water supply infrastructure

HWC has indicated that the existing water supply infrastructure is adequate for the proposed development. However, an investigation would need to be undertaken to determine the augmentation requirements for the piping network. There would certainly be a need for 'lead-in' pipes from the highway and possible augmentation to sections of the existing mains.

Because of the low lying nature of the study area (AHD 20m) relative to the elevation of the main reservoirs (AHD 80-100m), water pressure will not be a problem. This means that selection of lead-in points from the water mains along the Pacific Highway is relatively flexible.

5.9.3 Waste water

HWC advise that the existing pipe sewage collection system in the residential area of Belmont and Belmont North, adjacent to the study area, has little spare capacity.

The area is currently serviced by two waste water treatment plants (WWTP), Windale WWTP at Bennets Green and Belmont WWTP at Belmont South as shown on Figure 19.

A major regional sewerage upgrade scheme is currently being implemented within the Lake Macquarie area. HWC advise that the scheme includes the upgrading of Belmont WWTP to cater for an ultimate population of 75,000 equivalent persons (EP). The existing Windale WWTP will be shutdown and its catchment redirected to Belmont WWTP. Current scheduling is for a mid 1997 shutdown for the Windale plant.

HWC advise that urban development of the study area is not likely to overload the upgraded Belmont plant. An independent system (ie not attached to existing infrastructure) would be required for the development, which would link directly to the Belmont WWTP at the southern end of the BHP land.

Depending on the staging of the development it may be possible to link some early development of fringe areas into the existing system. However, this would need to be subject to detailed investigation in consultation with the developer. Due to the undulating and generally low lying nature of the topography, sewerage reticulation to service urban development will require a combination of gravity and rising (pressure) mains.

5.9.4 Gas

The AGL Gas Company has advised that existing mains reticulate natural gas to the Bennets Green area, north of the study area. Currently the mains are being extended to the south, from Bennets Green to Swansea, with the mains being located within the Pacific Highway road reserve. Gas reticulation is at present being considered for Wommara Avenue through to Kalaroo Road and Redhead.

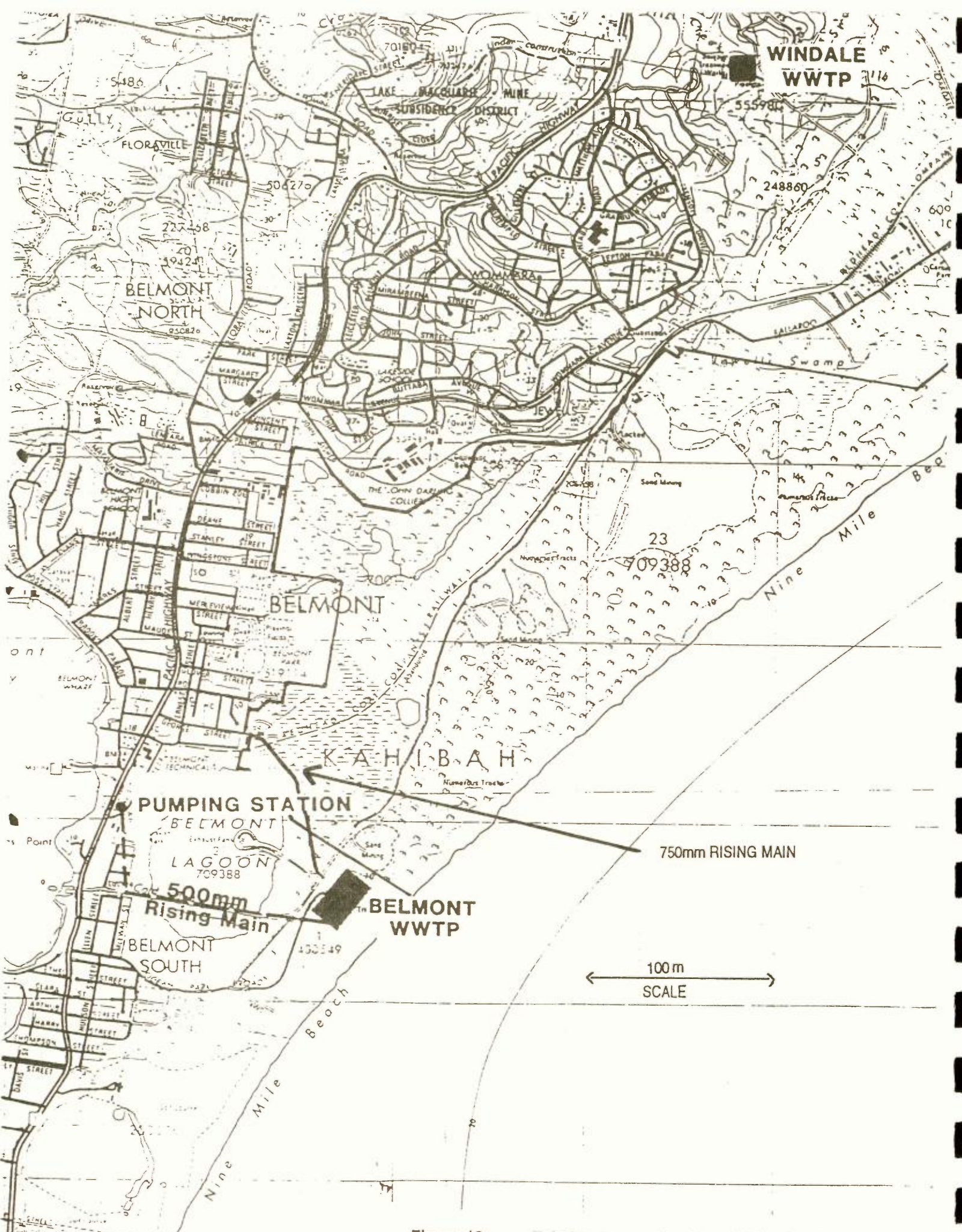


Figure 19

Existing sewage treatment infrastructure

AGL advise that there would be no impediment to installation of gas infrastructure to service development of the site, however, individual developments are reviewed on a commercial basis in consultation with developers.

The logical route for a lead in main would be along the route selected for road access to the Pacific Highway at the southern end of the development.

5.9.5 Power

Within the study area, power is currently supplied from the Jewells and Pelican zone substations. These are located at Wommara and Belmont South respectively as shown on Figure 20.

Orion Electricity advise that there is sufficient spare capacity within the zone substations to supply development at the site, with the probability that for full development, load would be shared between the two substations.

A 33 kV transmission line which links the two zone substations currently traverses the study area, following the route of the existing track between Kalaroo Road and the Belmont WWTP. This line is not protected by an easement within the site and its status within the proposed development would be subject to negotiation with Orion Electricity.

The alignment of the 33 kV line generally follows the route for the future RTA bypass road as shown on Figure 21.

5.9.6 Capacity and cost of services

5.9.6.1 Power

Orion Electricity has provided the following information about the spare capacity available at the Pelican and Jewells substations:

- Pelican Substation, 2700 dwellings; and
- Jewells Substation, 4500 dwellings.

These estimates are based on a peak demand of 3.7kW per dwelling. The costs for a standard underground power supply grid to dwellings are:

- Low Density residential land use, \$1870 per dwelling; and
- Medium Density residential land use, \$1360 per dwelling.

These costs are based on an analysis of the proximity of the proposed urban development to the power substations.

5.9.6.2 Water supply and sewerage

HWC was asked to investigate the limits and costs of the water supply and sewerage infrastructure. HWC indicated that the existing water supply trunk system is able to

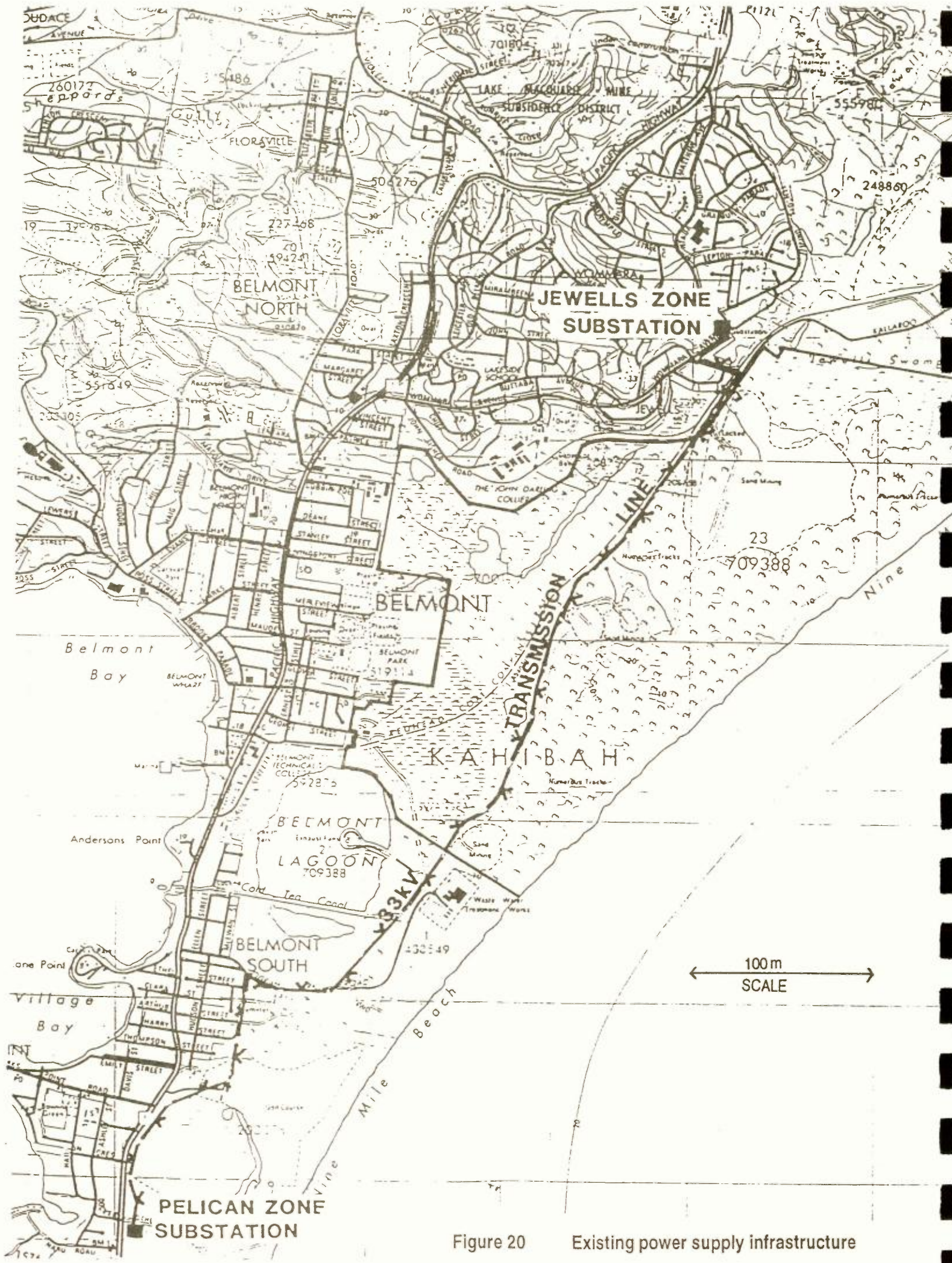


Figure 20 Existing power supply infrastructure

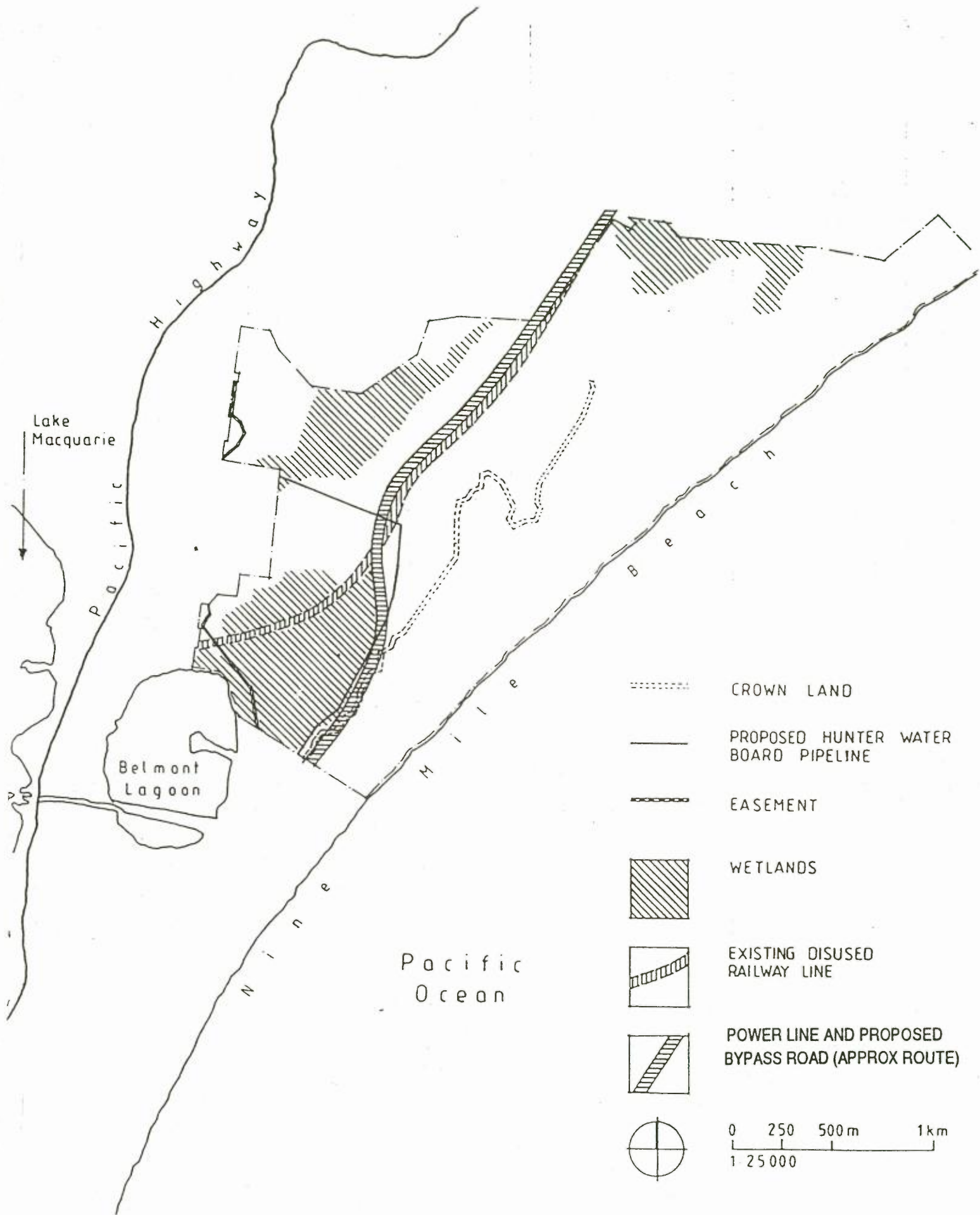


Figure 21 Physical constraints

Source: Development Planning and Management Pty Ltd, 1990

supply 3000 residential lots. The number of lots at which the trunk main system would need to be amplified was not determined.

HWC indicated that the upgraded Belmont WWTP could cater for an additional 3000 equivalent tenements in the study area.

The preliminary amplification charge (calculated by HWC) for water supply and sewerage for 3000 tenements is outlined below:

	Amount (\$)
Gross amplification charge	5,579,996
Administration fee	11,400
Sub-total	5,591,396
Less HWC's contribution	2,565,926
Total amplification charge	\$3,025,470
(valid until 10/12/95)	

HWC has assumed that any development will proceed successionaly in 30 stages of 100 lots. The above amounts do not include reticulation costs.

The cost of providing the sewerage infrastructure, including the collection and reticulation mains, is estimated to be \$4000/lot. For the water supply infrastructure, the cost of the distribution and reticulation mains is also estimated to be \$4000/lot. These costs are based on past experience and information from a cost analysis undertaken for the Ingleside Warriewood Urban Release Area Water Cycle Management Study (Patterson Britton, 1992). For 3000 lots, the cost of providing water supply and sewerage infrastructure is therefore estimated to be \$24 million.

The cost information for services are summarised in Table 24 below:

Table 24 Summary of estimated servicing costs (3000 lots)

Feature	Cost
Water supply+ sewerage	\$8000/dwelling + \$3.025M amplification charge
Power	\$1360/dwelling

5.9.7 Human services infrastructure

Any large development on this site will require the provision of human services to augment existing services in the area. Advice from the Department of School Education indicates that the provision of a primary school is required for every 1200-1400 lots released and a high school for every 4200-4400 lots released. The area required for a primary school is around 3ha and a high school 6ha. An additional 1ha is required for a high school offering agriculture.

There is currently no spare capacity in any of the primary schools in the Belmont/Redhead area, although there is some capacity in the Gateshead area. Consultation with the Department of School Education at the planning stage would be required to ascertain further details and requirements.

Most other human services agencies no longer operate on a "threshold limit" however the Community Profile prepared by Lake Macquarie City Council (1993) sets out the following minimum standards*:

Art gallery	1:165 000 people (400m ² floor space)
Children's service facility	1 place : 5 children or 154m ² floor space per 1000 residents (site area 462m ² :1000 residents)
Community care centre	1:30 000 residents or 19.2m ² floor space per 1000 residents
Community offices	400m ² floor space : 40 000 residents or 10m ² floor space:1000 residents
Library	1:15 000 residents or 30m ² floor space: 1000 residents
Neighbourhood centre	1:10 000 or 40m ² floor space:1000 residents
Performing arts centre	1:165 000 residents or 9m ² :1000 residents
Youth centre	1:15 000 residents or 18m ² floor space: 1000 residents

*Standards are based on minimum floor space areas and do not include landscaping, outdoor play areas or car parking site requirements.

A substantial increase in the population is required for the provision of additional large scale health services, however smaller increases in population will impact on the demand for services such as community health services and early childhood services. Consultation with the Hunter Area Health Service and the Department of Community Services as well as other human service providers should be conducted early in the planning process.

5.9.8 Open space and recreation

If assessed purely on the basis on quantity, Lake Macquarie has a substantial open space resource. At the time of publication of its *Section 94 Contributions Plan No 1* (June 1993), Lake Macquarie provided around 17ha/1000persons, which is considerably higher than the old quantitative standard of 2.83ha/1000persons.

The plan adopts the premise that there is sufficient reserves of land to meet the existing and future population demand over the program period, however these areas need to be augmented to a standard to meet the demand of the projected population. The plan projects an increase in population of approximately 8800 people over the period to 1998 and approximately 16000 over the ten year period (to 2003).

Should the Belmont-Redhead site be developed as outlined in section 7, it is likely that the impacts on open space provision would be quite substantial. The development could contribute substantially to the identified augmentation of beach and foreshore parks and the development of cycleways in the area. Its location between major wetlands and the coast also presents some unique recreation opportunities such as the potential for interpretative trails, wetland and foreshore walks and educational and small scale tourist operations. The site's key location in respect to the proposed coastal walk should also be considered in the design of any development.

Other recreational opportunities include beach fishing and the use of the beach for 4WD vehicles. Any use by vehicles will need to be carefully monitored and controlled to ensure that the sensitive dune environment is not disturbed. Controlled access for vehicles should be implemented off the site of via one access point only.

Any future development on the site will need to be closely monitored in terms of population growth and profile to ensure that planned recreation provision meets the needs of the population. The provision of informal recreation opportunities on the site is likely to be adequate, however the demand for formal recreation areas may need to be reviewed.

5.10 EMPLOYMENT

It is difficult to determine the type of employment likely to be created by the development of this site, particularly as it is suggested that any development on the site be based on merit with planning controls being flexible enough to allow a range of uses.

There is likely to be considerable short term employment generated during the construction phase of any development of the site, however the level of this employment cannot be determined. Other types of employment which may be generated through development of the site include jobs within the hospitality industry should tourist and/or hotels be developed; positions in any interpretative centre developed; general commercial employment; community services and education positions and employment in environmental management.

5.11 TRAFFIC AND TRANSPORT

5.11.1 Existing road system

The Sydney Newcastle Freeway (F3) provides on-load and off-load to the Pacific Highway at Doyalson and Palmers Road/Awaba Road (MR 220) between Awaba and Freeman's Waterhole. Ultimately, with extension to Newcastle, further on-load and off-load options beyond MR 223, New England Highway/Pacific Highway will provide good inter-regional connectivity to the site.

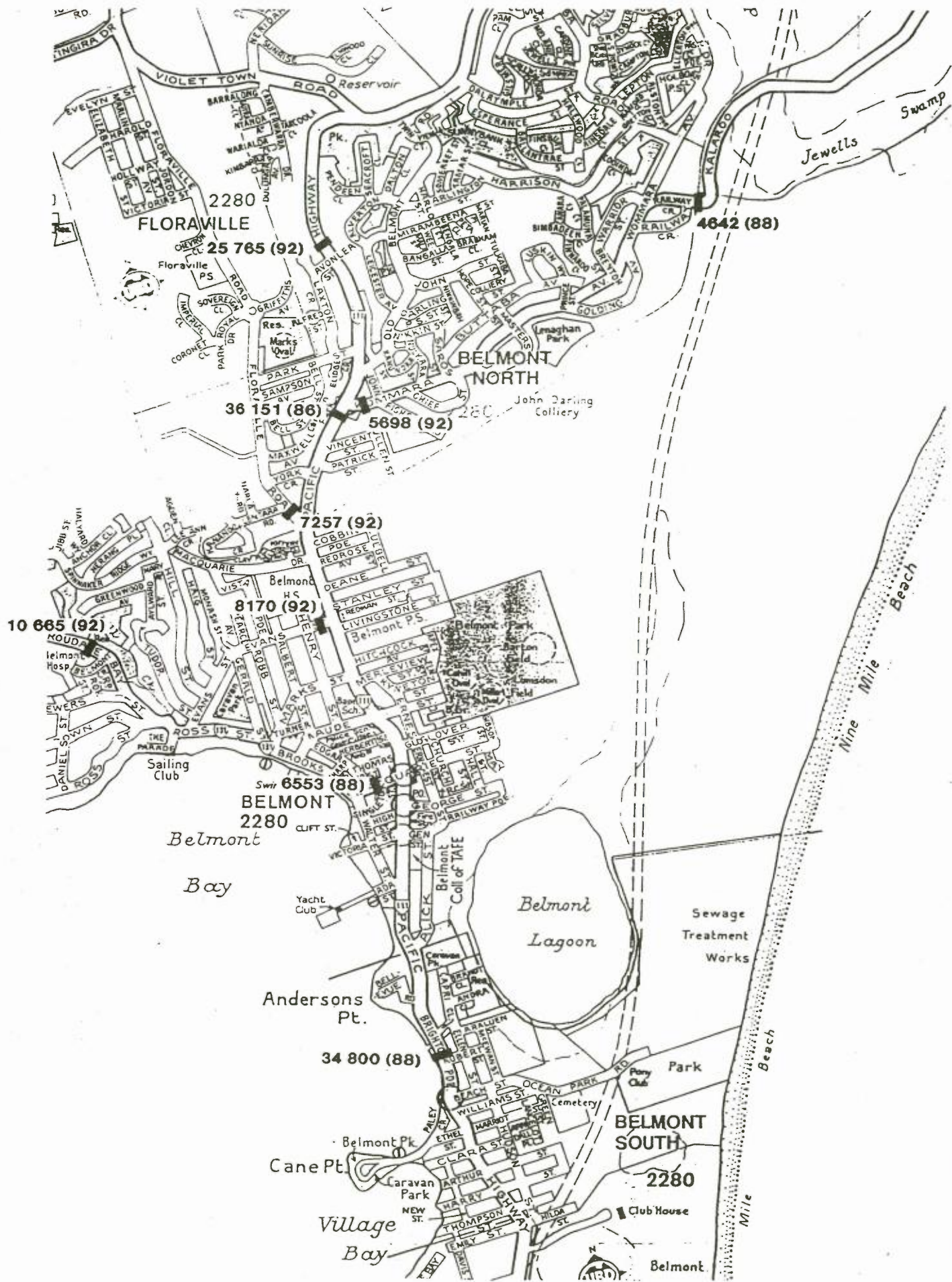


Figure 22

Average annual daily traffic flows
Source: Roads and Traffic Authority, 1992

The Pacific Highway (SH10) is located 500m from the western boundary of the site providing local access to adjacent suburbs, such as, Swansea and Charlestown, in addition to regional access to Newcastle, Gosford, Sydney and beyond.

Wommara Avenue/Kalaroo Road (MR 325) to the north of the site connects the Pacific Highway at Wommara via Redhead to Charlestown. This provides a more circuitous route to the highway, between the site and Charlestown.

Macquarie Street, Brooks Road and Croudace Bay Road (MR 527) provide access between Belmont and Croudace Bay/Warners Bay foreshore around Lake Macquarie.

In addition to the classified road system, local access roads adjoin the western side of the site. These roads include Merleview Street (via Belmont Park), Livingstone Street, Stanley Street, Deane Street, Glover Street and George Street. All of these streets are predominantly local residential streets.

The Pacific Highway to the west of the site provides a four lane divided carriageway. The central median constrains crossing and turning movements, particularly for northbound traffic turning to the east (towards the site). Traffic signal control is provided at Beach St (Ocean Park Road) to the south, Old Belmont Road, Wommara Ave, Floraville Road, Evans Street, Maude Street to the north and Victoria Street, George Street and Macquarie Street within the Belmont town centre.

5.11.2 Current traffic flows

Annual Average Daily Traffic (AADT) flows on major roads in the vicinity of the site are shown in Table 25.

Locations in proximity to the site are shown on Figure 22. The percentage growth figures shown in Table 25 indicate that there has been very little change in traffic flow on the Pacific Highway through Belmont since 1986. However, traffic growth has occurred on a number of roads, such as Floraville Road, due to development in the local area.

5.11.3 Public transport

The main northern rail line extends to the west of Lake Macquarie with stations at Gosford, Wyong, Tuggerah, Warnervale, Wyee, Morisset, Dora Creek, Awaba, Fassifern and further suburbs to Newcastle, Sydney and beyond. Express services stop at Gosford and Wyong, Fassifern and Newcastle with limited intermediate stops. Countrylink (XPT) services stop at Gosford and Broadmeadow. Peak business hour frequencies of 10 to 20 minutes, with daytime services frequencies of approximately one per hour, are provided at intermediate stations between Wyong and Fassifern.

Connection from the site to rail services is dependant on car and bus/coach travel. Parking is provided at all stations between Wyong and Fassifern although demand exceeds supply, particularly for commuters at Gosford and Wyong.

There is a limited local bus service which should be considered for extension into any new development.

Interstate and intrastate coach services generally provide stops at Gosford, Wyong and Doyalson with some services stopping at Swansea, Belmont and Charlestown.

Table 25 Summary of AADT traffic flows (1986 - 1992)

Road	1986	1988	1990	1992	% Change
SH10, Pacific Hwy, S of Smart St	42,995	43,884	43,680	42,079	-2.2%
SH10, Pacific Hwy, S of Oakdale Road	37,822	35,809	-	-	-5.6%
SH10, Pacific Hwy, N of Avonlea St	27,266	25,445	-	25,765	-5.8%
SH10, Pacific Hwy, N of Robert St	34,038	34,800	-	-	+2.2%
MR325, Dudley Rd, N of Collier St	6,871	7,213	7,619	7,160	+4.2%
MR325, Kalaroo Rd at Rwy Level Crossing	3,775	4,642	-	-	+23.0%
MR325, Wommara Ave E of SH10, Pacific Hwy	7,476	6,835	-	5,698	-31.2%
MR325 Warners Bay Rd N of Kalora Cres	11,082	11,056	-	12,690	+14.5%
MR527 Croudace Bay Rd N of Belmont Cres	9,885	10,445	10,768	10,665	+7.9%
MR527 Macquarie St W of Thomas St	6,885	6,553	-	-	-5.1%
Floraville Rd W of SH10 Pacific Hwy	5,335	5,324	-	7,257	+36.0%

Source: Roads & Traffic Authority, 1992.

5.11.4 Travel characteristics of residents

The 1991 Home Interview Survey conducted by the Australian Bureau of Statistics provides information on mode of travel for various purposes and statistics for origin/destination of journeys to work.

The survey indicates a high proportion of weekday car travel (approximately 91%) for home to work trips from the Lake Macquarie local area. This compares to 85% for Wyong and 68% for Gosford.

Weekday travel by car from home to shopping, personal business, social welfare and medical purposes accounted for 71% of trips in the Lake Macquarie area. The reduction in car travel for these purposes was mainly attributable to an increase in trips by walking (from 2.5% to 18.4%) and by bus (from 2.8% to 5.9%).

A high, 29.1% of weekend travel from home to shopping, personal business, etc, was made by bicycle. Approximately 64% of this type of trip were made by car.

In respect to the destination of home to work trips for the Lake Macquarie local area, 12% were directed to Newcastle with the balance of 88% directed to other destinations including Sydney CBD, North Sydney CBD, Chatswood, Parramatta and Wollongong.

5.11.5 Traffic generation

Throughout this section Strategy 3 is referred to. This is one of four options for development discussed in Section 6 of this study. For detailed information on Strategy 3 refer to Section 6.3.

A traffic generation rate was taken from the RTA's *Guide to Traffic Generating Developments* (1993), for dwellings in new subdivisions with little public transport provision.

Strategy 3 has the largest urban land use area of approximately 209ha and was therefore taken as the worst case for all options. A figure of 15 lots/ha was applied, again this was considered an upper limit, which resulted in 3135 dwellings for the whole site area. A factor of 0.85 per dwelling was applied to calculate the peak hour vehicle trips and 9 vehicle trips per dwelling for the daily trip total. This resulted in 28,215 for daily vehicle trips and 2,665 trips for a weekday peak hour.

For initial traffic analysis the morning peak direction was assumed to be traffic leaving the internal network of the development, ie major trip attractions were outside the site area, which corresponds to the majority of home to work based trips. A peak direction split of 90% for those trips which gained access to the external road network was applied. At this stage analysis is concerned with access provision from the primary road network and not internal circulation.

The worst case of Strategy 3 resulted in 2,400 trips leaving the site area over a peak hour period.

5.11.6 Access to external road network

A total trip production of 2,400 trips in the peak hour would require 3 lanes to provide a good level of service into and out of the development. This could be provided by 3 access roads providing 1 lane in each direction or 2 access roads, one of the roads having 2 lanes in each direction. The above assumes no bypass is in place. With the bypass in operation both north and south commuter trips would be taken off the access roads and transferred onto the bypass from intersections within the site. This would have the effect of reducing the road standard requirement of the access roads.

In general, the access options (discussed below) consider possible access point locations, one from the central area of development directly onto the Pacific Highway and a second point in the north west of the site connecting onto Wommara Avenue/Kalaroo Road.

The northern access point would provide connection to the Pacific Highway via Wommara Avenue through Wommara or Ntaba Road through Jewells. This access would provide for the majority of commuter trips with destinations in the north and local trips to Jewells and Redhead. The location could be directly onto Wommara Avenue or connecting into Railway Crescent.

A central access point provides east-west linkage between the site and the Belmont Centre along the Pacific Highway, this access would also cater for commuting trips both north and south. Merleview Street is considered the most appropriate link into the site as an access road would extend the existing street through Council owned parkland (Belmont Park) into the site via the narrowest strip of wetland, which would require a bridge or banked culvert.

5.11.6.1 Central access road

Should an east-west linkage between the site and the Pacific Highway off Merleview Street be implemented, it would require the construction of a transport corridor through the site adjacent to Belmont Park.

The area adjacent to Belmont Park rises to RL 14 m AHD above the SEPP14 wetlands located to the north and south. The surface geotechnical properties of this area are expected to transition from the firm silty clay alluvium found in the wetlands to loose and unconsolidated sands. The area is underlain by weathered siltstone and carbonaceous shale bedrock of the Newcastle Coal Measures. A narrow channel with an estimated width of 10m is aligned parallel to the eastern boundary of Belmont Park.

There are no obvious impediments to the construction of a 2-lane access road through the area, however, a geotechnical survey would need to be undertaken to more fully determine the surface geotechnical characteristics. This would allow for the determination of any potential problems which may be appropriately addressed at the design stage.

One important feature associated with the access road is the need for a bridge which would span the 10m width of the channel. The channel width is only an estimate and a field survey would be required to establish the channel morphology and width. If a wider channel is proposed then supporting piles spaced 10-15m apart would be required. These may be cast in-situ or pile-driven. A geotechnical survey would be required to determine potential problems with the soil such as settlement.

Given that a significant fraction of the soil is expected to be loose sand, compaction would be required for the area designated for the road surface.

5.11.7 TRANPLAN Model analysis

5.11.7.1 Traffic analysis for Belmont Bypass

A *Road Development Strategy (TRANPLAN) Study* was undertaken for the City of Lake Macquarie in March 1995 by Northern Transport Planning and Engineering. The study utilised the RTA's 24 hour TRANPLAN of the Lower Hunter, to evaluate potential road improvement projects in the region.

The model predicted that by the year 2011, congestion levels within Belmont will be sufficient to justify the requirement of an East Belmont Bypass. The road is considered to be built as a two lane arterial road, starting south of Belmont extending to Bennetts Green where it would link into the west Charlestown Bypass.

The TRANPLAN model indicated that with the introduction of the bypass, traffic volumes on the Pacific Highway in Belmont would be reduced by 13,000 per day, which is a significant 36% - 40% reduction. Traffic on Wommara Avenue in Belmont North would be reduced by 4,700 vehicles (36%). Based on the TRANPLAN model and findings of a cost-benefit analysis, the bypass would provide significant benefits.

With completion of the bypass, the proposed development would gain two further access points; to Kalaroo Road in the north and the Pacific Highway in the south. This would increase accessibility for the site and ease any pressure on the existing local road network as only local trips will use the initial access points. Development traffic with destinations over a longer distance, ie to Newcastle/Sydney, would be able to access the bypass directly.

As part of the arterial road network, access from the bypass is likely to be restricted, with no direct access to individual developments. Intersections within the site's road system would be at-grade.

The need for the bypass on traffic grounds is dependent on long term growth of regional traffic and major traffic generating developments with the progressive completion of the Sydney to Newcastle Freeway, the Pacific Highway has shown little growth since 1988. However, with increased population forecasts for the area and projects such as the one proposed the need and urgency for the bypass as indicated by the TRANPLAN model is likely to increase.

5.11.7.2 Traffic analysis for Belmont-Redhead development

Northern Transport Planning were engaged by Lake Macquarie City Council to undertake a TRANPLAN analysis of the proposed Belmont-Redhead development. The analysis was carried out using the RTA's TRANPLAN Model of the Lower Hunter Area with the Belmont-Redhead site being incorporated into this model.

The analysis was necessary to establish the effect of the generated traffic on the existing and future road network. Also to estimate the provision of access roads into the development and their lane requirements. The model assumed a development providing 2500 residential allotments together with a beachfront commercial/retail

centre. For the purposes of analysis, the development was divided into three land use zones.

The model tested access to the proposed development via the following local roads:

Northern link to Kalaroo Road
Central link via Merleview Avenue
Southern link via Railway Parade

Options were tested with all three access roads and combinations of the northern access road with either of the central or southern access points.

Three network options were tested:

No Belmont Bypass
With the Belmont Bypass
No access to the Pacific Highway via Ntaba Road

Summary of findings

- The TRANPLAN model reveals that three access points will provide adequate capacity for the generated development traffic with all three roads requiring a single lane in each direction.
- With the Belmont Bypass in place, traffic along the Pacific Highway in Belmont is greatly reduced. The access points will then have substantial reserve capacity as they will only be serving local traffic. The southern access point becomes redundant as the bypass in effect replaces it, linking into the Pacific Highway south of the Belmont Lagoon. It would therefore be more beneficial to the development to have the southern access point following the alignment of the bypass rather than the Railway Parade option. When the bypass is built, the southern access point would become part of the bypass.
- The model reveals that even with only two access points via the northern and central access roads and no bypass there will be sufficient capacity to deal with the generated traffic. This suggests that the possibility of staging the development would be to provide initially the two access points in the north and the central area, with the introduction of the bypass, the development would gain the third access point to the south.

It may therefore be concluded that:

- A preferred option without the bypass would include three access points all three having one lane in each direction. These access points would be located in the central area, in the north via Wommara Avenue/Kalaroo Road and in the south of the development following the proposed bypass alignment.
- With the bypass in place a central access point and a local access point to Wommara Avenue would be required. Direct access off the bypass into the

southern area of the development would also be required, this would be provided by an intersection on the bypass with a feeder arterial road into the development.

5.11.8 Intersections

Due to constraints on northbound traffic turning east towards the site, any central access point located at Merleview Street would require a major intersection upgrade. Currently it is un-signalised permitting left turning movements only, to and from the Pacific Highway. A signalised intersection would be required providing at least two lanes for traffic turning right and left from Merleview Street. The Pacific Highway would also require widening to allow for a right turning bay/lane for northbound traffic turning right into Merleview Street.

A connection in the north west of the development either at Kalaroo Road/Wommara Avenue or Railway Crescent/Wommara Avenue, would require a form of intersection control either by traffic signals or a roundabout. At Kalaroo Road, the connection would be approximately 200m east of the existing intersection at Wommara Avenue. An intersection which provides full turning movements into and out of the site would be required.

A connection to Wommara Avenue via Railway Crescent would require a priority change of the road system to allow the access road to link directly into Wommara Avenue via a roundabout or traffic signals.

Intersections along the bypass would be restricted. However, the arterial roads which penetrate the development and intersect the bypass would require some form of intersection control such as traffic signals or roundabouts. The bypass intersection on Kalaroo Road to the north of the development is also assumed to be an at-grade intersection.

5.11.9 Cycleway and pedestrian route development

Cycleway and pedestrian route development would be encouraged along the disused railway reservation and along the WPCP's. Connectivity to the major attractors within the site would also be desirable, ie to link the beach and the beach front commercial area to wetland and residential areas. Links would also be made to external attractors in Belmont and Jewells; a cycleway running along the WPCP's could connect up to the central access road leaving it at the site's boundary, skirting the boundary to the north before entering Belmont. Cycleways would run adjacent to road boundaries as well as having cycleway corridors along the disused railway, along the WPCP's and links to the beach.

5.11.10 Internal circulation

The development will have a high degree of urban land use, predominantly as residential areas. The internal road system would therefore have a hierarchy with arterial roads providing access from the primary road network, sub-arterials linking areas of development, collectors serving the residential areas and local roads providing access to individual dwellings.

The internal road system should have adequate alignment and capacity to accommodate the efficient and safe operation of the vehicular, pedestrian and bicycle traffic which is generated by the development.

5.12 CULTURAL HERITAGE

5.12.1 Methodology

5.12.1.1 Review of existing documentation

A range of documentation was reviewed in the process of compiling this report.

The primary literature source for Aboriginal aspects was a report by Theresa Bonhomme (1994a) documenting an archaeological survey of the study area. Other sources included the NSW National Parks and Wildlife Service (NPWS) Register of Aboriginal Sites and catalogue of archaeological reports.

Historical research included a review of known heritage items within the study area from the *City of Lake Macquarie Heritage Study*, (Suters Architects Snell et al, 1993) *Hunter Regional Environmental Plan* (NSW Dep. Planning, 1989), National Trust of Australia (NSW), and Australian Heritage Commission. A few primary historical resources were examined. The historical context for understanding the type of sites likely to be found was based on *Reid's Mistake* (Clouten, 1967) and the *City of Lake Macquarie Heritage Study*.

Contact was made with Lake Macquarie Historical Society but they did not provide any information for this survey work.

5.12.1.2 Field surveys

Aboriginal sites

A sample survey of the majority of the present study area has been carried out for Aboriginal sites by Bonhomme (1994a). She was accompanied in the field by a representative of the Bahtabah Local Aboriginal Land Council (LALC).

The study area has also been variously surveyed prior to Bonhomme's survey by Brayshaw (1981) and Dallas (1988) as referenced in Bonhomme (1994a:26).

The aim of the present Aboriginal sites survey was to familiarise the consultants with the study area and to briefly inspect the few areas which were not included in previous surveys of the area (Figure 23).

The field survey was carried out over one day by Kerry Navin and Kelvin Officer. Two representatives of the Bahtabah LALC, Michael Green and Noel Date, accompanied the consultants in the field.

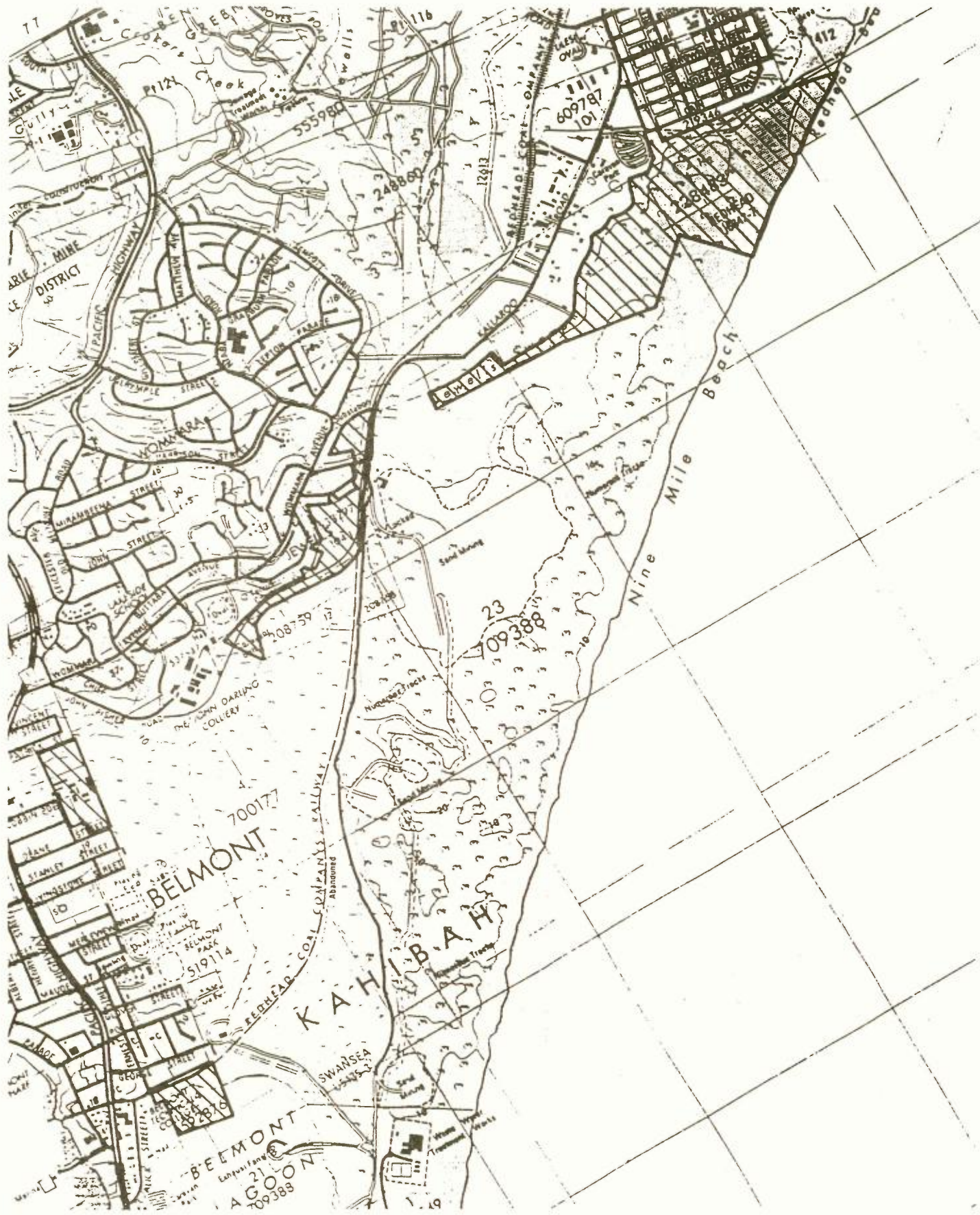


Figure 23 Areas inspected for cultural heritage

The field survey comprised walking transects through previously unsurveyed areas and a general inspection of the the study area.

Historic features

Historic and industrial sites were identified by examining historic maps, current topographic maps, and the inventory contained in the *City of Lake Macquarie Heritage Study*. This identified the presence of two rail lines associated with coal mining activity and little else.

A field survey was undertaken by walking part of the two rail lines and examining sections of it that were likely to contain structural features such as creek crossings and platforms. Any buildings or structures located on the current topographic plan within the study area were examined.

There was no field walking on the dunes or within the swamp areas. It was anticipated that the extent of previous and current sand mining would have destroyed any historic sites that may have existed in the dunal sections of the survey area. In addition, as there was no historical evidence to indicate the use of the wetlands by nineteenth-century Europeans for fishing or other similar activity, little attention was given to them.

All sites or features identified during the survey were recorded on inventory sheets and photographed. These inventory sheets are included in Appendix F. The survey was undertaken by archaeologists, Mary Casey and Tony Lowe.

Survey/inspection of historic sites included examining known heritage sites in the area, such as the two railway lines and associated features, and a search for other heritage items. *City of Lake Macquarie Heritage Study Site Inventory Cards* for known sites in the study area are included in Appendix G.

5.12.2 Archaeology

The study area would have represented an extremely resource-rich area in prehistory. Consequently, it could reasonably be expected that the area would have been extensively exploited by the Aborigines and would contain numerous Aboriginal sites. However, the study area has undergone severe and extensive disturbance as a result of European industrial and development activities. The survival of Aboriginal archaeological sites will have been prejudiced as a result of many of these practices. The types of land disturbance which would have disturbed Aboriginal sites include:

- removal of much of the original native vegetation;
- coal mining;
- extensive mineral extraction (rutile and zircon) over most of the study area sand body;
- extensive sand extraction in fore dune and hind dune contexts;
- erosion resulting from extraction activities;
- modification of the wetlands by introduced fill;
- installation of transmission lines, pipelines and rail lines;
- vehicular tracks; and

- modification of the original hydrological regime of the area, including construction of canals and bulldozing of a new outlet from Jewells Swamp to the beach during sand extraction activities.

Site types which would not have survived these levels of disturbance include carved and scarred trees, stone arrangements and earth rings or bora grounds. Site types which include scatters of lithic artefacts and shell middens are also vulnerable to land surface disturbance.

The NSW NPWS Register of Aboriginal sites lists seven sites as occurring in the study area. These are:

- NPWS Site 45-7-48 open camp site;
- NPWS Site 45-7-49 open camp site;
- NPWS Site 45-7-51 midden;
- NPWS Site 45-7-59 midden;
- NPWS Site 45-7-60 midden;
- NPWS Site 45-7-61 midden; and
- NPWS Site 45-7-130 open camp site.

The Site Register cannot be taken as an accurate indication of sites which are, or were, located in the study area. Sites 48 and 49 have the same map grid reference and it is assumed that they are probably the same site, entered twice on the site register. This is the same for sites 59 and 60. Many of the site locations for the Belmont/Dudley/Jewells Swamp area are not accurate. The sites were recorded by Dyall in 1972 and were only briefly documented. There is no information regarding their specific content, location or topographic setting. A sketch map published by Dyall (1972) provides the only basis for the NPWS site card grid references. Dyall's map has an approximate scale of around 1:60,000, providing an accuracy of, at best, ± 1 km when transposed onto larger scale topographic maps. This error may have been increased following the translation from imperial grid to metric grid references.

Based on available evidence the present status of the listed sites in the study area is outlined in Table 26.

The study area has previously been surveyed by Brayshaw (1981), Dallas (1987) and Bonhomme (1994a). The latter investigation included sample survey transects across the study area and concluded that

“few sites will still exist in the study area. Natural processes and human activities have taken their toll on sites in the area ... the sites that survive today are a small sample of the sites that would have been created daily, summer after summer, as people re-used the area and its resources. The main locations of activity would have been the headland, creeklines, the strand and the wetlands to the west” (1994a:27).

Bonhomme's survey concentrated on the area defined in her report as the most likely to be affected by redevelopment.

Table 26 Status of archaeological sites

NPWS Site	Type	Comment
45-7-48/49	open camp site	Could not be relocated in 1986 and is presumed destroyed.
45-7-51	midden	The site was reportedly destroyed by sand dredging but was relocated in 1990. Some material still remaining but the site has been disturbed.
45-7-59/60	midden	Artefacts were collected by Dyall and the site was destroyed by rutile mining in 1967.
45-7-61	midden	The site has apparently been destroyed.
45-7-130	open camp site	In 1987 the site was excavated by Dallas and Donlon. It has probably been disturbed by sand mining.

Bonhomme located three scatters of artefacts and one isolated find in the course of her surveys. All the cultural material in these sites had apparently been affected by sand mining. These sites are not yet listed on the NPWS Site Register and grid references have only been provided for one of the sites, thus the location of these sites is not clear.

5.12.3 History

5.12.3.1 Local history

The local Aboriginal group who occupied the area including the subject site were the Awabakal. They resided in the area until the 1860s when, according to historical sources, they moved away or were killed. After this period only a few Aborigines remained in the vicinity of Reid's Mistake, near Swansea. (Clouten, 1967)

European settlement was slow in arriving in the Lake Macquarie area. The poor agricultural resources of the area gave little incentive for permanent settlement. Early industry consisted of timber-getting and some attempts to exploit coal but until the development of good transport facilities there was no real exploitation of this resource. Two of the earliest attempts at coal mining in the area were in the 1830s at Warner's Bay and in 1841 at Coal Point (Suters Architects Snell, 1993).

The earliest government surveys of the Lake Macquarie district were undertaken from 1826 by Heneage Finch. Later work was undertaken by Surveyor Ralfe and from the 1830s settlers began to take up these surveyed parcels. (Jervis, 1945)

During 1850-51 a road to Lake Macquarie was surveyed. Prior to this the only access was a road cut by Reverend Lancelot Threlkeld to the Aboriginal Mission he established near modern day Belmont in 1825. (Jervis, 1945)

Threlkeld's mission was called Bahtabah and covered 10,000 acres. The mission was established at Belmont due to its proximity to "the Aborigines' rallying point at Reid's Mistake". In 1828 the mission was abandoned and the land reverted to the Crown. (Clouten, 1967)

In 1861 the New South Wales Land Act opened the area up for further settlement and development by small scale farmers leading to the establishment of small farms in the Heads district. (Clouten, 1967; Jeans, 1972; and Clark, 1978)

The mineral rights to the mission lands at Belmont were purchased in 1866 by Thomas Williamson who built two houses on the land, one of which was a guesthouse named 'Belmont'.

The remainder of the mission lands were slowly sold off as small allotments with the land being taken up for various purposes. During the 1870s a number of sawmills were opened, encouraging the arrival of new settlers to Belmont. In 1874 a fishing industry was established by George Clouten. (Clouten, 1967)

In 1873 27,000 acres of land around the lake was leased for coal mining. Until this period the Australian Agricultural Company had monopolised coal mining in the area. Coal mining had further opened up by 1887 when the railway became the primary means of transport and is now one of the largest industries in the region. (Jervis, 1945)

Also during the 1880s the road from Newcastle into Belmont was upgraded to provide better transportation for the local industries produce to Newcastle. By 1883 a school had opened at Belmont, testifying to the community's growing population.

Aside from coal mining, timber-getting and tourism, other economic activities in the area included orcharding, brickmaking, and fishing (Suters Architects Snell, 1993).

A number of historical maps and plans, which include the study area, illustrate its development and natural features from the 1880s onwards. The 1885 Parish Plan (Figure 24) shows the area in the ownership of the Redhead Coal Mining Company (portions 124, 117, 118, 140, 141, and 142). This company was formed in the late 1870s and had permission to construct a railway to Newcastle by 1883 (Figure 25) (Clouten, 1967). The 1891 parish plan indicates the extensive nature of the swampy land through the study area (Figure 26). An 1895 map emphasises the landscape of tea-tree swamps and an extensive dunal system (Figure 27). During this period the town of Belmont was growing and the Burwood Extended Mine (later known as the Redhead Colliery) was in operation with the initial section of the railway line operating from Newcastle. By 1931 it can be seen that the residential occupation of Redhead and Belmont was expanding along the line of the Pacific Highway (opened in the 1930s) (Figure 28). By this stage the Redhead Coal Mining Company's Railway had been built as well as the Jewells and Belmont Platforms.

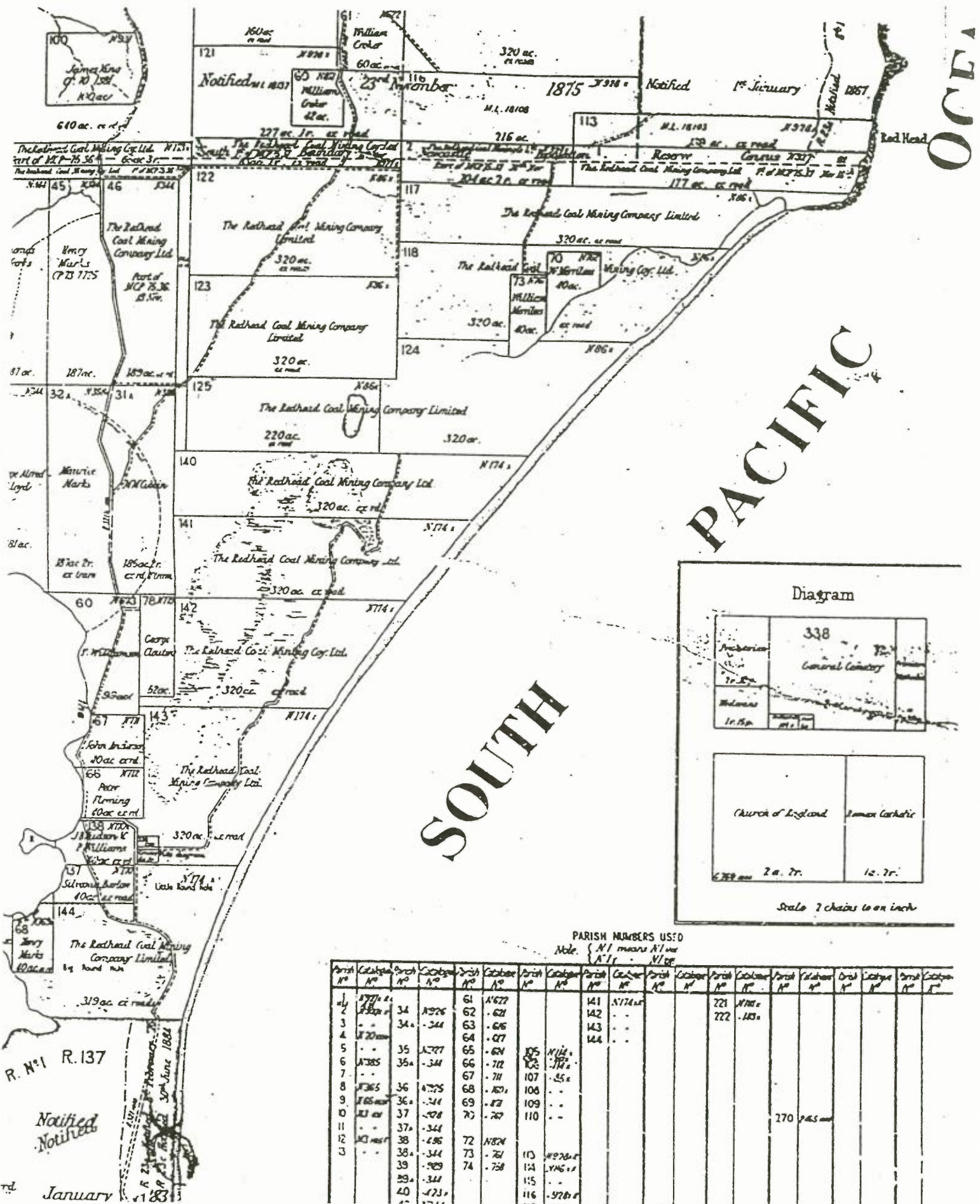


Figure 24 Parish plan of Kahibah, County of Northumberland, 1885

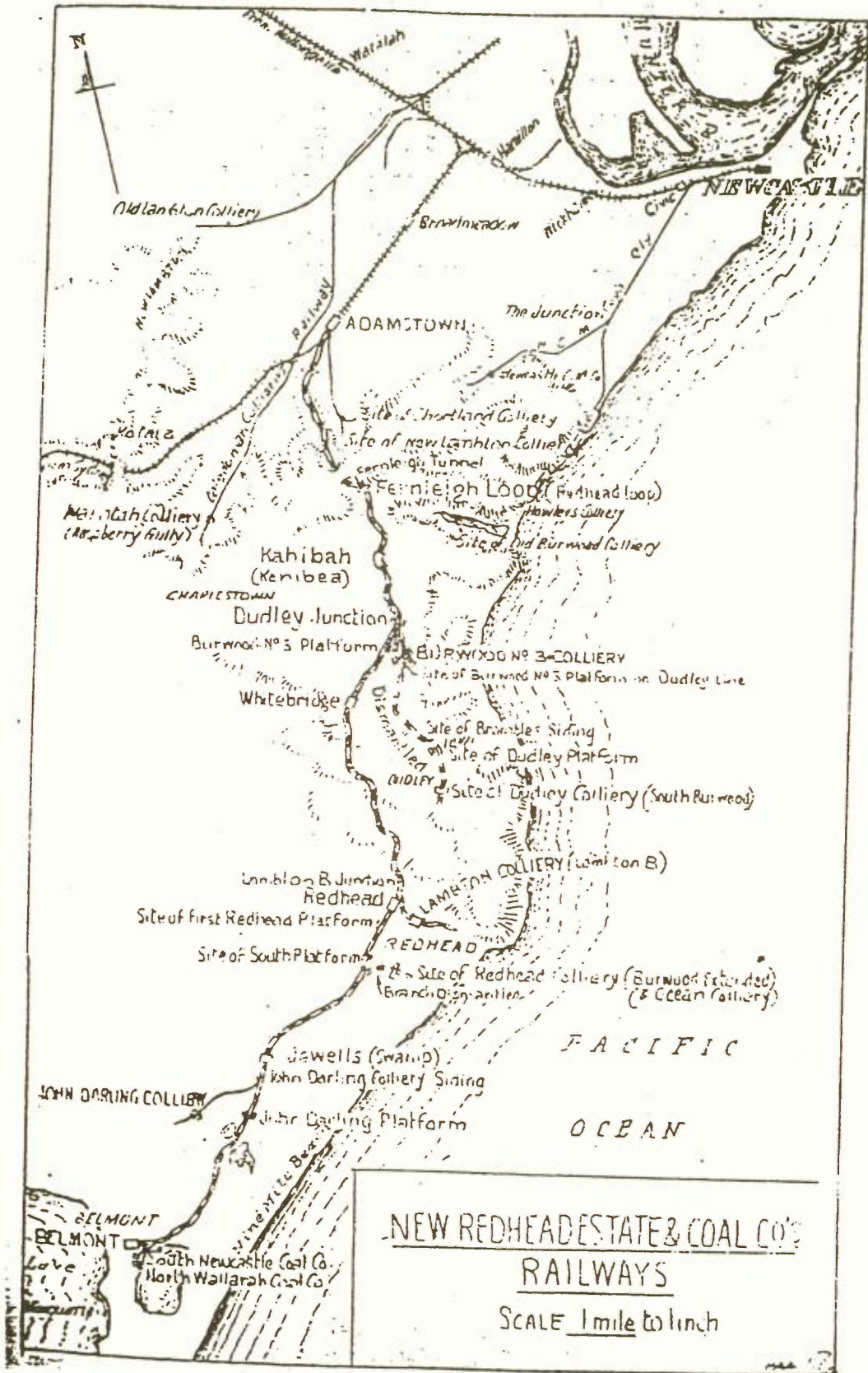


Figure 25 Redhead Coal Mining Company railway line

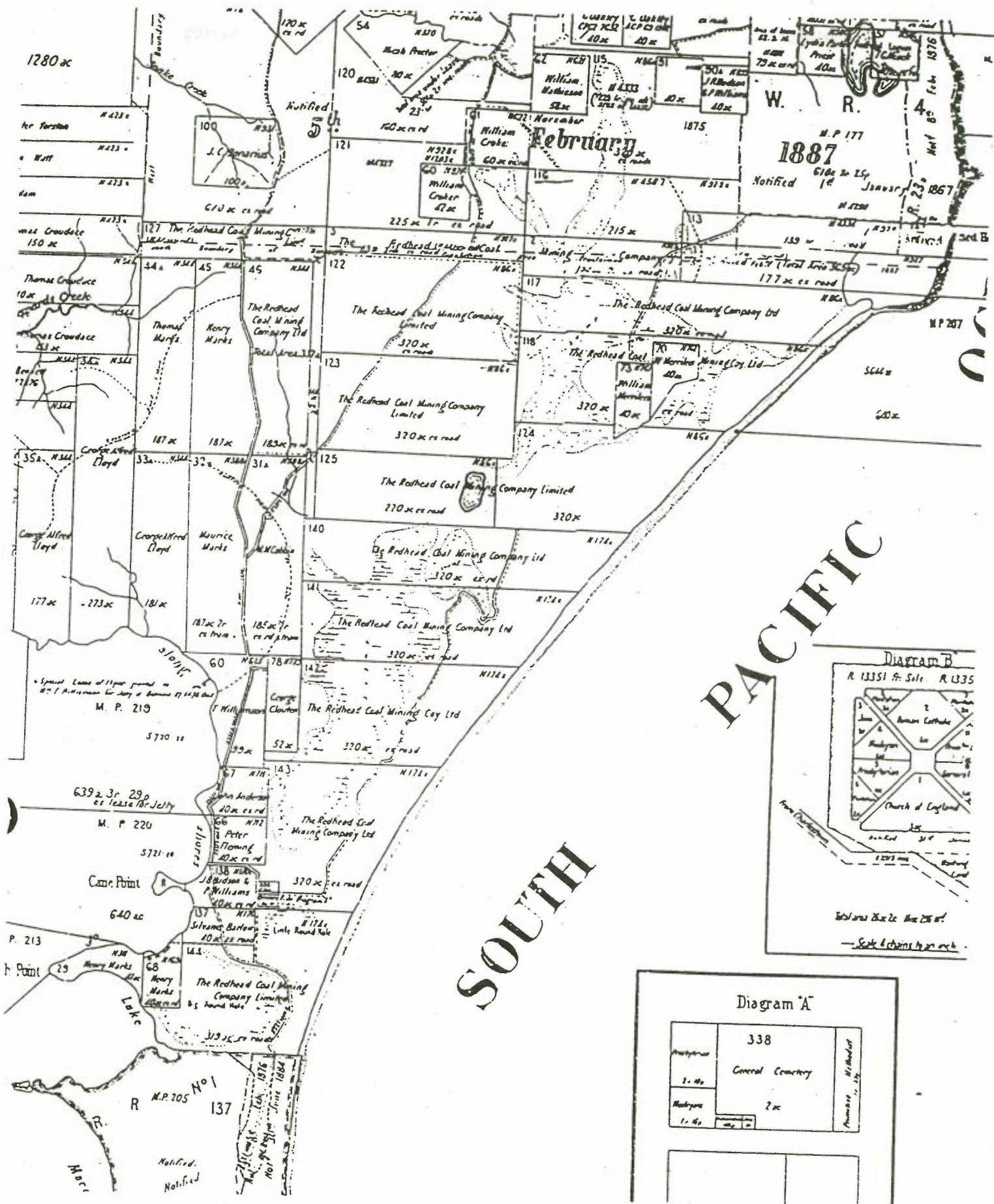


Figure 26

Parish plan of Kahibah, County of Northumberland, 1891

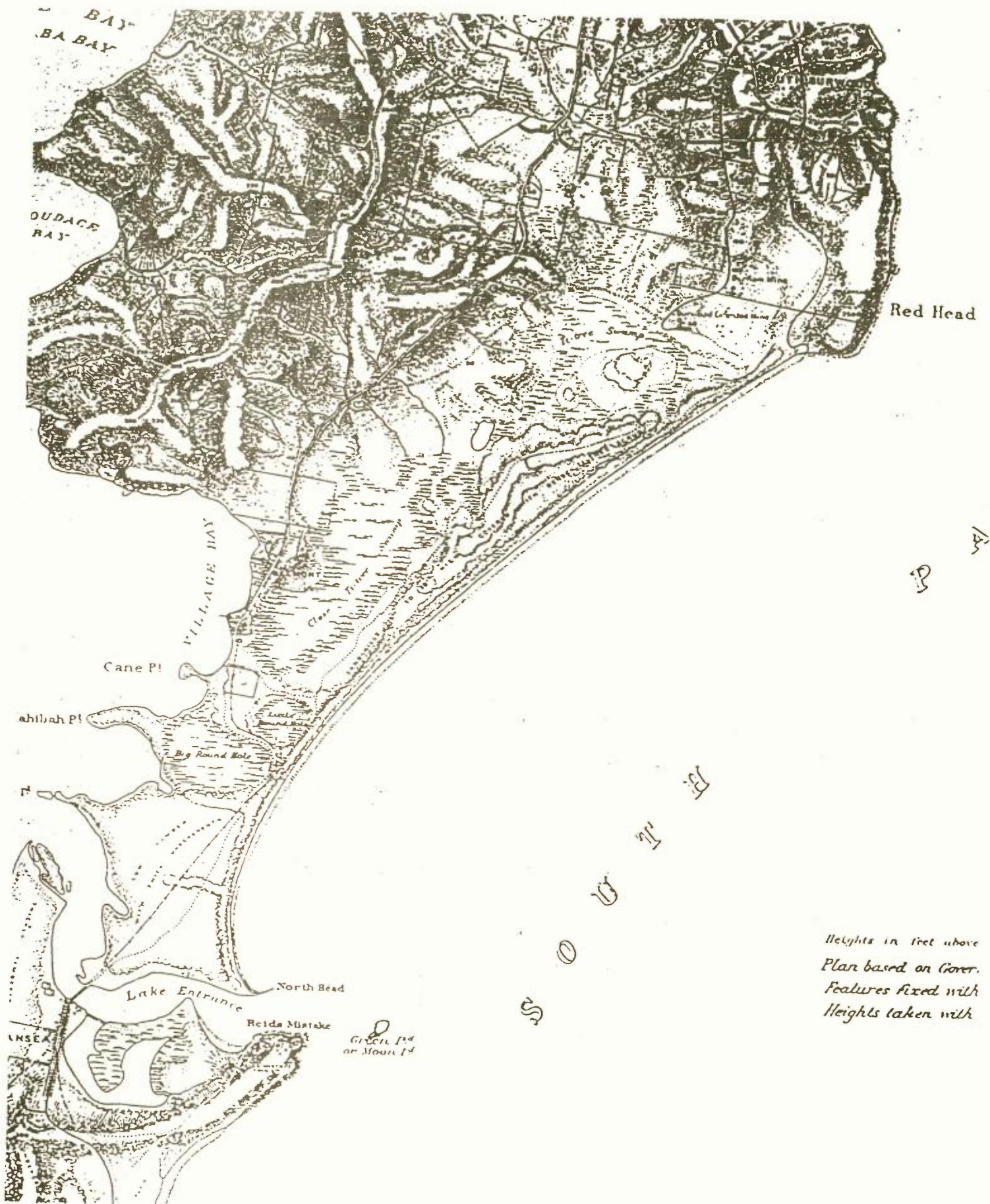


Figure 27

Map of the country around Newcastle
 By: Major T.S. Parrott, 1st November 1892

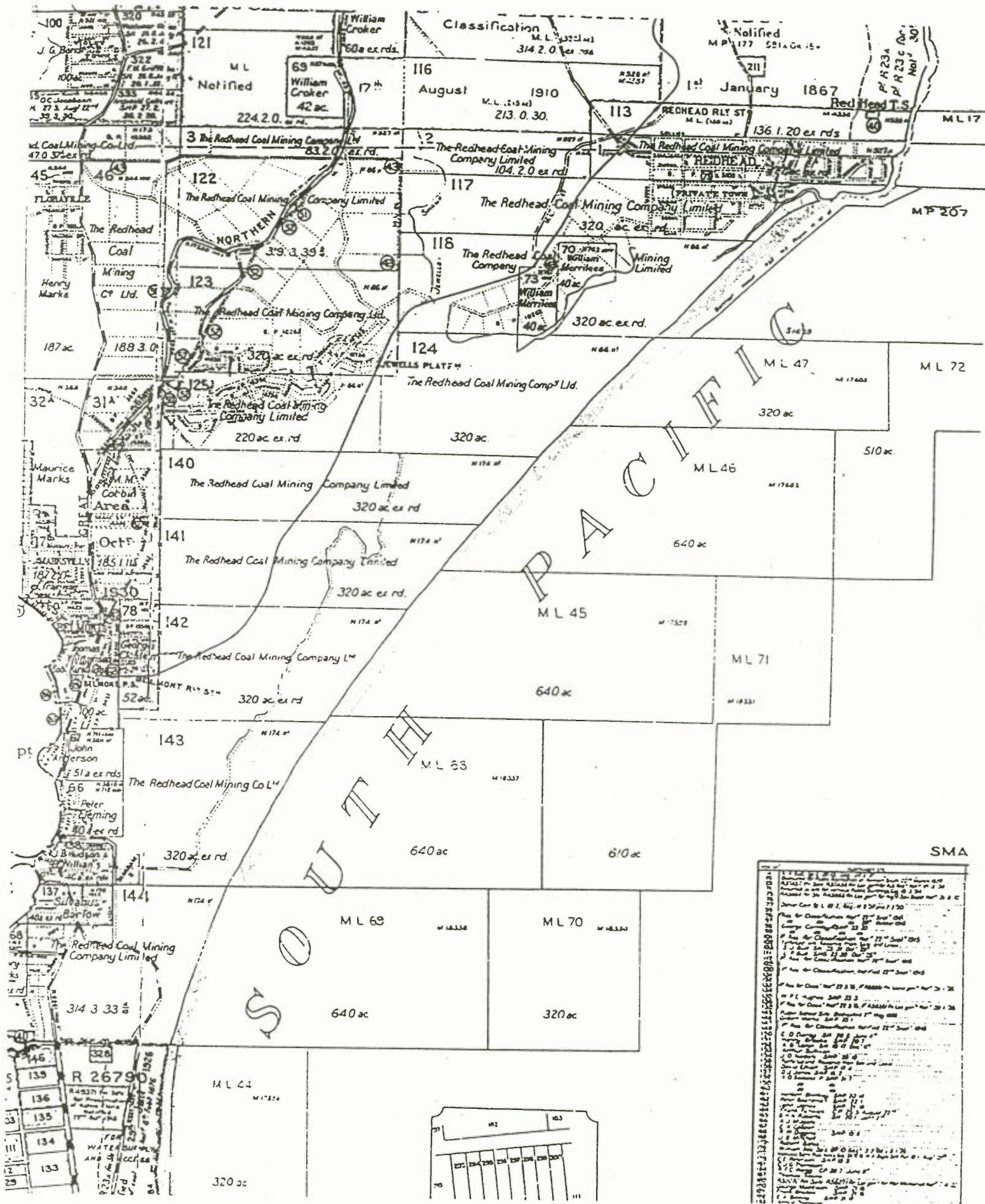


Figure 28 Parish plan of Kahibah, County of Northumberland, 1931

5.12.3.2 Study area occupation and land use

Redhead Coal Company's railway

In 1905 the Redhead Colliery Company changed its name to the New Redhead Estate and Coal Company (Parkes, 1974). They constructed and owned the railway line from Belmont to Adamstown (Figure 25) and controlled all the land in Belmont North, the colliery and all the associated coal mining rights. The train line was built with visions of a large residential population moving into the area and providing a facility for tourists (ARHSB, 1940; Parkes, 1974; and Fallins, 1992).

The building of the railway line to Belmont was the result of agitation by the local community as well as New Redhead Estate and the Coal Company. Permission to extend the Redhead Coal Company's line for passenger services from Burwood Extended Mine to Belmont was granted in 1914. Work was completed by October 1916 and this section of line was opened on the 23rd December 1916 (ARHSB, 1944). Platforms were erected at Redhead, Jewells Swamp and Belmont with passenger services operating six times daily. It eventually became known as the 'Belmont branch'. Jewells Swamp was renamed Jewells in 1923 and the location of the platform appears to have been moved in 1925. The Belmont Colliery siding was opened in 1926, and the Wallarah Colliery siding opened in 1941.

The linking of Belmont to the Newcastle railway line provided an impetus for development of the community with property owners sub-dividing their land as it became desirable for people to establish permanent residences at Belmont. Prior to opening of the Belmont branch it took up to three days for people living in Belmont to conduct business in Newcastle. With opening of the new line this period was reduced to one day. By 1946 14,728 passengers had travelled on the line and about 1,300,000 tons of coal had been hauled. Passenger service on the line finally ceased on April 8th, 1971 (Parkes, 1974).

Following is a description of the 'Belmont branch' in 1940.

"Jewell's has an island platform but only the left hand side is used, the right hand track being portion of the uncompleted duplication works long since abandoned. The station buildings here are in a deplorable condition, all windows, doors and about two-thirds of the weatherboards are missing and the platform is overgrown with grass and woods.

Shortly after passing Jewell's a branch line curves off to the right to the John Darling mine, the catch points to this siding actually joining the derelict duplication and by the layout it was apparently intended to work each road as an independent single line as far as Redhead.

The line now proceeds over marshy ground past a half-derelict platform on the right displaying no name but presumably for the miners from the adjacent John Darling Colliery. A short distance beyond this platform is the Landmark signal for Belmont, which is about half-a-mile further on, and its (sic) the terminus of the line.

The station here consists of a long platform on the right-hand side, with low buildings and offices. There is a run-round loop, a long goods siding and two additional sidings serving a colliery loading bank". (ARHSB, 1940)

Jewells platform

Jewells Station was erected for the John Darling Colliery miners and was part of the plan for the New Redhead Estate and the Wommara housing estate (developed in 1925 by the Coal Company Limited) (Fallins, 1992). There appear to have been two platforms near Jewells, known as Jewells and John Darling (Figure 25). Around 1940, passenger use of the line dropped due to the introduction of a local bus service.

Belmont platform

This platform provided a passenger rail service for Belmont. The last passenger train to use this platform was in April 1971 (Fallins, 1992).

John Darling Colliery and railway

In 1920 BHP started expanding its Newcastle steel industry and began mining to ensure ample reserves of coking coal. A series of geological surveys and coking tests led to the establishment of the John Darling Colliery which was the first coal mine owned by BHP. By 1925 construction of the colliery had commenced. The colliery mine lease was for 10,500 acres, one third of which was under the ocean

John Darling Colliery is just outside the study area; however, it had a branch rail line connecting into the main Redhead Coal Company Railway which ran through to Adamstown. Part of this branch line is within the study area (Figure 29). The branch line was built in 1925 when operations commenced at the John Darling coal mine (Fallins, 1992).

Working of this underground colliery ceased in 1987 (Bonhomme, 1994a). The colliery buildings now form part of a Baptist school complex.

Other nearby colliers outside the study area

Aside from the John Darling Colliery there were several other collieries immediately outside the study area. These were Redhead Colliery, originally called Burwood Extended (Figure 25), Lambton Colliery and Burwood Colliery. The latter two were purchased by BHP in 1932. (Fallins, 1992)

Impact of Mining on Surrounding Land

Descriptions of various activities associated with the John Darling Colliery illustrate its impact on the surrounding environment. During the 62 years of operation of John Darling the:

WOMMARA

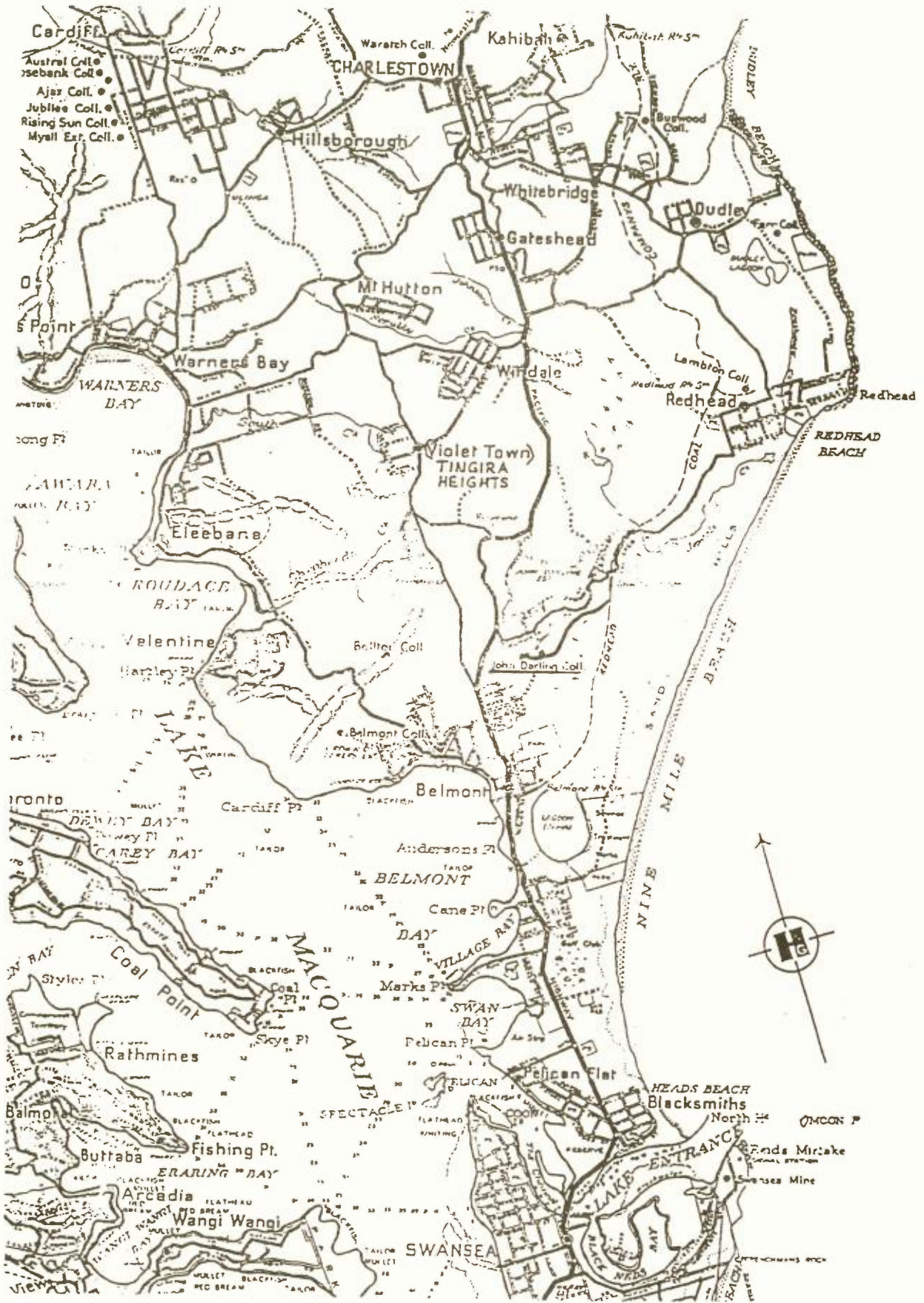


Figure 29

John Darling Colliery railway line

"...refuse of stone, claybands and inferior coal was all tipped into the adjacent swampland. Much of the low-lying land around Belmont and Swansea was reclaimed for building and recreational purposes from the mine's refuse." (Fallins, 1992)

5.12.4 RESULTS

5.12.4.1 Aboriginal sites

Previously recorded sites in the study area were not inspected in the course of this present investigation, as these sites were inspected by Bonhomme in 1994.

Two apparently previously unrecorded sites were located in the study area in the course of the present reconnaissance level survey.

Site locations in the study area are shown in Figure 30.

BSAS-1 (Grid reference: 37948:634601 Swansea 1:25000 topo 2nd Ed)

Chert artefacts were located on an original land surface which formed part of the northern margin of Jewells Swamp adjacent to Redhead township. One artefact was noted approximately every 10m on the track following the sewage pipeline easement. The track is 2.5m wide and survey visibility was 80%. Visibility away from the sewerage line track was 50% due to a recent fire.

BSAS-2 (Grid reference: 37733.634540 Swansea 1:25000 topo 2nd Ed)

Chert, silcrete and quartzite artefacts (approximately 100) were located on a remnant land surface which has been deflated and truncated by sand quarrying activities. The site is located on dunal slopes which would have originally been located on the southwestern edge of Jewells Swamp. Some remnant sections of original vegetation which may include undisturbed site material occur adjacent to surface exposures. Artefacts occurred over an area of approximately 100m². Artefact densities ranged from 1/3m² to 5/1m². Visibility in deflated areas ranged from 50-70%.

5.12.4.2 Historic sites

Site locations are shown in Figure 31.

Redhead Coal Company railway line (BSHS-1)

Sections of this line were examined where possible. It was frequently overgrown, inaccessible, invisible, partly destroyed and could be identified for only part of its presumed length.

The railway consists of occasional *in situ* sleepers with metal spikes. The most intact section was located to the south of Railway Parade and adjacent to Jewell's platform.

The railway line consists of a low embankment with gravel bedding and timber sleepers with spikes. There are no rails remaining, although occasional sleepers are



Figure 31 Identified historic sites

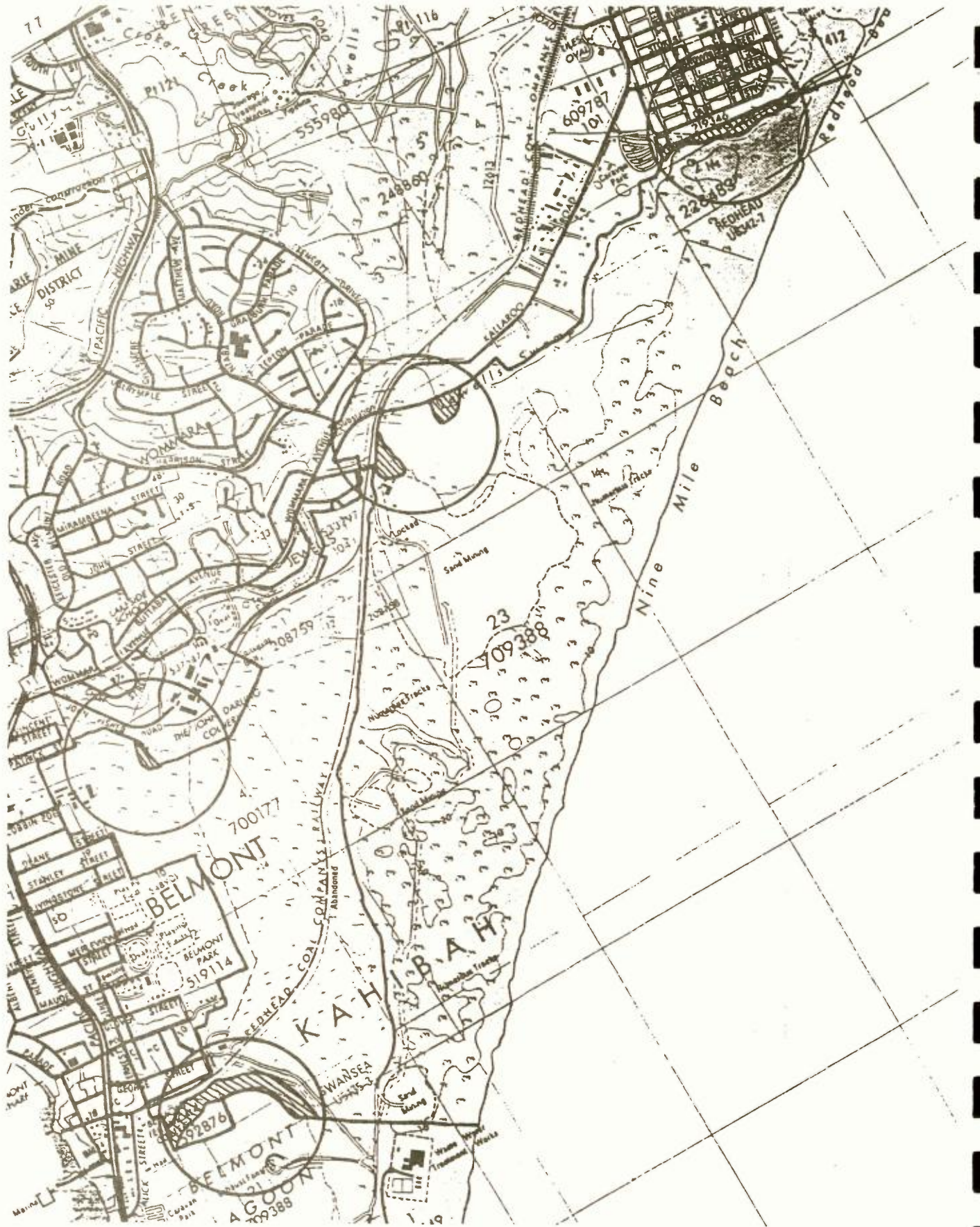


Figure 32 Zones of Aboriginal archaeological potential

visible and provide evidence of the location of the rail line. In the area of Jewells platform, a recent road runs parallel to the railway line. At the junction with the John Darling Colliery rail line, the track verges to the west to follow that line.

The rest of the Redhead line is very overgrown. The line of the railway can be located in a number of areas; whilst, in many instances it is effectively invisible or has been badly disturbed by roadworks. These have impacted on the railway line easement.

Jewell's platform (BSHS-1.1)

The platform consists of two concrete walls approximately 0.75m high running parallel to the line. These concrete walls are topped by an earthen platform.

In situ sleepers to the east of the platform indicate the location of the railway. In this area the railway embankment has been partially disturbed by the track and in some sections there is little evidence of an embankment. Large deposits of gravel have spilled onto the track.

Junction with John Darling Colliery line

There is clear evidence that a junction existed between these two lines to the south of Jewells platform, where the sleepers are close together. There are also remains of metal artefacts associated with the switching of the two lines.

Belmont platform (BSHS-1.2)

This area was examined to determine if there were any remains associated with the platform and any evidence of the terminus. Remains include the platform, railway embankment, *in situ* sleepers, steel frame of platform office, rail fencing and other features associated with the line. Again this area was overgrown with *Nasturtiums* and other exotic weeds.

One feature, consisting of four concrete footings, is the remains of a railway bridge. These footings are approximately 4m long and 1m high. The top of the footings contain the profile cut of two rails, with a distance of 1.6m between the rails. The platform embankment continues off to the west beyond this feature.

Attempts to examine the line to the northeast of this point were unsuccessful due to dense vegetation. Attempts to cross to the southeast and come up behind Belmont platform were also unsuccessful as the road was covered by water and there was extensive overgrowth in the area.

John Darling Colliery Railway (BSHS-2)

The John Darling Colliery railway line commences at the junction of the Redhead Coal Company railway. Only part of the line is located within the study area. The remains of the line include a low embankment with gravel and an occasional sleeper with metal spikes. All rails have been removed and sleepers and gravel are the

clearest evidence of the line which is generally overgrown by grass. A recent track runs next to the line for much of its length.

The section of the line near the oval and tennis courts contains few visible *in situ* sleepers. However, gravel bedding for the line and parts of the low embankment are still visible.

Other Structures (BSHS-3)

The only other structure that was identified within the study area was the concrete floor of a building associated with one of the largest sand mining operations in the area. The structure comprised extensive concrete flooring sitting on a compacted sand bed.

5.13 LANDSCAPE AND VISUAL ASSESSMENT

The landscape assessment is based on the methodology suggested in the Department of Planning's *Rural Land Evaluation Manual* (1988). Visual assessment has been undertaken by identifying and classifying the extent and significance of visual disturbance indicators. Scenic quality is a culmination of factors, including patterns of land use, the observer's position, the degree of enjoyment and the way physical features are arranged. It is also important that scenic assessment is based on the values of the community or responses to the scenery.

5.13.1 Landscape assessment

Scenic quality in coastal areas has been defined as increasing as:

- "...relief and topographic ruggedness increases;
- vegetation patterns become more varied;
- the proportion of natural or agricultural landscapes (compared to urban landscapes) increases; and
- the incidence of waterforms and water areas increases, without becoming common."

In applying this 'definition' to the subject site, it is apparent that some aspects apply and some not. The site can be divided into three main components or units - dunal, wetland and previously mined areas. In the dunal areas, largely along the coastal edge of the site, the increase in relief is quite apparent. This strip is characterised by steep sided dunes ranging in height up to 15m. There are other dunes on the subject site, however these are not as steep or high.

Patterns of vegetation on the site are described in Section 2.3 of this report. In respect to landscape significance, however, the wetland areas on the site are the most visually and floristically significant. Vegetative cover in previously sandmined areas is largely exotic with a predominance of *Chrysanthroides minilifera* (Bitou Bush) used for dune stabilisation.

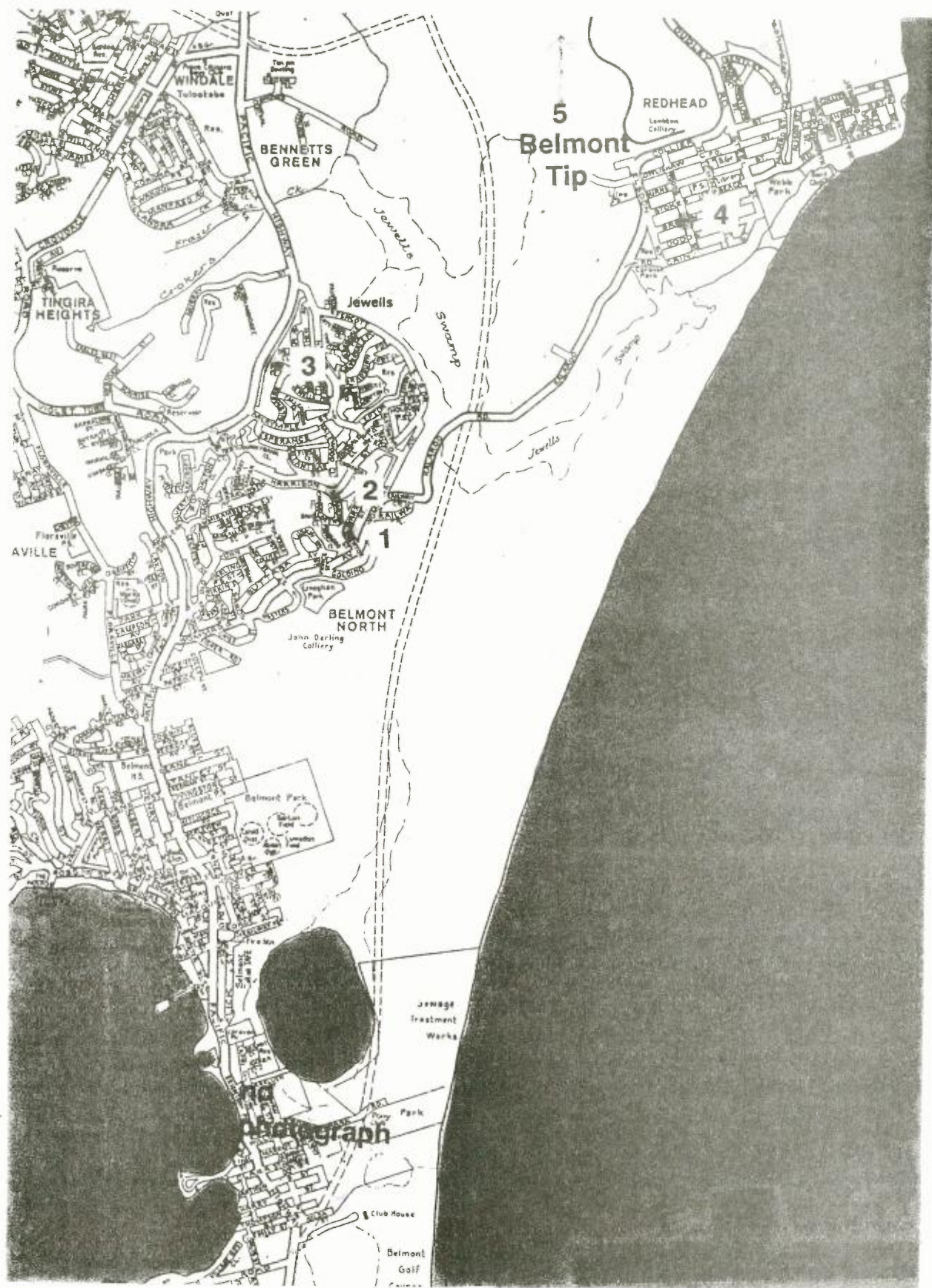


Figure 33

Visual assessment locations



Photo 1 Brentor Street



Photo 2 Palamuna Close

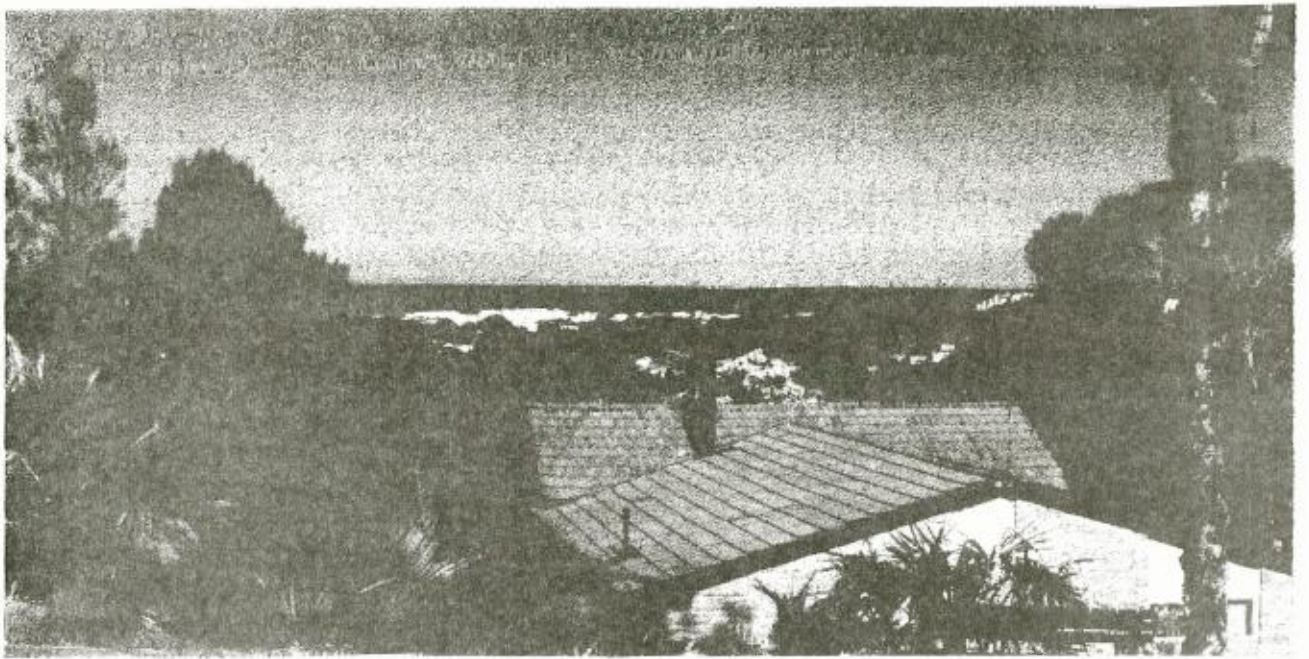


Photo 3 Pam Close

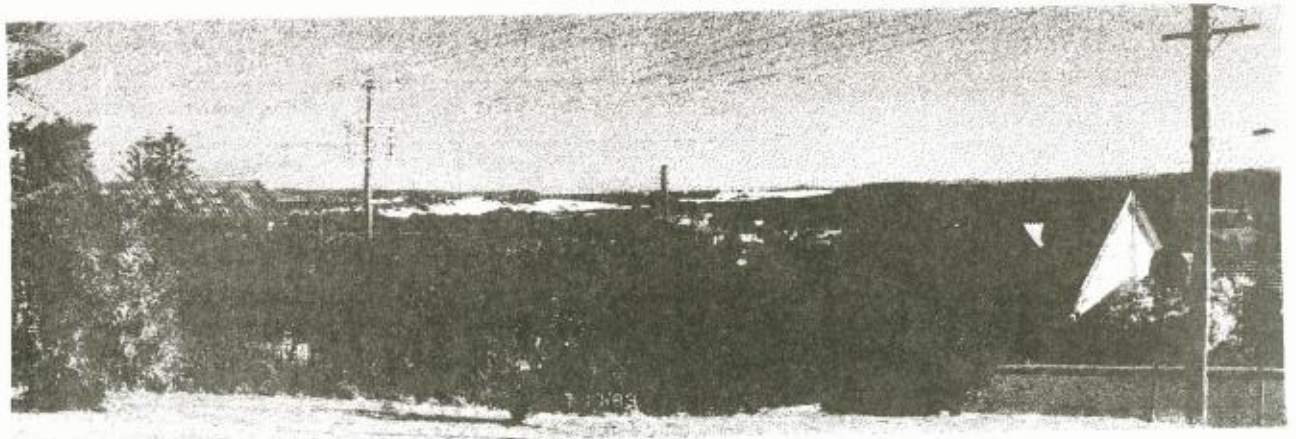


Photo 4 Brown Street

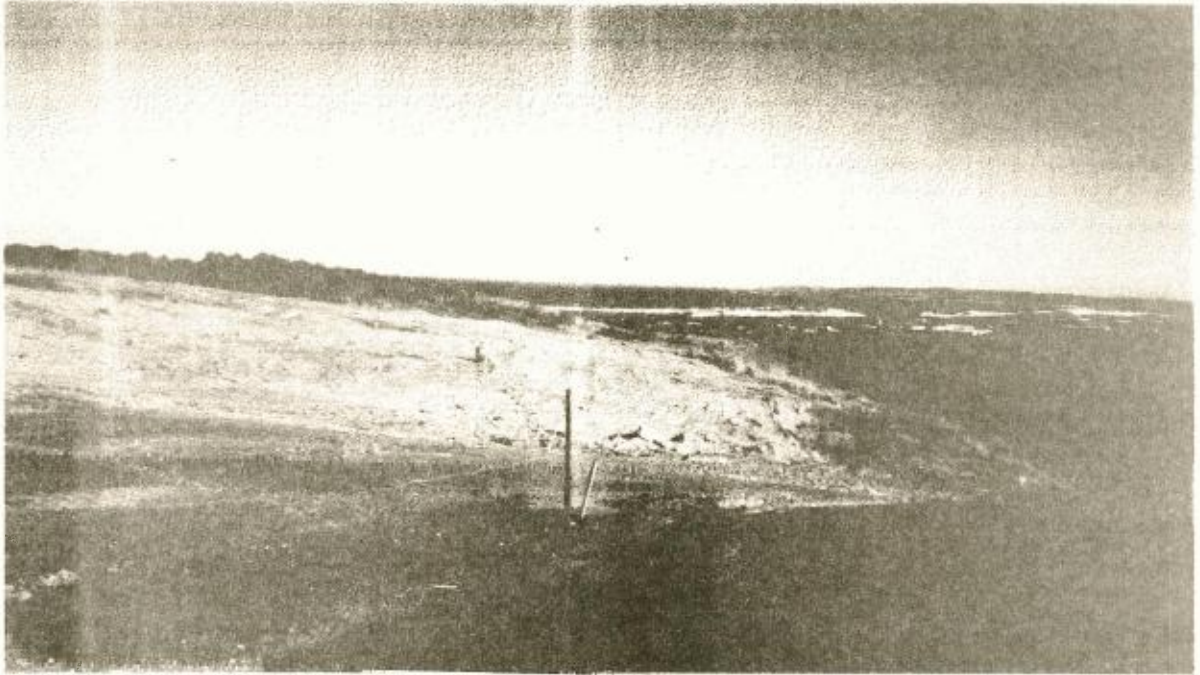


Photo 5 Belmont Tip

Due to previous sand mining activities on the site, there is very little natural (or agricultural) landscape. Most significant are the dune and wetland areas previously mentioned. Water is associated with the site through both its proximity to Nine Mile Beach and Belmont Lagoon, and the incidence of both SEPP 14 and other wetland areas on the site.

5.13.2 Visual assessment

To assess the visual impact of the proposal, cadastral and topographic maps were used to select a series of sites which were accessible and provided vantage points to the subject site. These viewing points are shown on Figure 33.

By observing the existing environment and considering the proposed development from these sites, it is possible to gain an overview of the sensitivity of the existing landscape to the intrusion of the proposal, ie the degree of visibility.

5.13.2.1 Overview of the probable impacts

The visual quality of the surrounding areas is of medium to high quality, with a largely low density urban area overlooking a substantial stretch of coastline to the east and in some cases Lake Macquarie to the west. Directly surrounding the site are predominantly urban uses.

The degree of relative visual impact has been based on an examination of the height, width and length of disturbance due to the following indicators:

- cut and fill;
- structures; and
- removal of vegetation.

For each disturbance indicator, the physical extent of the disturbance has been classified as being small, medium and large and its significance as being:

- immediate (say, within 200m of the site);
- local (say, within 500m of the site); or
- district (say, in excess of 500m of the site).

Table 27 outlines these impacts according to this criteria at each of the 5 viewing points.

5.13.2.2 Outcome of the assessment

In all but one case, the building of structures on the site would cause a large impact on the visual amenity of the selected locations. This impact would be exacerbated by removal of vegetation in the wetland areas to the west and north of the site. Filling on site is likely to increase the visual disturbance.

It is important that the integrity of the frontal dune remain intact in order to retain the visual amenity of the area. To this end, any structures on the development site should be well below the height of the front dune. While it is not within the context of

Table 27 Visual disturbance indicators

Photo No.	Viewing point & height (AHD)	Visual disturbance indicators				Description
		Cut	Fill	Structures	Removal of vegetation	
No photo	Bellevue Road (18)	o L	○ D	○ D	N.A.	Views across Belmont Lagoon to the southern portion of the site. The topography (including Sewerage Treatment Plant) is extremely flat making the foredune appear very prominent. Water views via gaps in dunes. Development in this southern area would have a large impact particularly as there is no vegetative screening.
1	Brentor Street (32)	● L	○ D	○ D	○ D	Almost the entire length of the site is visible from this point - particularly the foredunes and the wetland vegetation. Removal of vegetation from the western side of the site will increase the already significant impact of development in this area. The impact of fill and development of this area is likely to have an impact on a local if not district level.
2	Palamuna Close (40)	● L	○ L	○ L	○ L	This location looks south along the site with both the foredune, rear grassed dunes and wetland areas clearly visible. Any development on this site is likely to have a significant impact on local views. Distant ocean and frontal dune views are unlikely to be affected due to the height of the viewing location. Given the lack of screen vegetation in the immediate vicinity, views to the near development are likely to be significantly affected.

Photo No.	Viewing point & height (AHD)	Visual disturbance indicators				Description
		Cut	Fill	Structures	Removal of vegetation	
3	Pam Close (60)	o	o	● L	● D	Views to the site are partially blocked by vegetation close to the viewing location. there would be a moderate disturbance to the views from this location, although it is likely that views to the ocean and front dune would not be affected. Removal of vegetation from the site would considerably increase both the extent and significance of the disturbance.
4	Brown Street (20)	● L	● L	○ L	● L	Brown Street has views of the site and the edge of Jewells Swamp. The northern edge of the site is quite close (650m) and there is likely to be large visual disturbance from structures built on the site. Cut, fill and removal of vegetation will also impact on the view from this location but ocean glimpses would still be available.
5	Belmont Tip (70)	o	○ D	○ D	○ D	The Belmont Tip overlooks the subject site and the John Darling Colliery buildings to the south. The visual disturbance from development on the site is likely to be large and of district significance, given the proposed use of the Tip site as a scenic lookout and carpark.

this study to make specific recommendations about amelioration of visual impact, it is suggested that the following be considered should a development on this site proceed in the future:

- screen planting along the boundary of any new development;
- tree planting (ie canopy planting) between buildings to ultimately soften visual impact;
- forward planting along boundaries and internally along roadways to maximise vegetation height at the time of development;
- leave all elevated areas planted and retain all significant vegetation on site (including significant wetland species mentioned in Section 2.3.4.1);
- retain all distant views to the horizon;
- limit height of development to below that of the frontal dune; and
- avoid bringing any new roadways directly up to elevated areas - roads layout should ensure minimum visibility from outside and within the study area.

5.14 RADIATION INSPECTION AT JEWELLS CROSSING

A survey was conducted at the Jewells Crossing mineral sand processing site to determine radiation levels. Elevated radiation levels had previously been reported for this area by the NSW Department of Health (1991) (now part of the Environmental Protection Authority).

5.14.1 Site description

Approximately 100m south of the entrance gate to the processing site, on the eastern side of the existing access road, there is evidence of demolished structures erected on two concrete slabs (see Figure 34). The northern-most slab is designated Slab 1 and the southern-most slab Slab 2 (see Figure 35).

5.14.2 Slab 1

There is no evidence of tailings being used in the construction of Slab 1 and no exposed areas were visible on the underside of the slab. Radiation levels at 1m above the slab were in the range of 0.1 to 0.3 μ Gy/h.

5.14.3 Slab 2

Tailings containing monazite appear to have been used as packing material under the south-eastern corner of Slab 2. This material can be seen under the exposed edge of the slab at this corner and extending northwards. Other filling materials appear to have been used under the southern edge of the slab.

Erosion of material is evident under the exposed part of the southern end and south-eastern corner of Slab 2. Beneath the southern end there appear to be traces of chitter or similar material and under the south-eastern corner a layer of dark sand (approximately 100mm thick) is visible on top of compacted road base type material. Some of the road base material has been removed and placed on top of the slab at this corner. In addition, dark sand appears to have trickled out from beneath the

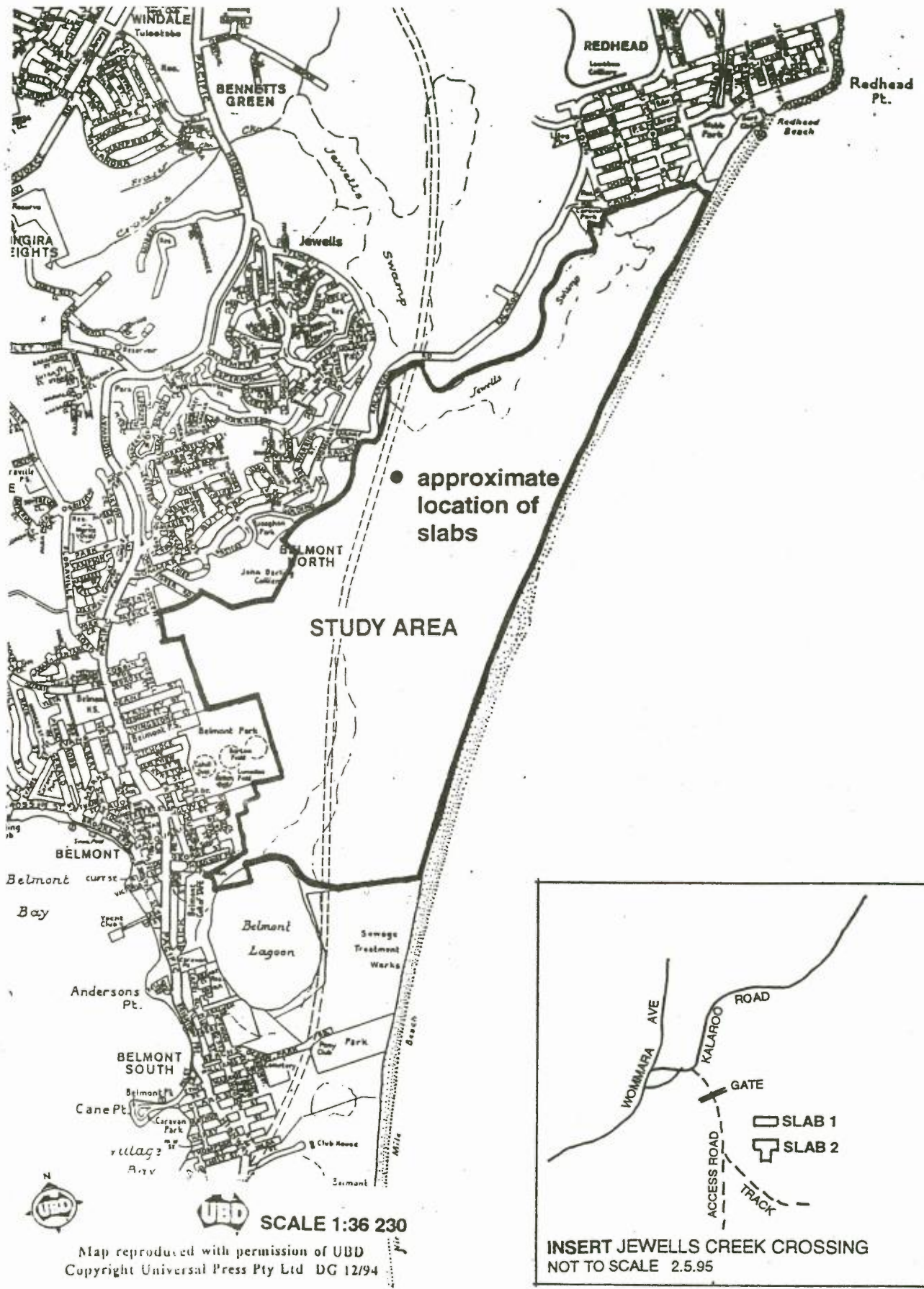


Figure 34 Location of slabs

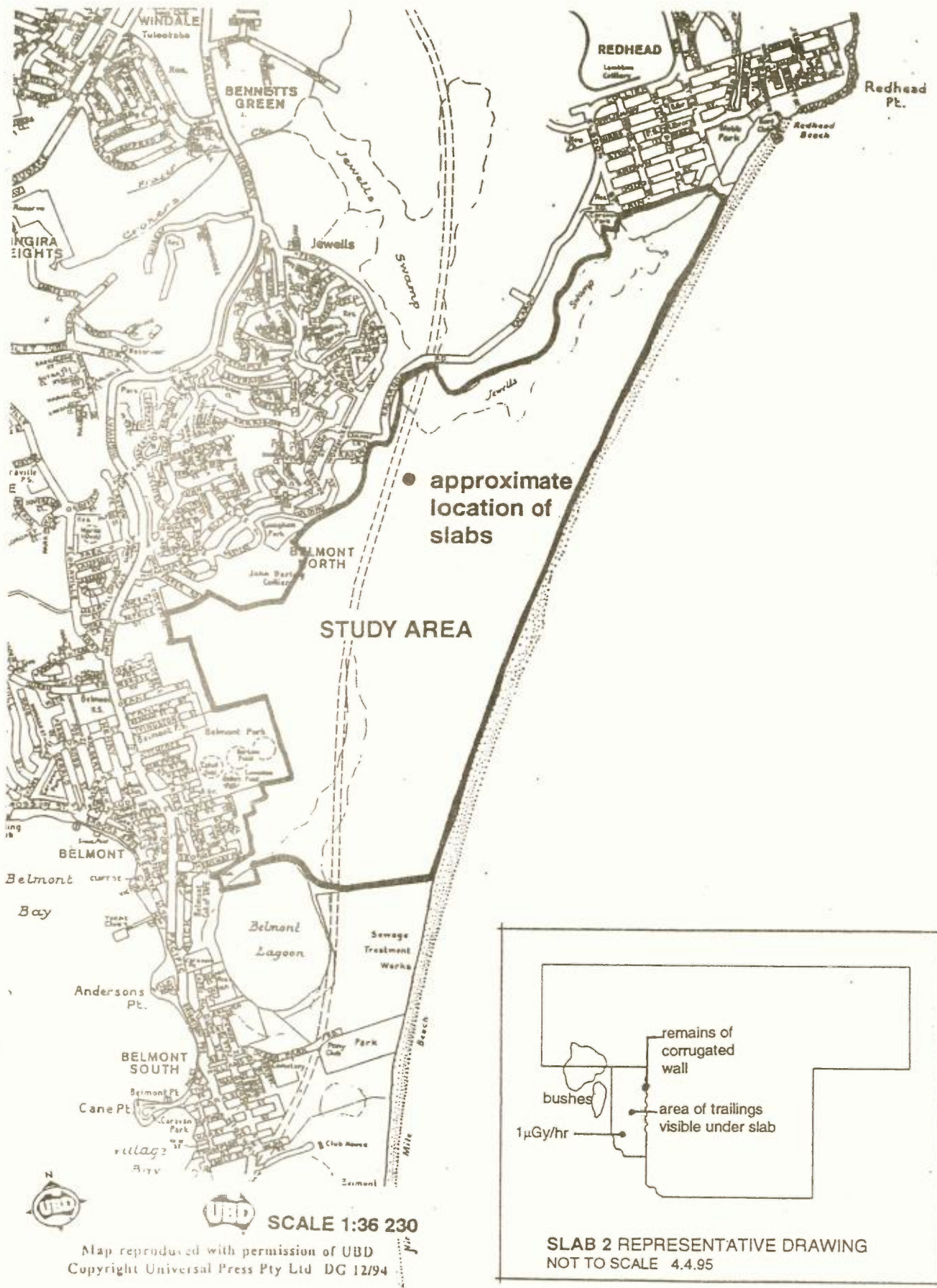


Figure 35 Slab 2

slab. A sample of the dark sand was removed and the radiation spectrum found to match that of a known monazite sample. Following are radiation levels measured at and close to Slab 2.

- 1m above the slab at the southern edge/south-eastern corner peak radiation levels measured $1\mu\text{Gy/h}$.
- Approximately 20-30cm from the southern edge/south-eastern corner of the slab levels in the range of 1.0 to $1.2\mu\text{Gy/h}$ were measured at 1m above ground level (the approximate height of tailings beneath the slab).
- 6-7m from the the south-eastern corner of the slab levels upto $0.6\mu\text{Gy/h}$ were detected at 1m above the slab. Levels decrease with distance from this corner.
- At other locations on the slab levels in the range of 0.2 to $0.3\mu\text{Gy/h}$ were measured at a height of 1m above the slab.

Peak radiation levels at 1m above the south-eastern corner of the slab exceed the NH&MRC Action Level Criteria for dwellings, schools (including playgrounds), businesses, factories etc where occupancies by the same individuals occur regularly on a day to day basis ($0.7\mu\text{Gy/h}$). The size of the area that comes under this classification at the Jewells Crossing processing site is approximately 10m^2 .

Peak radiation levels at 1m above the ground adjacent to the south-eastern corner of the slab also exceed the NH&MRC Action Level Criteria for areas where occupancies are for a few hours per week by the same or differing individuals and for garden areas ($1.0\mu\text{Gy/h}$). The size of the area that comes under this classification is less than 10m^2 .

5.14.4 Areas in the vicinity of the slabs

Moving away from the south-eastern corner of Slab 2, towards the access road (west of the slabs), readings diminish rapidly and are typically 0.1 to $0.3\mu\text{Gy/h}$ at 1m above the ground.

Radiation levels on the eastern side of the slabs, at 1m above the ground, were in the range of 0.1 to $0.2\mu\text{Gy/h}$. These levels are slightly below those measured on the side of the slabs nearest the access road and are probably due to the presence of mined sand from which most of the monazite has been removed.

6

LAND USE OPTIONS

6.1 INTRODUCTION

This section outlines the land use options devised for the Belmont Redhead site as a result of the investigations carried out during this study. The investigations of the site have indicated the following.

- Some of the features of the site, particularly the extensive wetland areas, have a high conservation value, despite having been disturbed in some areas.
- Several large portions of the site are severely degraded as a result of extensive sand mining operations over a number of years.
- A major road reservation exists through the site. Advice from the RTA cannot confirm whether or not the motorway ("Belmont Bypass") will ever be built or whether the reservation alignment is likely to be the final road alignment.
- A number of Aboriginal and European heritage items of varying significance have been identified on the site.
- Access to the site from most areas is constrained by natural features particularly the designated SEPP 14 wetlands.
- Dunal areas of the site provide significant topographic relief and are a major visual feature when viewed from the surrounding areas.
- Vegetation species considered to have conservation value, either regionally or at a State level including *Melaleuca quinquinervia*, *M.styphelioides* and *M. linearifolia* occur on the site. A buffer is required around the sewage treatment works adjacent to the southern edge of the site.

6.2 DEVELOPMENT PRINCIPLES

The environmental capacity of the site to support urban development has been based on an assessment of the ecological, visual, transport and land management constraints applicable. The environmental investigations carried out as part of this study, described in Section 5 of this report, have indicated that there are significant environmental constraints on the site, however these also constitute considerable opportunities.

Areas on the site which do not have high conservation value or are not required to act as buffer areas to the environmentally sensitive areas have potential for urban development, provided that development is properly controlled and undertaken in a sensitive manner. The development of options for the site and the assessment of those options has been based on the following planning/development principles devised for the site.

1. Urban development on the site is unlikely to form a "natural" part of the existing Belmont settlement due to constraints on access to the site and the proximity of significant wetlands. Therefore the development should establish it's own unique character.

2. Development on the site should maximise the unique opportunities provided by the attributes of the area including the wetlands, historical features and proximity of the coastal landscape.
3. Wildlife corridors, significant vegetation, wetlands and historical features should be developed and actively managed to ensure their integrity and long term viability.
4. Opportunities exist and should be utilised to create a 'model' development which will embrace innovative design and environmentally sustainable development practices, to create an attractive, high quality living, recreational, tourist and educational environment which is in harmony with the natural surroundings.
5. Public access to open spaces and the beach area should be encouraged where appropriate and transport (including pedestrian and cycle) links should be developed accordingly.
6. Water quality on the site and leaving the site should be of the highest possible quality and water pollution control ponds should be designed to ensure this.
7. Any development of the site should include detailed flora and fauna impact assessment. Under the four potential development strategies it is considered that only development which could affect the wetlands may require a fauna impact statement. Other habitat areas of the site are not considered likely to support endangered fauna populations, though there is a small likelihood the threatened little tern may colonise bare parts of the dune or the nearby beach.

6.3 STRATEGIES

Based on the investigations carried out and the outcomes of these, listed in Section 6.1 above, four potential development strategies were devised. These potential development strategies were then analysed in terms of the development principles outlined above.

The following sections describe each of the four options and provide a commentary of each.

6.3.1 Strategy 1 - Rail/bypass option

Strategy 1 is shown in Figure 36. The key features of this option are as follows:

1. The Belmont bypass reservation is maintained following the alignment provided by Lake Macquarie LEP, 1984 except for a slight deviation on the northern edge of the site. The deviation has been included to avoid a site of Aboriginal archaeological significance (BSAS - 1).
2. The railway corridor (including the John Darling spur line) is preserved as is. Both Belmont and Jewells Crossing Platforms are retained due to their heritage significance and potential as tourist attractions. The disused railway line is proposed to be used as a walking/cycle track linking the Belmont Platform in the

south to Jewells Crossing and the Aboriginal archaeological site in the north (BSAS-1).

3. A link between the wetland areas to the west of the railway line (SEPP 14 wetlands 867 and 866) has been provided adjacent to Belmont Oval. A further link between wetlands 866 and 861 has been included via an underpass of the John Darling Spur. This enables a link to be made between all the designated wetlands and to provide a continuous, functional wetland system.
4. A 160m dune stabilisation zone (originating from high water mark) is provided along the beach front and a further 40m is allowed as a wildlife corridor, creating a 200 metre reservation along the coastline. This will facilitate the stabilisation of the dune through vegetation and the provision of a managed walking trail along the crest of the dunes.
5. A system of water pollution control ponds (WPCPs) is provided along the eastern edge of the bypass and in the northern corner of the site. These ponds will ensure that nutrients, suspended solids and litter are removed from stormwater runoff prior to discharging into SEPP 14 wetlands. It will also form a buffer between the road and development to the east. The ponds would be surrounded by open space to provide an attractive setting for recreation, walking paths and cycleways internal to the development.
6. Access to the site would be from two points. The first access point is along Livingstone Road, through existing open space in Belmont Park and skirting through the narrowest point of the existing wetlands. Because wetlands 866 and 867 would be linked, a bridge and culverts would be required across this area. This access would continue along an east-west route down to the commercial centre on the eastern edge of the site west of the dunes. A second access point to the development would be in the north of the site linking Railway Crescent to the bypass and through onto the site.
7. A commercial (neighbourhood) centre is located on the eastern edge of the site, on the main entrance road into the site.

6.3.1.1 Commentary

The series of WPCPs and open space in this option provides a continuous and alternative habitat link through the middle of the site, however the positioning of the WPCPs compromises the effectiveness of the habitat linkage. It is preferable that the open space and WPCP corridor run adjacent to the wetland system. It is important that habitat and wetland linkages are sufficiently wide enough to operate effectively for wildlife movement and/or wetland water movement - linkages need to be at least 120 metres. Some habitat would be removed in this option as the northern access from Railway Crescent does not use the existing access.

As the existing road alignment has been used, the Belmont bypass corridor remains through designated wetland 867. This is a major disadvantage of this option and it is considered unlikely that this alignment would be ultimately acceptable.

The use and interpretation of the railway corridor is a positive aspect of Strategy 1 and, while there is some impact on the archaeological area BSAS-1, impacts on most significant sites is minimised or avoided.

The proposed access from Livingstone Street will require intersection treatment at the Pacific Highway. Access roads from Livingstone Street, Wommara Avenue and Railway Crescent would all need to be one lane in each direction (a reservation of around 11m). Where the bypass crosses the access roads to the proposed development, at-grade intersections with full turning movements would be required. The intersection with Kalaroo Road would need either traffic signals or roundabout treatment. Traffic signals would also be required at the southern connection with the Pacific Highway. This option provides adequate capacity for traffic generated by the subject site as long distance traffic would be attracted directly onto the bypass (north and south).

6.3.2 Strategy 2 - Railway corridor option

Strategy 2 is shown in Figure 37. It's key features are:

1. In the same way as Strategy 1, the railway corridor (including the John Darling spur line) is preserved as is. Both Belmont and Jewells Crossing Platforms are retained due to their heritage significance and potential as tourist attractions. The disused railway line is proposed to be used as a walking/cycle track linking the Belmont Platform in the south to Jewells Crossing and the Aboriginal archaeological site in the north (BSAS-1).
2. The Belmont bypass reservation has been removed from this option to investigate alternatives to the bypass.
3. A system of WPCPs are provided traversing the railway corridor on both the east and western sides to provide an open space and recreation link from the north of the site through to the south.
4. An 'Interpretative/Tourist' centre is proposed for the western side of the railway to the north of wetland 867. This would provide information on the history of the area including the site's significant features and information on the wetland system including represented species. Interpretative signage could be used along the route of the WPCPs and/or wetlands describing species significance etc.
5. Access to the site is via Livingstone Street through existing open space in Belmont Park and skirting through the narrowest point of the existing wetlands. A further access to the site is provided to the north of the site extending Wommara Avenue across the railway corridor and down into the eastern section of the proposed development.
6. A commercial centre is provided in two sections along the eastern boundary of the site. Cafes etc. could be provided in the smaller section which face the beach and shops in the other which addresses the road. This would provide a "neighbourhood centre" for the development and also provide a focus for the existing community and tourists who visit the beach or the facilities on site.

Commercial facilities could also be provided in the area reserved for the interpretative centre.

7. Wetlands 866 and 867 are linked adjacent to Belmont Oval, however 861 is not directly linked. A WPCP and open space areas separate these wetlands 861 and 866.

6.3.2.1 Commentary

This option provides an enhanced corridor in the middle section of the site due to open space and WPCPs being adjacent to wetland 866. This area includes dunes which are regenerating well and would result in retention of different habitats adjacent to one another. It also provides an enhanced link to dunes in the south. The removal of the bypass reservation may however lead to a future bypass development scenario of the road alignment traversing the wetlands and/or open space.

Some areas denoted as having future development potential restrict the habitat link between wetlands 866 and 867 and part of the shrub swamp north east of wetland 867 is lost to open space and WPCPs. The lack of a bypass reservation however allows for more vegetation regeneration.

Although most of the proposed roads follow existing tracks, some roads may cause fragmentation of retained vegetation in the south of the site. Due to only two access roads and the absence of the bypass in this strategy, each access road would need to be two lanes either way (reservation of around 22m). A third access point could be included to provide more appropriate access to the site, either along the northern edge of Belmont Lagoon, linking into the Pacific Highway via Gen Street or through an access road following the alignment of the bypass from the south of Belmont Lagoon again linking into the Pacific Highway. Both of these road options would provide an impact - the former on an archaeological site the latter on designated wetland areas.

Strategy 2 provides the best outcome in terms of retention of archaeological and historical features, although there would likely be some impact on BSAS-1 through development of open space and possible loss of context. This may be addressed through management options. The inclusion of an interpretive centre provides opportunities for the wetland areas and historic/archaeological features to be retained and managed, and to provide valuable educational and tourist resources.

6.3.3 Strategy 3 - Bypass option

Figure 38 shows development Strategy 3. Some of its features include:

1. The Belmont bypass reservation has been retained, however, the alignment has been altered to run along the eastern borders of wetlands 866 and 867. This forms a barrier between any proposed urban development and the wetland systems, providing a buffer against direct access to the wetland and providing an attractive view along the road.

2. A series of WPCPs are provided along the eastern alignment of the bypass creating an open space network addressing the proposed development.
3. Wetlands 866, 867 and 861 area linked to form a continuous wetland system. These links have been provided adjacent to Belmont Oval and via an underpass of the John Darling Spur.
4. Access to the site is from two main points. As in Strategies 1 and 2, along Livingstone Street and also an access point to the southern area via Gen Street and Railway Parade. Two additional access points are proposed off the bypass.
5. The railway platforms at Belmont and Jewells Crossing are preserved as historic features. Sites of archaeological potential along the northern edge of Belmont Lagoon and the area off the western side of the Kalaroo 'Loop' near Railway Crescent (BSAS-1) are also preserved.
6. A commercial centre is located on the eastern edge of the site, providing a focus for the main urban precincts.

6.3.3.1 Commentary

The chain of WPCPs and open space provides a continuous habitat link through the middle of the site which would further be enhanced if the bypass reservation were left undeveloped. However the isolation of the WPCPs and the open space from the wetland area may contribute to fragmented habitats.

Future development of the bypass would remove a significant amount of wetland 867 as discussed above in Strategy 1. The southern access to the site via Gen Street/Railway Parade would also have a significant impact on this wetland as does the enlarged areas of urban potential defined by this option. The proposed urban areas also constrict the corridor between wetland 866 and 867.

This option provides the maximum access and capacity of roads from the development to the primary road network. The two access roads via Gen Street/Railway Parade and the bypass towards the south would both be catering for similar traffic and therefore it is likely that only one of these access points would be required to achieve a good level of service in the south of the development. Gen Street has the advantage of having an existing intersection with the Pacific Highway. An intersection with the bypass north east of the lagoon would be advantageous as traffic from the south could get off the bypass at the earliest point to access the development's local road network. Access off the bypass in the north would also be required as there is no direct access road between the development and the existing local road network.

Although this option avoids direct impact on the significant archaeological areas on the site, there is considerable indirect impact and loss of context, mainly caused by the proximity of the bypass and adjacent road developments, particularly in relation to the railway corridor and BSAS-1.

6.3.4 Strategy 4

Figure 39 shows the key features of Strategy 4. These are summarised below:

1. Both the railway corridor and the Belmont Bypass are excluded from this option.
2. A system of WPCPs is provided along the central eastern portion of the site providing an open space and water feature for adjoining urban areas.
3. Four links with existing development are established via Gen Street and Railway Parade in the South; Livingstone Street in the central area; Master Street in the north west and Wommara Avenue in the north.
4. All three SEPP 14 wetlands are linked near Belmont Oval and under the John Darling spur line, however, access roads cross the wetland system at various points.
5. A central recreation 'square' is provided adjacent to the commercial precinct on the eastern edge.
6. Aboriginal archaeological and historical features, including Belmont and Jewells Platforms and the sites of archaeological potential are preserved.

6.3.4.1 Commentary

This strategy provides maximum capacity and access without the bypass via the for proposed access roads. However three of the access roads will provide major disruption to the wetlands. This, in turn, would create short and long term disruption to fauna movement, removal of habitat, siltation and disruption to hydrology. Changes to the alignment of the roads would be required.

The proposed urban area beside the central access road removes some *M.linearifolia* wetland and narrows the corridor significantly. With the railway corridor removed, there is a significant detrimental effect on the historical features along it.

This option also presents the highest potential flood hazard, although the actual location of WPCPs within the urban areas is a advantage.

6.3.5 Strategy 5 - No development

While not a formal strategy, a fifth option for the site is to leave it in it's present state and not develop. This would alleviate any problems associated with traffic impacts and development pressures on the natural resources on the site, however there are also issues to be addressed in the no development option.

Currently, the wetland system is in relatively poor condition. This is likely to be due to high nutrient levels partly as a result of untreated runoff from existing urban areas. The site is also extensively used for (illegal) dumping of rubbish and motor vehicles. This is likely to continue along with the areas use by 4WD vehicles. All of these

contribute to the degrading of the site and lead to potentially negative impacts on the areas considerable environmental assets.

It is unrealistic to fence the site and public liability issues are likely to be of concern should unsafe and illegal activities continue on the site.

While the option to leave the site in it's present state is a valid one, it is not one likely to achieve the best outcome for the extensive environmental assets on the site.

6.4 CONCLUSION

While these options have been designed to optimise the use of the site while maintaining the environmental integrity of the area, the discussion above highlights that there are advantages and disadvantages with each. To develop a "preferred strategy" these options were further analysed to determine which one (or combination) was the most feasible. Table 28 provides an outline of that analysis on the basis of the development principles.

Based on this analysis and the commentary above a suggested strategy has been devised for the Belmont-Redhead site. Section 7 discusses the details of this strategy and Figure 40 shows the strategy graphically.

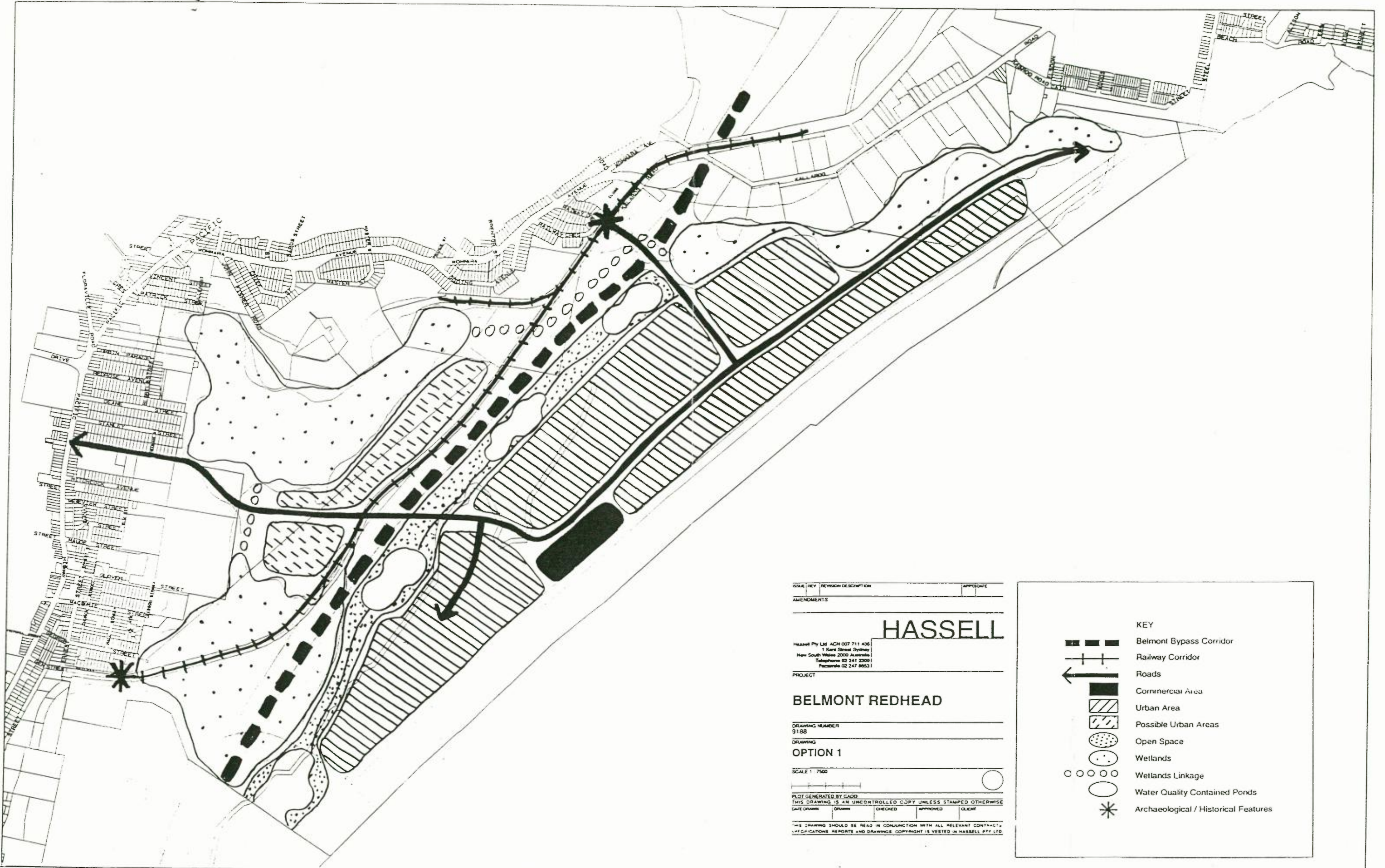
Table 28 Options analysis

Development principle/criteria	Option 1	Option 2	Option 3	Option 4
<i>Does the option.....</i>				
<i>maximise opportunities of....</i>				
wetlands	3	4	2	1
historical features	4	4	3	2
coastal landscape	4	4	4	4
<i>retain, protect and/or use significant aspects such as....</i>				
wildlife corridors	3	3	2	2
significant vegetation	3	3	2	2
wetlands	2	4	2	1
railway corridor	5	5	2	1
BSAS 1 & arch sensitive area	2	3	3	4
Kallaroo Rd arch. sensitive area	4	4	4	4
Belmont Lagoon arch. sensitive area	4	4	3	4
Redhead arch. sensitive area	5	4	5	5
<i>encourage public access through....</i>				
road & cycle links	5	4	5	3
beach access	4	4	2	4
<i>minimise impact of the development by....</i>				
reduction of flood hazard	4	4	4	0
adequately treating runoff	4	5	4	4
providing detention storage as open space	0	0	0	0
locating WPCPs off line	1	1	1	1
Total score	57	60	48	42

Score key:

0 - meets criteria to the least extent

5 - meets criteria to the greatest extent



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AMENDMENTS		

HASSELL

Hassell Pty Ltd ACN 007 711 436
 1 Kent Street Sydney
 New South Wales 2000 Australia
 Telephone 02 241 2200
 Facsimile 02 247 8853

PROJECT

BELMONT REDHEAD

DRAWING NUMBER
9188

DRAWING

OPTION 1

SCALE 1:7500

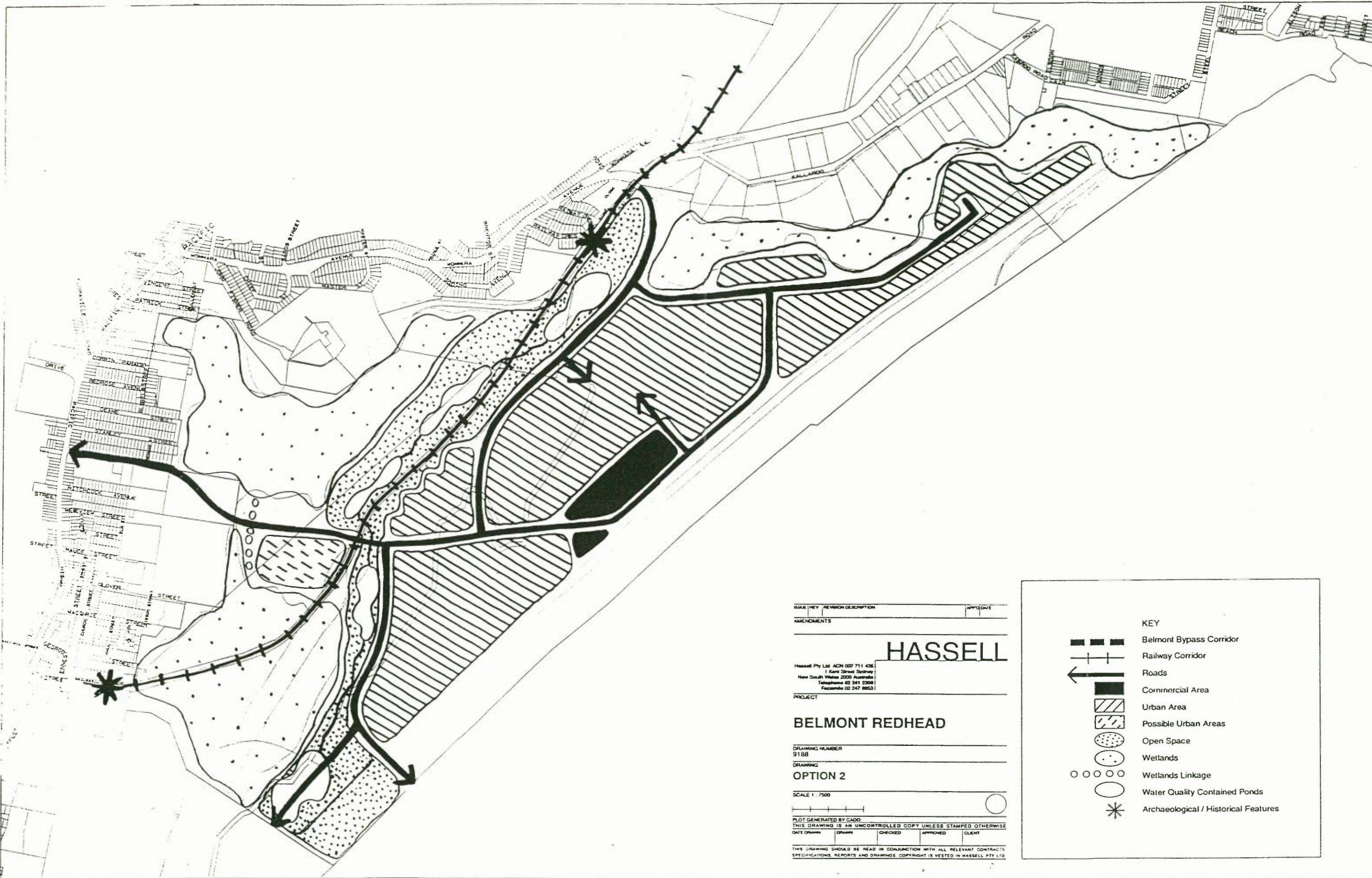
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KEY

- Belmont Bypass Corridor
- Railway Corridor
- Roads
- Commercial Area
- Urban Area
- Possible Urban Areas
- Open Space
- Wetlands
- Wetlands Linkage
- Water Quality Contained Ponds
- Archaeological / Historical Features



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BELMONT REDHEAD

DRAWING NUMBER
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DRAWING
OPTION 2

SCALE 1:7500

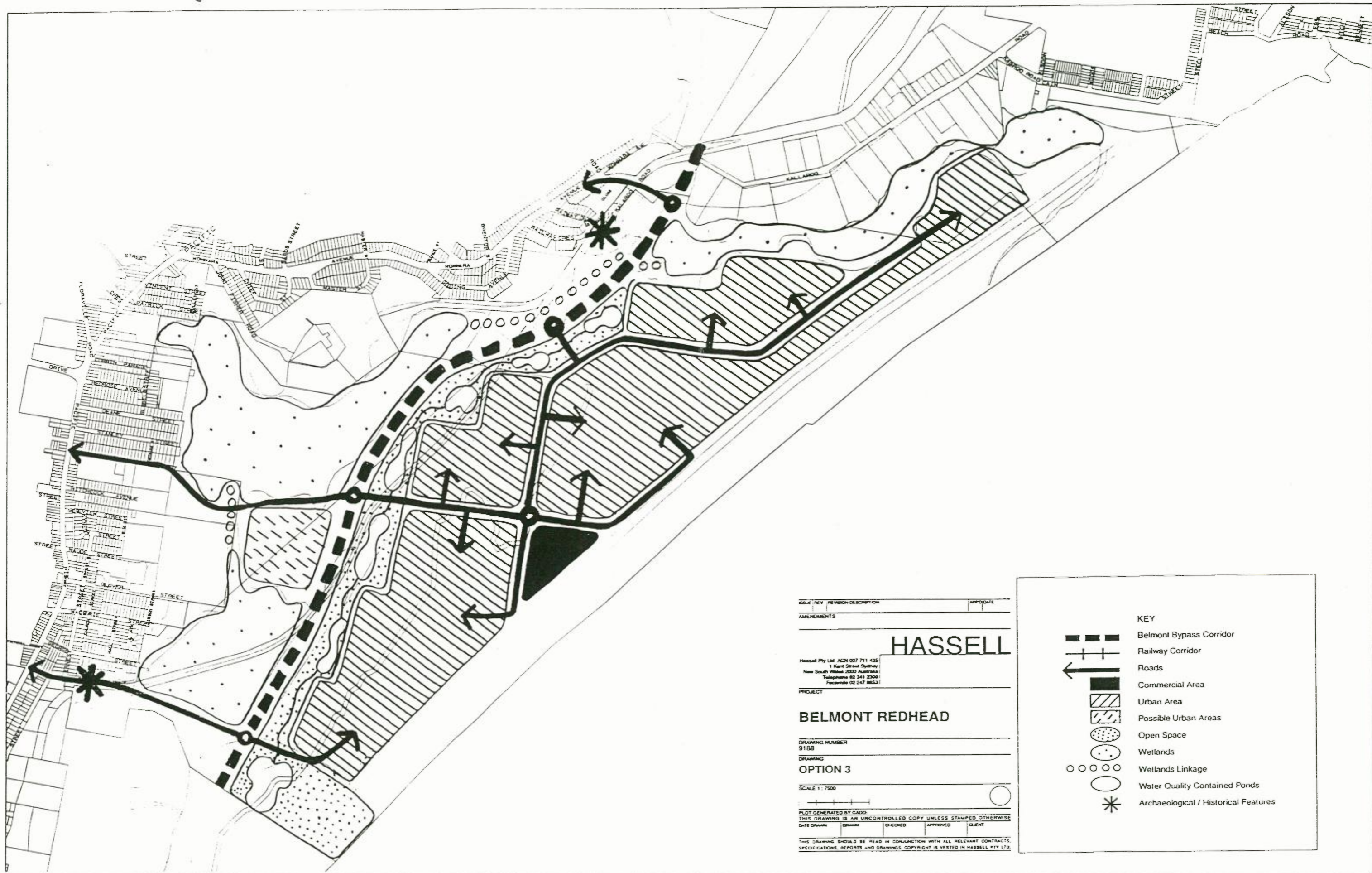
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KEY

- Belmont Bypass Corridor
- Railway Corridor
- Roads
- Commercial Area
- Urban Area
- Possible Urban Areas
- Open Space
- Wetlands
- Wetlands Linkage
- Water Quality Contained Ponds
- Archaeological / Historical Features



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OPTION 3

SCALE 1:7500

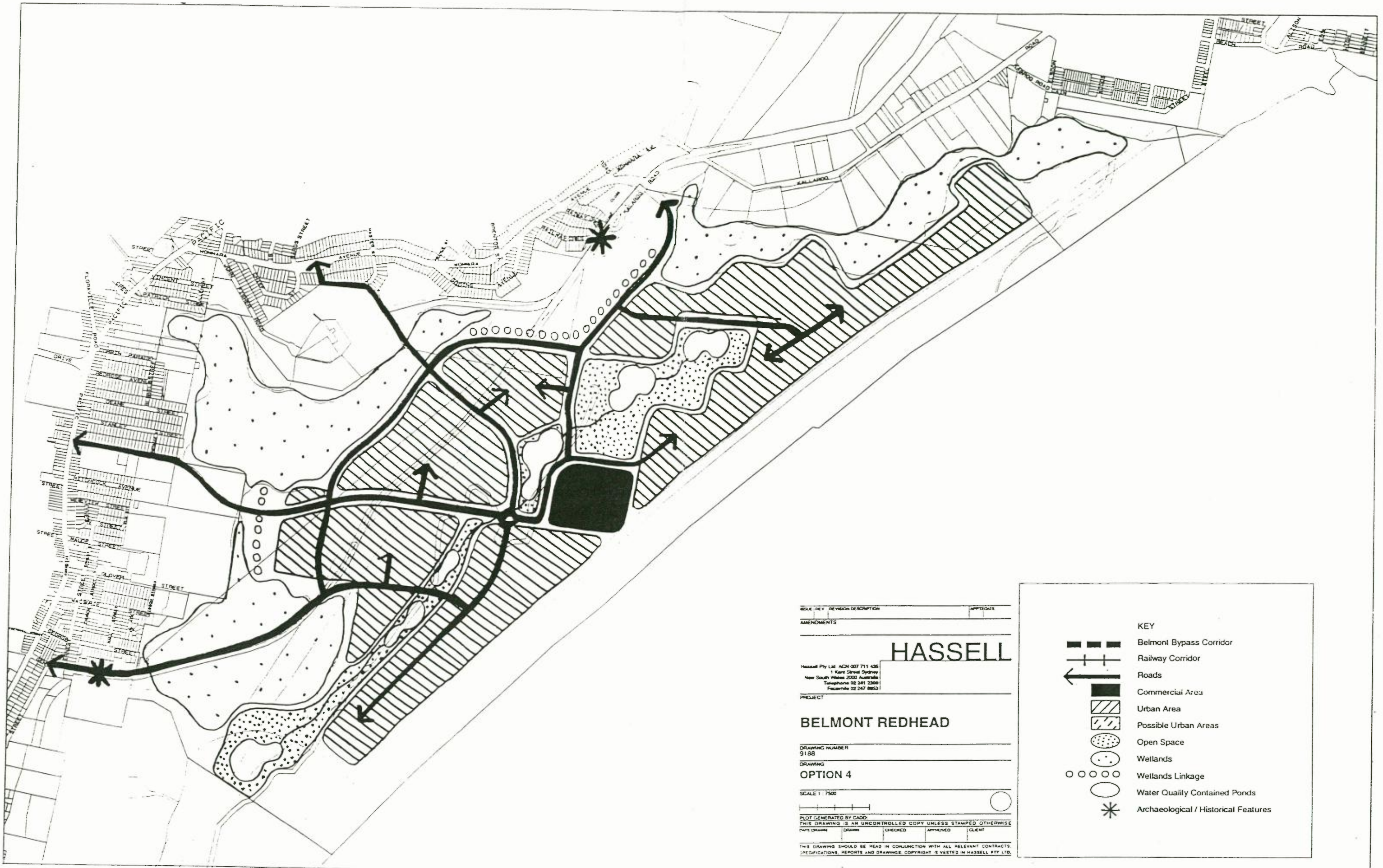
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KEY

- Belmont Bypass Corridor
- Railway Corridor
- Roads
- Commercial Area
- Urban Area
- Possible Urban Areas
- Open Space
- Wetlands
- Wetlands Linkage
- Water Quality Contained Ponds
- Archaeological / Historical Features



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DRAWING NUMBER
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DRAWING
OPTION 4

SCALE 1:7500

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KEY

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- Railway Corridor
- Roads
- Commercial Area
- Urban Area
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- Open Space
- Wetlands
- Wetlands Linkage
- Water Quality Contained Ponds
- Archaeological / Historical Features

CONCLUSIONS AND RECOMMENDATIONS

This section outlines the conclusion reached by the study team in relation to the suitability of the site for development. Also included is a suggested planning strategy, objectives and recommendations for the development of the site.

7.1 CONCLUSIONS

7.1.1 Development potential

Based on the investigations carried out as part of this study, it is considered that urban development could be achieved on the Belmont-Redhead site. However, as the site is extremely sensitive in some areas, any urban development on the site should be restricted to locations which will not impact on those sensitive areas.

Given the Belmont-Redhead site's significance, special attributes and coastal location it offers a unique opportunity in the Belmont area and potentially the Hunter, to create an urban area which is environmentally sustainable and which optimises its special characteristics. In order to achieve this, it is recommended that the planning framework in the following section be used as a guide to development on the site.

7.1.2 Planning framework

While it is not within the consultant's brief to prepare planning documentation, it is suggested that a planning framework be devised which is able to effectively manage the development of the site. This framework would ideally include a local environmental plan (LEP), development control plan (DCP) and design guidelines.

It is recommended that any LEP prepared for the site be flexible enough to allow a variety of development to occur, including residential, tourist facilities, recreation facilities, and commercial developments such as neighbourhood shops and cafes. It is difficult to comment at this stage what form the ultimate development will take, however it is important that Council set objectives for development on the site and develop (where possible) performance standards to be met before development proceeds. The development principles outlined in Section 6.2 could be adapted and expanded to become objectives, and performance measures developed to support them. The existing provisions in the Lake Macquarie LEP 1984 do not provide sufficient flexibility to enable this framework to be developed.

To support the LEP which affects the zoning of the site, a DCP should be prepared. The DCP would encompass urban development principles which would encourage good quality development and ensure that development is in keeping with the special qualities of the site. Issues which should be addressed in the DCP include:

- the relationship of the development with the dunes, the coastal landscape and the ocean;
- providing access to the beach areas without negatively impacting on the fragile environment;

- developing a “sense of community” through the arrangement of components of urban development, such as the street geometry, access to community and commercial facilities and to open space networks;
- landscape design issues;
- access to public transport, particularly the development of a road system which can accommodate public transport; and
- developing the character of the development - for example as a “beach village”.

In addition, and where possible, the DCP should address the preservation, management and maintenance of other areas on the site such as the wetlands, dune areas, and if applicable any interpretative centre and associated infrastructure.

Depending on the level of detail covered by the DCP, it is suggested that design guidelines could provide another layer of design detail which would cover specific issues such as site planning, efficiency of the development in terms of street layout and energy efficiency, privacy and public safety, street character, and other site planning principles which create better living environments such as gardens, house layout and overshadowing.

Additional policies and/or plans of management could also be developed for special areas on the site such as the wetlands to ensure they are appropriately developed and managed as a whole system ie including the Jewell’s wetlands and Belmont Lagoon.

7.2 SUGGESTED PLANNING STRATEGY

The recommended planning strategy, shown in Figure 40 is indicative of the development potential of the site, based on the outcomes of the investigations carried out as part of the study, the development principles set out in Section 6 and the review of the strategies.

The key features of the recommended strategy are as follows:

1. Wetlands 866, 867 and 861 are linked to form a continuous wetland system which will provide habitat for flora and fauna on the site and around the area.
2. An area of approximately 150ha has urban potential for development, however the final area will be dependant on detailed design. Based on an occupancy rate of 3, this would support a population of around 6750 (15 lots/ha). However, there is also scope within this area for development of a small scale tourist development such as an “eco-tourist” village or boutique hotel development. It is important to ensure that any tourist infrastructure planned is sustainable and does not impact negatively on associated residential development or the natural environment.
3. The main dune along the beach front is protected by an area of around 200m which also provides a wildlife corridor. A walking track can be included along the beach with tracks leading to the crest of the dune in certain areas to provide views of the beach and ocean and the surrounding area. Limited access to the beach should be provided through fenced breaks in the dune which are of sufficient size

to allow access but small enough not to impact on the stabilisation of the dune system.

4. Access to the development is via three entry points:
 - south, running along the alignment of the proposed Belmont Bypass;
 - north, via Wommara Avenue; and
 - centrally in the vicinity of Merleview Street.
5. Provision is made for a bypass of the Pacific Highway through the site should one be required in the future, however it would take the form of a "high street" rather than a freeway-type link.
6. Water pollution control ponds are provided in three locations on the site, separate to the SEPP 14 Wetlands to ensure that runoff is properly treated prior to discharge into the designated wetlands. These areas, which include provision for detention storage, total around 10ha.
7. Pedestrian and cycle access is provided along all roads connecting the development with existing settlements on the fringe of the site. A major cycleway is located along the disused railway line linking the historic features. Internal cycle and pedestrian networks are also provided.
8. An interpretive centre is suggested on site to provide a landmark on entrance to the site and information about the wetlands and the other cultural and natural features of the site. A series of boardwalks could be located throughout the wetlands, and viewing platforms are located along the dune regeneration area to provide views into and information about the wetland areas.
9. A "village green" could be provided in the area to create a focus point on the way through the development to the beach and to create an interactive open space area.

7.3 RECOMMENDATIONS

The following recommendations are made with respect to the Belmont-Redhead site. They do not relate specifically to the suggested planning strategy, but generally apply whether or not the recommended strategy is adopted.

7.3.1 Geotechnical considerations

1. Combustible fill from the John Darling Colliery site should be removed and replaced with compacted sand or other fill material to a suitable level if residential/commercial development is proposed. It is recommended that a "compacted earth" raft should be provided to seal the fill site and that this area be used for recreation purposes only.
2. Radioactivity levels in areas proposed for residential use should be tested at the detailed design stage.

3. If the site is left undeveloped, further dispersal of tailings containing monazite from under Slab 2 (refer Figure 35) should be prevented. This can be achieved by raising ground level around the exposed southern edges or by sealing the edges with a stabilising coating.
4. If development is to proceed for residential or other purposes where the occupancy level would exceed several hours per week it is recommended that tailings containing monazite be removed and disposed of at an active beach sand processing site.
5. A buffer zone should be provided around the John Darling Colliery shafts.

7.3.2 Wetlands and vegetation

1. Orthophotomaps illustrating extensions to the SEPP 14 wetlands should be submitted to the Department of Urban Affairs and Planning (Newcastle Office) to assist in their current review.
2. To encourage a better understanding and appreciation of the wetland values, interpretive walks through and beside the wetlands should be established. Shortlands Wetlands Centre should be consulted for advice on establishing this type of facility.
3. Existing problems in the wetlands, particularly wetland 866, need attention. There is weed invasion by both aquatic and terrestrial plant species and stormwater pollution. The implementation of water pollution control ponds at drain entrances should be considered and weed control programs implemented.
4. Runoff into the wetlands from existing urban areas needs to be addressed and a management plan implemented to ensure that further uncontrolled runoff does not occur.
5. Bitou bush and four wheel drive tracks should be removed. The area west of the railway line should be replanted to encourage and facilitate regeneration. NSW Agriculture should be consulted for information on bitou bush control programs.
6. Parrot's feather should be managed in the reedland open water. Biological control of this species elsewhere in the community should be assessed prior to determining management options.

7.3.3 Water quality

1. Water pollution control ponds should be located offline to increase their effectiveness and efficiency. Where these are located within 40 metres of a natural wetland, an environmental impact statement will be required for their development.
2. Alternative ways of discharging effluent should be investigated, such as recycling for irrigation and/or dual water supply for residential use and allowing infiltration for groundwater recharge.

3. The integration of the system of water pollution control ponds with the Belmont Lagoon system should be investigated.

7.3.4 Coastal/dune issues

1. An area of at least 160m (preferably 200m) measured from the high water mark should be reserved along the coastline to ensure protection from beach erosion.
2. Pedestrian access to the beach should be prohibited in the vicinity of the Third Creek channel.
3. Frontal dunes should be rehabilitated with intensified planting and four-wheel drive access to the beach should be limited to areas outside the site.
4. Walking tracks should be provided from the urban areas behind the dunes to allow improved public access to the beach. These tracks should be at regular intervals and located in areas where there is already disturbance of dune vegetation.
5. A walking track along the beach with restricted access to the crest of the frontal dune should be considered. It would provide excellent views of both the ocean and beach. Where the track accesses the crest of the dune, strategies such as laying sleepers across the track, providing windbreaks and winding the track should be implemented to prevent wind erosion.
6. All tracks through and along the dunes should be fenced to prevent incursion by visitors into the vegetation.

7.3.5 Flora and fauna

1. At least part of the dune area west of the railway line should be retained to provide a juxtaposition of habitat between it and the wetland and maintain a corridor for fauna movement.
2. Passive recreation should be provided in this area with walking tracks and platforms for views over the wetlands. Interpretative signage could be incorporated.
3. Large grassed areas should be avoided within the development as they not only restrict habitat corridors but also encourage aggressive bird species such as the Indian myna and silver gull. Proper design and maintenance of litter control is also important in reducing the proliferation of pest species.
4. Where any development is likely to impact on habitat of endangered (Schedule 12) species, a fauna impact statement will be required.

7.3.6 Transport

1. Consideration should be given to the extension of the local bus service into any residential development on this site. Where possible, bus stops should be within reasonable (400m) distance from residential areas and located in commercial and school precincts.
2. Roads should be designed to allow bus services to use them where appropriate, including bus standing bays and adequate turning areas.
3. Road connections from the site to major arterial roads or the Pacific Highway should be signalised or treated to ensure safe and easy access to the site from both the north and south.
4. Cycleway and pedestrian access should be encouraged along the disused railway line. Cycle access should link any proposed development with the centres of Belmont, Redhead and Jewells as well as the beach, schools, shops and other neighbourhood facilities. Cycleway access could be provided on lower order streets in the development.

7.3.7 Aboriginal heritage

1. The recommendations of Bonhomme (1994a) should be implemented where necessary. These are:

- 1 For site 45-7-71, a consent to destroy be applied for with condition of prior collection of artefacts by the Bahtabah Local Aboriginal Land Council.
- 2 A consent to destroy be applied for the portion of 45-7-130 recorded within BHP lands. A Bahtabah representative should be on site to monitor and collect material.
- 3 Any earth moving activity along the wetland margins should be monitored by a member of the Bahtabah Local Aboriginal Community.
- 4 A NPWS consent to destroy be applied for over the scatters and isolated artefacts described in this report with condition that the Bahtabah Local Aboriginal Land Council as the opportunity to collect items of interest prior to destruction.
- 5 If human skeletal material is located during earth moving works all activity at the locations should cease and the Bahtabah Aboriginal Land Council and the NPWS should be contacted.
- 6 The Bahtabah Local Aboriginal Land Council be asked to participate in the development where it concerns sites and their protection, their interpretation or display of aspects of Aboriginal culture and history. The developer should discuss the possibility of the construction of a

keeping place for artefact (sic), if considered appropriate by the Bahtabah Land council, from the area." Bonhomme (1994a)

2. The sites referred to as BSAS-1 and BSAS-2 should be conserved. If disturbance is anticipated in the area of these sites, further investigation and assessment of the heritage value of these sites should be carried out.
3. An assessment of the archaeological resource in the areas shown on Figure 30 as being zones of archaeological potential should be carried out, if impact to these areas is anticipated.
4. Representatives of the Bahtabah Local Aboriginal Council should be involved in any decisions relating to the remaining Aboriginal archaeological resource of the Belmont-Redhead area.

7.3.8 European/Industrial heritage

1. The Redhead Coal Company Railway line and its associated features should be retained.
2. Comprehensive survey and recording of the Redhead Coal Company railway line should be carried out to determine the extent of remains prior to undertaking any development within the study area. This is particularly pertinent in the areas of the railway platforms. The extent of remains associated with Belmont sidings within the study area needs to be verified.
3. The recommendations for reuse identified in the *City of Lake Macquarie Heritage Study* are endorsed. The two railway lines have great potential for interpretation along a network of industrial heritage trails around Lake Macquarie or as a pedestrian/cycleway.
4. If it is not possible to retain the full length of the existing railway easements, sections of it, such as Belmont and Jewells Platforms, may be retained and interpreted for the public.
5. Any disturbance or removal of structures, features or deposits associated with either of the railway lines will require an extraction permit from the Heritage Branch, Department of Urban Affairs and Planning.
6. The sand mining structure (BSHS-3) may be removed. It does not require an excavation permit as it is not older than 50 years.

7.3.9 Engineering and other related issues

1. Floor levels of any development adjacent to wetland No 866 should be maintained above 4.4AHD to ensure it is above the 100 year flood level.
2. An integrated pollution control strategy for the site should be implemented, including sediment basins during construction, gross pollutant traps and water pollution control ponds or wetlands.

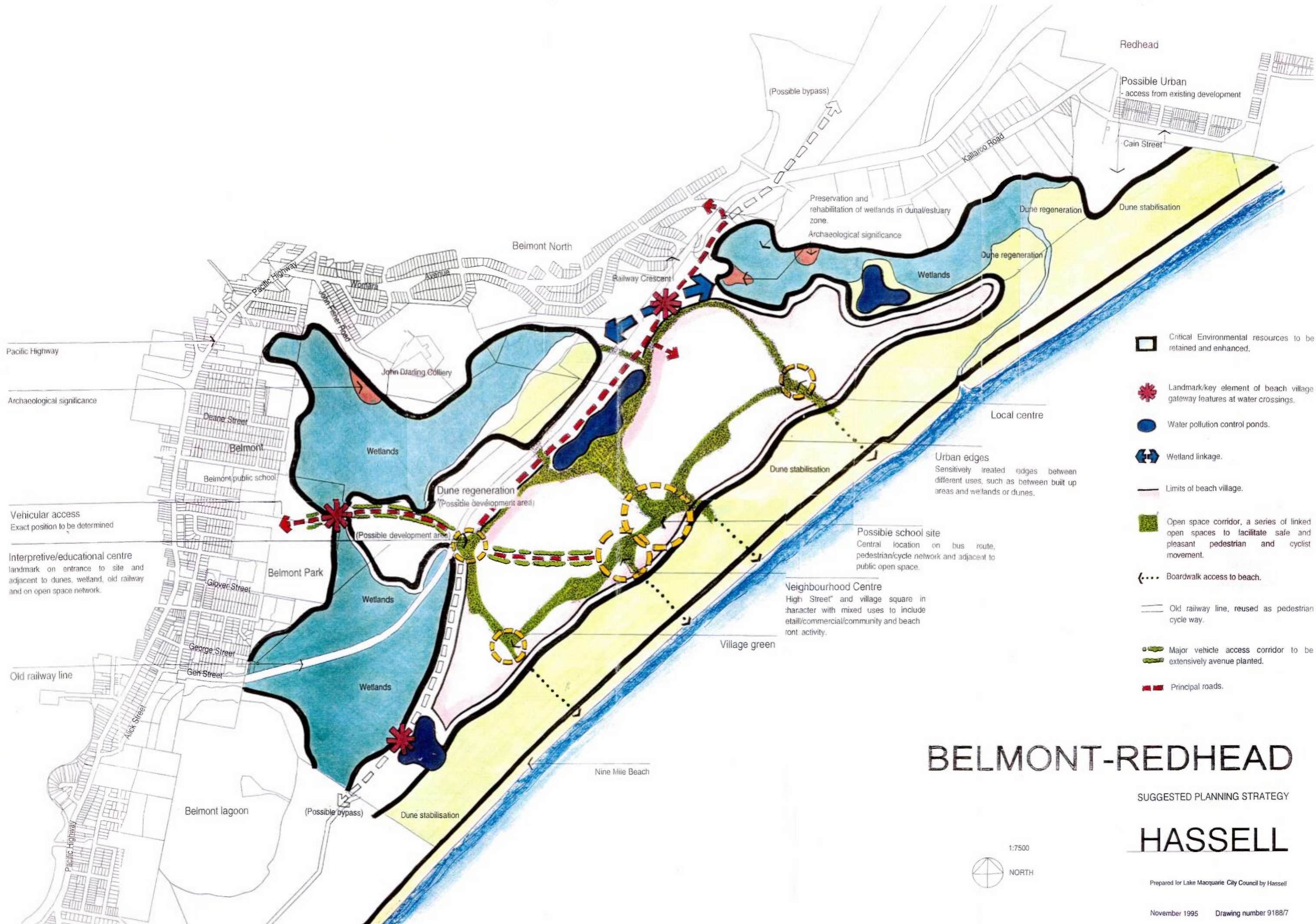
3. Residential development should not occur close to wetlands to ensure bushfire risk is minimised.

7.3.10 Land use considerations

1. Based on the preferred strategy, the developable areas could yield a potential population of around 6750. In this case, areas should be allocated to allow sufficient space for a school site(s) and at least 2ha of commercial/retail space for neighbourhood centres.
2. Any tourist development on the site should be small scale and in keeping with the character of the area ie. take into account its environmental sensitivity. Tourist development on the site should also be both ecologically and economically sustainable so as not to detract from surrounding development.

7.4 FURTHER ACTION

1. Testing for acid sulphate soils should be conducted at the development application stage to ensure appropriate conditions are placed on future development.
2. If the John Darling Colliery site is to be used for anything other than recreation, the matter of combustible fill needs to be fully addressed.
3. A bush regeneration program should be implemented by council, in conjunction with the local community and Landcare groups.
4. Any large scale and/or disruptive projects may require an EIS or FIS where they are likely to impact on endangered fauna, particularly the squirrel glider.
5. Service authorities such as Orion Electricity and AGL will need to be consulted regarding specific requirements for any future development.
6. A geotechnical survey would be required prior to development of any central access road to determine any geotechnical constraints.



Pacific Highway

Archaeological significance

Vehicular access
Exact position to be determined

Interpretive/educational centre
landmark on entrance to site and adjacent to dunes, wetland, old railway and on open space network.

Old railway line

- Critical Environmental resources to be retained and enhanced.
- Landmark/key element of beach village gateway features at water crossings.
- Water pollution control ponds.
- Wetland linkage.
- Limits of beach village.
- Open space corridor, a series of linked open spaces to facilitate safe and pleasant pedestrian and cyclist movement.
- Boardwalk access to beach.
- Old railway line, reused as pedestrian cycle way.
- Major vehicle access corridor to be extensively avenue planted.
- Principal roads.

BELMONT-REDHEAD

SUGGESTED PLANNING STRATEGY

HASSELL

1:7500
NORTH

Prepared for Lake Macquarie City Council by Hassell

November 1995 Drawing number 9188/7

8

ABBREVIATIONS

AADT	annual average daily traffic
AHD	Australian height datum
ARI	average recurrence interval
BHP	Broken Hill Proprietary
BSAS	Belmont site archaeological site
BSHS	Belmont site historical site
CBD	central business district
cm	centimetre
DCP	development control plan
EPA	NSW Environment Protection Authority
h	hour
ha	hectare
HWC	Hunter Water Corporation
kg	kilogram
km	kilometre
kW	kilowatt
LEP	local environmental plan
LMCC	Lake Macquarie City Council
m	metre
mg/L	milligrams per litre
mins	minutes
ML	mega litres
mm	millimetre
NH&MRC	National Health and Medical Research Council
NPWS	National Parks and Wildlife Service
°C	degrees centigrade
RL	reduced level
RAFTS	Rainfall Analysis and Flow Training Simulation Model
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
SEPP 14	State Environmental Planning Policy N° 14 (Coastal Wetlands)
TDS	total dissolved solids
TP	total phosphorus
USEPA	US Environmental Protection Agency
WHO	World Health Organisation
WPCP	water pollution control pond
yr	year

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Belmont - Redhead



Local Environmental Study

Appendices

Prepared for Lake Macquarie City Council

by

HASSELL

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APPENDICES

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- A Plant Species List
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- I Heritage Assessment Criteria for Aboriginal and Historic Sites
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APPENDIX A
PLANT SPECIES LIST

Appendix A - Plant Species List - Belmont-Redhead LES.

* - denotes introduced species

Scientific Name	Common Name
LYCOPSIDA - CLUB MOSSES	
SELAGINELLACEAE	
<i>Selaginella uliginosa</i>	-
FILICOPSIDA - FERNS	
BLECHNACEAE	
<i>Blechnum indicum</i>	Swamp Fern
DAVALLIACEAE	
<i>Nephrolepis cordifolia</i> *	Fishbone Fern
DENNSTAEDTIACEAE	
<i>Histiopteris incisa</i>	Batswing Fern
<i>Pteridium esculentum</i>	Bracken Fern
GLEICHENIACEAE	
<i>Gleichenia dicarpa</i>	Coral Fern
OSMUNDACEAE	
<i>Todea barbara</i>	King Fern
SINOPTERIDACEAE	
<i>Pellea falcata</i>	Sickle Fern
CONIFEROPSIDA- CONIFERS	
PINACEAE	
<i>Pinus radiata</i> *	Radiata Pine
MAGNOLIOPSIDA - FLOWERING PLANTS	
LILIIDAE - MONOCOTYLEDONS	
ANTHERICACEAE	
<i>Tricoryne simplex</i>	
ARACEAE	
<i>Livistona australis</i>	Cabbage-tree Palm
CYPERACEAE	
<i>Baumea juncea</i>	-
<i>B.rubiginosa</i>	
<i>B.articulata</i>	
<i>Cladium procerum</i>	Leafy Twig-rush
<i>Cyperus polystachos</i>	-
<i>Elaeocharis sphaceolata</i>	Tall Spike Rush
<i>Gahnia sieberiana</i>	Saw Sedge
<i>Isolepis rodosa</i>	
<i>Lepironia articulata</i>	

Scientific Name	Common Name
<i>Lepidosperma laterale</i>	Sword Sedge
<i>L.sp</i>	Rapier Sedge
<i>Schoenus apogon</i>	Common Bog-rush
IRIDACEAE	
<i>Patersonia sericea</i>	Silky Purple Flag
JUNCACEAE	
<i>Juncus contrnuus</i>	A Rush
<i>J.kraussii</i>	Sea Rush
<i>J.planifolius</i>	Broad-leaf Rush
JUNCAGINACEAE	
<i>Triglochin striata</i>	Streaked Arrow Grass
LEMNACEAE	
<i>Spirodella pusilla</i>	Duckweed
LOMANDRACEAE	
<i>Lomandra filiformis</i>	Iron Grass
<i>L.longifolia</i>	Spiky Mat-rush
PHILESIACEAE	
<i>Eustrephus latifolius</i>	Wombat Berry
PHORMIACEAE	
<i>Dianella caerulea</i>	paroo Lily
PHYLIDRACEAE	
<i>Phylidrum lanuginosum</i>	Wooly Frogmouth
POACEAE	
<i>Agrostis avenacea</i>	Blown Grass
<i>Ammophila arenaria *</i>	Marram Grass
<i>Chloris gayana*</i>	Rhodes Grass
<i>Cortaderia selloana *</i>	Pampas Grass
<i>Cynodon dactylon</i>	Couch
<i>Echinopogon caesipotus</i>	Tufted Hedgehog Grass
<i>Entolasia marginata</i>	Wiry Panic
<i>Eragrostis sp</i>	Love Grass
<i>Hemiarthria uncinata</i>	Mat Grass
<i>Hyparrhenia hirta *</i>	
<i>Imperata cylindrica</i>	Blady Grass
<i>Microlaena stipodes</i>	Weeping Grass
<i>Oplismenus aemulus</i>	-
<i>Paspalum dilatatum *</i>	Paspalum
<i>Phragmites australis</i>	Common Reed
<i>Themeda australis</i>	Kangaroo Grass
RESTIONACEAE	
<i>Empodisma minus</i>	Spreading Rope-rush
<i>Leptocarpus tenax</i>	Slender Twine-rush
<i>Restio tetraphyllus</i>	

Scientific Name	Common Name
SMILACACEAE <i>Smilax australis</i>	Bush Lawyer
TYPHACEAE <i>Typha orientalis</i>	Cumbungi
XYRIDACEAE <i>Xyris sp</i>	
MAGNOLIIDAE - DICOTYLEDONS	
AMARANTHACEAE <i>Alternanthera denticulata</i>	Lesser Joyweed
AIZOACEAE <i>Carpobrotus glaucascens</i>	Pigface
APIACEAE <i>Foeniculum vulgare</i> * <i>Hydrocotyle boniariensis</i> * <i>Platysace lanceolata</i> <i>Trachymene incisa</i>	Fennel Lance-leaf Platysace
ARALIACEAE <i>Polyscias sambucifolius</i>	Elderberry Panax
ASTERACEAE <i>Ageratina adenophora</i> * <i>Chrysanthemoides moniliferum</i> * <i>Senecio hispidula</i> <i>Taraxacum officinale</i> *	Crofton Weed Bitou Groundsel Dandelion
APOCYNACEAE <i>Parsonsia straminea</i>	Common Silkpod
ASCLEPIADACEAE <i>Araujia hortorum</i> *	Moth Plant
CAMPANULACEAE <i>Wahlenbergia gracilis</i>	Tall Bluebell
CASUARINACEAE <i>Casuarina glauca</i> <i>Allocasuarina littoralis</i>	Swamp Oak Black She-oak
CLUSIACEAE <i>Hypericum gramineum</i>	St John's Wort
COMMELINACEAE <i>Commelina cyanea</i>	Scurvy Weed
CONVULVULACEAE <i>Ipomoea cairica</i> * <i>I. indica</i> * <i>Polymeria calicina</i>	Morning Glory Swamp Bindweed

Scientific Name	Common Name
<i>Centella asiatica</i>	
DILLENIACEAE	
<i>Hibbertia dentata</i>	Trailing Guinea Flower A Guinea Flower
<i>H. obtusifolia</i>	
DROSERACEAE	
<i>Drosera peltata</i>	Sundew
EPACRIDACEAE	
<i>Astroloma pinifolium</i>	
<i>Brachyloma daphnoides</i>	
<i>Epacris pulchella</i>	
<i>Leucopogon juniperinus</i>	
<i>L. lanceolatus</i>	Bearded Heath
<i>Monotoca elliptica</i>	Lance Beard-heath
<i>M. scoparia</i>	Broom Heath
<i>Styphelia laeta</i>	Tree Broom Heath
EUPHORBIACEAE	
<i>Breynia oblongifolia</i>	
<i>Glochidion ferdinandi</i>	
<i>Omolanthus populifolius</i>	Cheese Tree
<i>Ricinocarpus pinifolius</i>	Bleeding Heart Wedding Bush
FABACEAE	
Sub-family Mimosoidea	
<i>Acacia binervata</i>	
<i>A. elongata</i>	Two-veined Hickory
<i>A. longifolia</i>	
<i>A. myrtifolia</i>	Sydney Golden Wattle
<i>A. terminalis</i>	Myrtle-leaved Wattle
<i>A. saligna</i> *	Sunshine Wattle
<i>A. ulicifolia</i>	Golden Wreath Wattle
Sub-family Faboidea	
<i>Bossiaea heterophylla</i>	Prickly Moses
<i>B. ensata</i>	Variable Bossiaea
<i>Daviesia genisitifolia</i>	Plank Plant
<i>Desmodium brachypodum</i>	
<i>Dillwynia retorta</i>	
<i>Erythrina x sykesii</i>	Eggs & Bacon
<i>Glycine clandestina</i>	Coral Tree
<i>Hardenbergia violacea</i>	Twining Glycine
<i>Mirbelia speciosa</i>	Purple Twining-pea
<i>Pultanaea flexilis</i>	
<i>Viminaria juncea</i>	Bush-pea
GOODENIACEAE	
<i>Goodenia ovata</i>	Golden Spray
HALORAGACEAE	
<i>Gonocarpus tetragynus</i>	Goodenia
<i>Myriophyllum aquaticum</i> *	Raspwort Parrots Feather

Scientific Name	Common Name
LAMIACEAE	
<i>Lycopus australis</i>	Gypsy Wort
LAURACEAE	
<i>Cassytha glabella</i>	Devil's twine
LOBELIACEAE	
<i>Lobelia alata</i>	-
<i>Pratia purpurescens</i>	White Root
MENISPERMACEAE	
<i>Stephania japonica</i>	Snake Vine
MYRTACEAE	
<i>Angophora costata</i>	Smooth-barked Apple
<i>A. floribunda</i>	Rough-barked Apple
<i>Callistemon citrinus</i>	
<i>Eucalyptus gummifera</i>	Red Bloodwood
<i>E. maculata</i>	Spotted Gum
<i>E. robusta</i>	Swamp Mahogany
<i>E. tereticornis</i>	Forest Red Gum
<i>Leptospermum juniperium</i>	Prickly Tea-tree
<i>L. laevigatum</i>	Coast Tea-tree
<i>L. polygalyfolium</i>	Yellow Tea-tree
<i>Melaleuca ericifolia</i>	Swamp Paperbark
<i>M. linariifolia</i>	Snow-in-summer
<i>M. quinquinervia</i>	Paperbark
<i>M. thymifolia</i>	Thyme Honey-myrtle
OLEACEAE	
<i>Ligustrum lucidum</i> *	Large-leaf Privet
<i>L. sinense</i> *	Small-leaf Privet
<i>Notolaea longifolia</i>	Mock Olive
ONAGRACEAE	
<i>Ludwigia peploides ssp montevidensis</i>	-
PASSIFLORACEAE	
<i>Passiflora edulis</i> *	Passionfruit
PHYTOLACCACEAE	
<i>Phytolacca octandra</i> *	Ink Weed
PITTOSPORACEAE	
<i>Pittosporum undulatum</i>	Sweet Pittosporum
POLYGALACEAE	
<i>Comesperma ericinum</i>	Matchheads
POLYGONACEAE	
<i>Persicaria strigosum</i>	Spotted knotweed
<i>P.sp</i>	Knotweed

Scientific Name	Common Name
PROTEACEAE	
<i>Banksia ericifolia</i>	Heath-leaved Banksia
<i>B.integrifolia</i>	Coast Banksia
<i>B.serrata</i>	Old Man Banksia
<i>Conospermum ellipticum</i>	Smoke-bush
<i>Persoonia levis</i>	Broad-leaved Geebung
<i>P.lanceolatus</i>	Lance-leaved Geebung
RANUNCULACEAE	
<i>Clematis aristata</i>	Travellers Joy
RUBIACEAE	
<i>Morinda jasminoides</i>	Morinda
<i>Opercularia aspera</i>	Stink-weed
<i>Pomax umbellata</i>	-
RUTACEAE	
<i>Boronia polygalifolia</i>	Milkwort Boronia
SANTALACEAE	
<i>Exocarpus cupressiformis</i>	Cherry Ballart
SAPINDACEAE	
<i>Cupaniopsis anacardioides</i>	Tuckeroo
<i>Dodonaea triquetra</i>	Hop Bush
STERCULIACEAE	
<i>Commersonia frasei</i>	Brush Kurrajong
<i>Lasiopetalum ferrugineum</i>	Rusty Petals
THYMELIACEAE	
<i>Pimelea linifolia</i>	Slender Rice-flower
VERBENACEAE	
<i>Lantana camara</i> *	Lantana
<i>Verbena boniariensis</i> *	Purple-top
VIOLACEAE	
<i>Viola hederacea</i>	-

APPENDIX B
FAUNA SPECIES LIST

Appendix B Fauna Species List, Belmont-Redhead LES.

Key: Habitat: O - reedland/open water; F-swamp sclerophyll forest; S-open heath/scrub regrowth

Status: A - Abundant
 C - Common
 M - Moderately common
 U - Uncommon
 E - Endangered - listed on Schedule 12 of the National Parks and Wildlife Act (1974)
 * - introduced

The status for birds is given for the site (S), region (R) (Blakers *et al.* 1984) and New South Wales (N) (Morris *et al.* 1981). The status for mammals is given for the site and for Australia (N) (Strahan 1991). No published data is available for reptile and frog status at regional or state levels. For these groups the site status only is given. Status categories are defined in **Appendix C**.

Scientific Name	Common Name	Habitat	Status		
			S	R	N
BIRDS					
<i>Podiceps novaehollandiae</i>	Australasian Grebe	O	U	M	A
<i>Phalacrocorax carbo</i>	Great Cormorant	O	C	C	C
<i>P. sulcirostris</i>	Little Black Cormorant	O	C	C	A
<i>P. melanoleucus</i>	Little Pied Cormorant	O	C	C	A
<i>Ardea novaehollandiae</i>	White-faced Heron	O	U	C	A
<i>Egretta intermedia</i>	Intermediate Egret	O	U	U	M
<i>Threskiornis aethiopica</i>	Sacred Ibis	O,S	M	M	A
<i>Platalea regia</i>	Royal Spoonbill	O	U	M	M
<i>Cygnus atratus</i>	Black Swan	O	C	M	C
<i>Chenonetta jubata</i>	Wood Duck	O	C	C	A
<i>Anas superciliosa</i>	Pacific Black Duck	O	M	C	A
<i>Haliastur sphenurus</i>	Whistling Kite	overhead	U	M	M
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle	"	U	M	U
<i>Hiareetus morphnoides</i>	Little Eagle	"	U	U	M
<i>Gallinula tenebrosa</i>	Dusky Moorhen	O	C	C	A
<i>Porphyrio porphrio</i>	Purple Swamphen	O	C	M	A
<i>Fulica atra</i>	Eurasian Coot	O	C	M	A
<i>Vanellus miles</i>	Masked lapwing	S	U	C	A
<i>Streptopelia chinensis</i> *	Spotted Turtledove	S	M	C	A
<i>Columbia livia</i> *	Feral Pigeon	S	U	C	A
<i>Ocyphaps lophotes</i>	Crested Pigeon	S	M	M	A
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	F	M	C	C
<i>Platycercus eximius</i>	Eastern Rosella	F	M	C	A
<i>Cuculus pyrrhophanus</i>	Fan-tailed Cuckoo	F	M	C	C
<i>Centropus phasianinus</i>	Pheasant Coucal	F	M	U	M
<i>Podargus strigoides</i>	Tawny Frogmouth	F/S	U	M	A
<i>Dacelo novaeguineae</i>	Kookaburra	F	U	C	A
<i>Eurostomus orientalis</i>	Dollarbird	F	U	C	M
<i>Hirundo neoxena</i>	Welcome Swallow	F,S	C	C	A
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	F,S	U	C	A
<i>Pachycephala rufiventris</i>	Rufous Whistler	F	C	C	A

Scientific Name	Common Name	Habitat	Status		
			S	R	N
<i>Rhipidura fuliginosa</i>	Grey Fantail	F	C	C	A
<i>R.leucophrys</i>	Willie Wagtail	F	U	C	A
<i>Psophodes olivaceus</i>	Eastern Whipbird	F,S	C	C	A
<i>Malurus cyanea</i>	Superb Blue Wren	F,S	C	C	A
<i>Sericornis frontalis</i>	White-browed Scrub-wren	F	M	C	A
<i>Acanthiza nana</i>	Yellow Thornbill	F	C	C	A
<i>Climacteris leucophaea</i>	White-throated Treecreeper	F	C	C	A
<i>Anthochaera chrysoptera</i>	Little Wattlebird	F,S	C	C	C
<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	F	C	C	A
<i>Philydonyris nigra</i>	White-cheeked Honeyeater	F,S	C	C	A
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	F	U	C	A
<i>Zosterops lateralis</i>	Silvereye	F,S	C	C	A
<i>Pardalotus punctatus</i>	Spotted Pardalote	F	U	C	A
<i>Embema temporalis</i>	Red-browed Firetail	F,S	C	C	A
<i>Oriolus sagittatus</i>	Olive-backed Oriole	F	U	C	C
<i>Gymnorhina tibicen</i>	Australian Magpie	S	C	C	A
<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	F/O	C	C	A
<i>Cracticus torquatus</i>	Grey Butcherbird	F	M	C	A
<i>Corvus coronoides</i>	Australian Raven	F/S	C	C	A

MAMMALS

<i>Parameles nasuta</i>	Long-nosed Bandicoot	F,S	C	-	C
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	F	C	-	C
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	F	C	-	C
<i>P.scapulatus</i>	Little Red Flying-fox	F	C	-	C
<i>Oryctolagus cuniculus</i> *	Rabbit	S	M	-	A
<i>Lepus capensis</i> *	European Hare	S	C	-	A
<i>Vulpes vulpes</i> *	Fox	F,S	C	-	A

REPTILES

<i>Lamprophilus delicata</i>	Grass Skink	F,S	M	-	-
<i>Eulamprus quoyii</i>	Eastern Water Skink	F	U	-	-
<i>Varanus varius</i>	Lace Monitor	S	M	-	-

FROGS

<i>Crinia signifera</i>	Eastern Common Froglet	F,O,S	C	-	-
<i>Uperoleia laevigata</i>	Keffersteins Frog	F,O	c	-	-
<i>Limnodynastes peronii</i>	Brown-striped Frog	F,O	C	-	-
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	O	C	-	-
<i>L.caerulea</i>	Green Tree Frog	F	C	-	-

APPENDIX C
FAUNA LIKELY TO OCCUR

Appendix C Fauna Likely to Occur, Belmont-Redhead LES.

* - denotes introduced species

L - species listed as "likely to occur"

E - schedule 12 species

Scientific Name	Common Name
BIRDS	
<i>Ardea ibis</i>	Cattle Egret
<i>A. alba</i>	Great Egret
<i>Rallus pectoralis</i>	Lewin's Rail
<i>Anhinga melanogaster</i>	Darter
<i>Elanus notatus</i>	Black-shouldered Kite
<i>Circus approximans</i>	Swamp Harrier
<i>Calyptorhynchus funereus</i>	Yellow-tailed Black Cockatoo
<i>Alisterus scapularis</i>	King Parrot
<i>Chrysococcyx lucidus</i>	Shining Bronze-cuckoo
<i>Cuculus variolosus</i>	Brush Cuckoo
<i>Eudynamys scolopacea</i>	Koel
<i>scythrops novaehollandiae</i>	Channel-billed Cuckoo
<i>Ceyx azurea</i>	Azure Kingfisher
<i>Halcyon sancta</i>	Sacred Kingfisher
<i>Hirundopus caudacutus</i>	White-throated Needletail
<i>Coracina tenuirostra</i>	Cicadabird
<i>Petroica rosea</i>	Rose Robin
<i>Eopsaltria australis</i>	Eastern Yellow Robin
<i>Pachycephala pectoralis</i>	Golden Whistler
<i>Colluricincla harmonica</i>	Grey Shrike-thrush
<i>Monarcha melanopsis</i>	Black-faced Monarch
<i>Rhipidura rufifrons</i>	Rufous Fantail
<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler
<i>Cisticola exilis</i>	Golden-headed Cisticola
<i>Malurus lamberti</i>	Variiegated Wren
<i>Stipiturus malachurus</i>	Southern Emu-wren
<i>Gerygone olivacea</i>	White-throated Warbler
<i>Acanthiza lineata</i>	Striated Thornbill
<i>A. pusilla</i>	Brown Thornbill
<i>Anthochaera carunculata</i>	Red Wattlebird
<i>Philemon corniculatus</i>	Noisy Friarbird
<i>Lichenostomus leucotis</i>	White-eared Honeyeater
<i>Melithreptus brevirostris</i>	White-naped Honeyeater
<i>Phylidonyis novaehollandiae</i>	New Holland Honeyeater
<i>poephila bichenovii</i>	Double-bar Finch
<i>Dicrurus hottentotus</i>	Spangled Drongo
<i>Sturnus vulgaris</i> *	Common Starling
<i>Acridotheres tristis</i> *	Common Mynah
<i>Ptilorhynchus violaceus</i>	Satin Bowerbird
<i>Grallina cyanoleuca</i>	Australian Magpie-lark
<i>Strepera graculina</i>	Pied Currawong
<i>Cracticus torquatus</i>	Grey Butcherbird
MAMMALS	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum
<i>Petaurus norfolcensis</i> (E)	Squirrel Glider
<i>Vespadelus vulturnus</i>	Little Forest Bat
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat
<i>Mormospterus sp</i>	A Freetail Bat
<i>Nyctophilus gouldi</i>	Gould's Long-eared Bat

Scientific Name	Common Name
MAMMALS (cont)	
<i>Scotorepens orion</i>	Eastern Broad-nosed Bat
<i>Scoteanax ruepelli</i> (E)	Greater Broad-nosed bat
<i>Miniopterus schreibersii</i> (E)	Common Bent-wing Bat
<i>M.australis</i> (E)	Little Bent-wing Bat
<i>Rattus lutreolus</i>	Swamp Rat
<i>R.rattus</i> *	Black Rat
<i>Pseudomys novaehollandiae</i>	New Holland Mouse
<i>Mus domesticus</i> *	House Mouse
<i>Canis familiaris</i> *	Dog
<i>Felis catus</i> *	Cat
REPTILES	
<i>Oedura lesueurii</i>	Lesueur's Gecko
<i>Phyllurus platyrus</i>	Southern Leaf-tailed Gecko
<i>Lialis burtonisi</i>	Burton's Legless Lizard
<i>Amphibolurus muricatus</i>	Jacky Lizard
<i>Cryptoblepharus virgatus</i>	Fence Skink
<i>Ctenotus robustus</i>	Striped Skink
<i>C.taeniolatus</i>	Copper-tailed Skink
<i>Egernia whitii</i>	White's Skink
<i>Eulepis platynota</i>	Red-throated Skink
<i>Lampropholis guichenoti</i>	Grass Skink
<i>Saiphos equalis</i>	Three-toed Skink
<i>Saproscincus mustelina</i>	Weasel Skink
<i>Tiliqua scincoides</i>	Blue-tongued Lizard
<i>Rhamphotyphlops nigrescens</i>	Blind Snake
<i>Dendrelaphis punctulata</i>	Green Tree Snake
<i>Cacophis squamulosus</i>	Golden-crowned Snake
<i>Hemiaspis signata</i>	Marsh Snake
<i>Pseudechis porpyhriacus</i>	Red-bellied Black Snake
<i>Pseudonaja textilis</i>	Eastern Brown Snake
<i>Demansia psammophis</i>	Yellow-faced Whip Snake
FROGS	
<i>Limnodynasetes tasmanienis</i>	Spotted Marsh Frog
<i>L.dumerilli</i>	Pobblebonk
<i>L.ornatus</i>	Ornate Burrowing Frog
<i>Pseudophryne coriacea</i>	Red-backed Toadlet
<i>Litoria dentata</i>	Bleating Tree Frog
<i>L.latopalmata</i>	Broad-palmed Frog
<i>L.leseurii</i>	Lesueur's Frog
<i>L.peroni</i>	Perons Tree Frog
<i>L.verreauxii</i>	Bleating Tree Frog

APPENDIX D

FAUNA STATUS CATEGORY DEFINITIONS

Appendix D - Fauna Status Category Definitions

1. Birds

Site Status - based on survey results.

Common - the species or indirect evidence of the species commonly encountered (>10 occasions)

Moderately Common - the species or indirect evidence of the species encountered on 2-10 occasions

Uncommon - the species or indirect evidence of the species only encountered once.

Regional Status - based on Blakers *et al.* (1985) reporting rate for the 1^o block whose north-west corner is 33°S 151°E. The reporting rate is the percentage of record sheets in the Field Atlas on which a given species was recorded.

Common - reporting rate >40%

Moderately Common - reporting rate 11%-40%

Uncommon - reporting rate <11%

NSW Status - based on Morris *et al.* (1981) where the status is given according to an estimate of the maximum NSW population in any given year.

Abundant: > 1 000 000

Common: 100 000 - 1 000 000

Moderately Common: 10 000 - 100 000

Uncommon: 1000 - 10 000

Scarce: 100 - 1000

Rare: <100

2. Mammals

Site Status - based on survey results.

Common - the species or indirect evidence of the species commonly encountered (>10 occasions)

Moderately Common - the species or indirect evidence of the species encountered on 2-10 occasions

Uncommon - the species or indirect evidence of the species only encountered once

Regional Status - information not available for most species.

NSW Status - information not available for most species.

Australian Status - based on Strahan (1983). Status categories not defined.

3. Reptiles and Frogs

Site Status - based on survey results.

Common - the species or indirect evidence of the species commonly encountered (>10 occasions)

Moderately Common -the species or indirect evidence of the species encountered on 2-10 occasions

Uncommon -the species or indirect evidence of the species only encountered once

Regional Status - information not available.

NSW Status - information not available.

APPENDIX E

WATER POLLUTION CONTROL PONDS: CALCULATIONS

Water Pollution Control Ponds: Calculations

Annual Runoff											
Existing Landuse											Total
Effective annual runoff coefficient (after AR&R 1987)											0.26
Average Annual Rainfall (mm)											1100
Subcatchment No.	1	2	3	4	5	6	7	8	9	10	
Subcatchment Area (m2)	171673	179031	234212	469037	518700	382587	437768	27590	78724	47823	
Annual Runoff (ML)	49.10	51.20	66.98	134.14	148.35	109.42	125.20	7.89	22.52	13.68	728.48
Proposed Landuse											
Effective annual runoff coefficient (after AR&R 1987)											0.65
Average Annual Rainfall (mm)											1100
Subcatchment No.	1	2	3	4	5	6	7	8	9	10	
Subcatchment Area (m2)	171673	179031	234212	469037	518700	382587	437768	27590	78724	47823	
Annual Runoff (ML)	122.75	128.01	167.46	335.36	370.87	273.55	313.00	19.73	56.29	34.19	1821.21
Annual Total Phosphorus Load											
Existing Landuse											
Subcatchment No.	1	2	3	4	5	6	7	8	9	10	
Event Mean Concentration (mg/l):	0.22										
Annual Runoff (ML)	49.10	51.20	66.98	134.14	148.35	109.42	125.20	7.89	22.52	13.68	728.48
Annual TP Load (kg)	10.80	11.26	14.74	29.51	32.64	24.07	27.54	1.74	4.95	3.01	160.27
Proposed Landuse											
Event Mean Concentration (mg/l):	0.48										
Subcatchment No.	1	2	3	4	5	6	7	8	9	10	
Annual Runoff (ML)	122.75	128.01	167.46	335.36	370.87	273.55	313.00	19.73	56.29	34.19	1821.21
Annual TP Load (kg)	58.92	61.44	80.38	160.97	178.02	131.30	150.24	9.47	27.02	16.41	874.18
Water Pollution Control Pond Sizing											
% Reduction of TP required	82%	82%	82%	82%	82%	82%	82%	82%	82%	82%	
Retention time required (yrs)**	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Basin Volume Required (m3)	12275	12801	16746	33536	37087	27355	31300	1973	5629	3419	182120.87
Surface Area (m2)	7220.4	7529.8	9850.7	19727.1	21815.9	16091.2	18412.0	1160.4	3311.0	2011.4	107129.92
** Determined using the Lawrence Curves (1986)											

APPENDIX F
HISTORIC SITES INVENTORY SHEETS

BELMONT SANDS SURVEY 1995

Name: Redhead Coal Company Railway		Site Number: BSHS-1	
Type of Item: rail line and associated structures		Date: 20/3/1995	
Location: Parallel to Kalaroo Road then in the south across the swamp to Belmont Station near Railway Pde. Grid Ref: E377200/N6345480 to E374900/N6343400		Recorder: MTC, AL	
Description: Remnant rail line between Adamstown and Belmont. Rails have been removed. Sections with intact sleepers. Remains of platforms at Jewells and Belmont. Section of the rail line that runs parallel to the roadway has been destroyed by bulldozing. Visibility is poor in some areas.			
History/Comments: Permission to extend the Redhead Coal company's line for passenger services from Burwood Extended Mine to Belmont was granted in 1914. Work was completed by October 1916. Platforms were erected at Redhead, Jewells Swamp and Belmont. This section of line was opened on the 23rd December 1916. Passenger services operated six times daily. Jewells swamp was renamed Jewells in 1923 and the location of the platform appears to have been moved in 1925. The Belmont Colliery siding was opened in 1926, and the Wallarah Colliery siding opened in 1941. Passenger services finished in 1971.			
Date: 1916-1980s			
Themes: coal mining, transportation, major industry			
Assessment of Cultural Significance:			
Historic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Archaeological Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Social Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Architectural Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Scientific Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Aesthetic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Other:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Statement of Cultural Significance: This branch line has historic and social significance for past, present and future generations. This railway provided a vital transport link for important coal mines along the line from 1916 to 1991 and the development by BHP of coal resources for its Newcastle steel industry. From 1916 to 1971 this line carried passengers to and from Belmont. Many of these passengers worked in the collieries located along the line and in Newcastle. It facilitated the development of permanent residences and tourism in the Belmont township and surrounding areas along the lake. This line in association with the various features along the line have the ability to illustrate local early twentieth-century coal and passenger services which were eventually superseded by the development of the popularity of the private car. This line, while elements of the original fabric have been removed, in association with the other relics of the Belmont Branch line illustrates the linkages between the development of coal mining and the surrounding townships, and the operation of a small scale twentieth-century railway line. This line and its associated features have considerable cultural significance.			
Extent of Impact: unknown			
Recommendations: retain and interpret for the public			
Heritage Listings/Planning Instruments:			
AHC <input type="checkbox"/>	NAT. TRUST <input type="checkbox"/>	HREP <input type="checkbox"/>	CLMLEP <input type="checkbox"/> CLMHS <input checked="" type="checkbox"/> OTHERS <input type="checkbox"/>
Informants:		Photographs:	
References: <i>Australian Railways Historical Society Bulletin</i> , 37, November 1940, p.48-49; No. 79, May 1944, p.58f.			

BELMONT SANDS SURVEY 1995

Name: Jewells Platform	Site Number: BSHS-1.1		
Type of Item: Railway platform	Date: 20/3/1995		
Location: Redhead Coal Company Railway Grid Ref: E377150/N6345400	Recorder: MTC, AL		
Description: The platform consisted of two concrete walls approximately 0.75m high running parallel to the line. The concrete walls were topped by an earthen platform. There were <i>in situ</i> sleepers to the east of the platform indicating the location of the railway. The railway embankment in this area was partially disturbed by the road that runs parallel to it. In some sections there was little evidence of an embankment. There were considerable remains of gravel that had spilled over onto the track.			
History/Comments: Jewells platform, originally called Jewell's Swamp, was erected for the John Darling Colliery miners in 1925 because it was closer to that colliery than the Belmont Station on the Redhead Coal Company Railway line. Provided a general passenger service. About 1940 the passenger usage of the line dropped because of the introduction of a local bus service. This is probably the second Jewells platform.			
Date: 1925-1971			
Themes: transportation, mining			
Assessment of Cultural Significance:			
Historic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Archaeological Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Social Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Architectural Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Scientific Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Aesthetic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Other:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Statement of Cultural Significance: This platform is part of the Redhead Coal Company Railway line. It provided a service for workers at John Darling Colliery from 1925 to 1971. The platform, the remnant sleepers and associated relics effectively illustrate the development of a local coal and passenger service. This platform is specifically linked with BHP's development of the John Darling Colliery.			
Extent of Impact: unknown Recommendations: Should be retained and interpreted as part of the railway.			
Heritage Listings/Planning Instruments: AHC <input type="checkbox"/> NAT. TRUST <input type="checkbox"/> HREP <input type="checkbox"/> CLMLEP <input type="checkbox"/> CLMHS <input type="checkbox"/> OTHERS <input type="checkbox"/>			
Informants:		Photographs:	
References:			

BELMONT SANDS SURVEY 1995

Name: Belmont Platform	Site Number: BSHS-1.2
Type of Item: Railway platform	Date: 20/3/1995
Location: south of Railway Street, Belmont Grid Ref: E375300/N6343400	Recorder: MTC, AL
Description: Evidence for the platform, embankment and another feature were identified. The remains of a small bridge consisted of four concrete footings. The approximate overall dimensions for the four footings were 4m x 1.6m x 1m high. The top of the concrete footings contained the profile cut of two rails. The platform embankment continued off to the west beyond this feature. It was overgrown with Nasturtiums and other exotic weeds. There were remains of steel rail frame for the platform building, some rail fencing. A number of sleepers were <i>in situ</i> indicating the location of the line.	
History/Comments: Permission to extend the Redhead Coal company's line for passenger services from Burwood Extended Mine to Belmont was granted in 1914. Work was completed by October 1916. Platforms were erected at Redhead, Jewells Swamp and Belmont. This section of line was opened on the 23rd December 1916. Passenger services operated six times daily. Passenger services finished in 1971.	
Date: 1916-1971	
Themes: transportation, mining	
Assessment of Cultural Significance:	
Historic Significance:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Archaeological Significance:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Social Significance:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Architectural Significance:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Scientific Significance:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Aesthetic Significance:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Other:	Rare <input type="checkbox"/> Representative <input type="checkbox"/> Group <input type="checkbox"/>
Statement of Cultural Significance: This platform is part of the Redhead Coal Company Railway line. It provided an important link in the settlement and urbanisation of Belmont.	
Extent of Impact: Recommendations:	
Heritage Listings/Planning Instruments: AHC <input type="checkbox"/> NAT. TRUST <input type="checkbox"/> HREP <input checked="" type="checkbox"/> CLMLEP <input type="checkbox"/> CLMHS <input type="checkbox"/> OTHERS <input type="checkbox"/>	
Informants:	Photographs:
References:	

BELMONT SANDS SURVEY 1995

Name: John Darling Colliery Railway Line	Site Number: BSHS-2				
Type of Item: railway line	Date: 20/3/1995				
Location: Grid Ref: E377000/N6345180 to E376400/N6345100	Recorder: MTC, AL				
Description: The John Darling Colliery railway line commences at the junction of the Redhead Coal Company railway. The remains of the line include a shallow embankment with gravel and the occasional sleeper with metal spikes. All rails have been removed. For much of its length only part of it is within the study area, a recent track runs next to it. It is generally overgrown by grass. The sleepers and the gravel are the clearest evidence for the old line of the railway.					
History/Comments: This branch line into the mine was built in 1925 when operations at the coal mine commenced. John Darling Coal Mine was the first coal mine owned by BHP. In 1920 BHP began to expand its Newcastle steel industry and was concerned to insure ample reserves of coking coal and therefore began its own mining. A series of geological surveys and coking tests lead to the establishment of the John Darling Colliery. By 1925 construction of the colliery commenced. Coal extraction ceased in 1987.					
Date: 1925-1980s.					
Themes: communication, transportation					
Assessment of Cultural Significance:					
Historic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Archaeological Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Social Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Architectural Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Scientific Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Aesthetic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Other:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>		
Statement of Cultural Significance: This line mainly provided coal haulage for coal trucks to BHP steel works at Newcastle. This railway was important in the development by BHP's own coal resources and the insurance of their supply to the Newcastle steel works. It has considerable cultural significance.					
Extent of Impact: unknown					
Recommendations:					
Heritage Listings/Planning Instruments:					
AHC <input type="checkbox"/>	NAT. TRUST <input type="checkbox"/>	HREP <input type="checkbox"/>	CLMLEP <input type="checkbox"/>	CLMHS <input checked="" type="checkbox"/>	OTHERS <input type="checkbox"/>
Informants:		Photographs:			
References: Fallins, Hilary . 1992;					

BELMONT SANDS SURVEY 1995

Name: Sand mining site	Site Number: BSHS-3																												
Type of Item: structure	Date: 20/3/1995																												
Location: Off Kallaroo Road Grid Ref: E377250/N6345350	Recorder: MTC, AL																												
Description: There were extensive concrete flooring sitting on sand. No remains of relics associated with sand mining.																													
History/Comments: This appears to have been a large sand mining operation in the area.																													
Date: post 1960																													
Themes: mining																													
Assessment of Cultural Significance: <table style="width: 100%; border: none;"> <tr> <td style="width: 33%;">Historic Significance:</td> <td style="width: 10%;">Rare <input type="checkbox"/></td> <td style="width: 10%;">Representative <input type="checkbox"/></td> <td style="width: 10%;">Group <input type="checkbox"/></td> </tr> <tr> <td>Archaeological Significance:</td> <td>Rare <input type="checkbox"/></td> <td>Representative <input type="checkbox"/></td> <td>Group <input type="checkbox"/></td> </tr> <tr> <td>Social Significance:</td> <td>Rare <input type="checkbox"/></td> <td>Representative <input type="checkbox"/></td> <td>Group <input type="checkbox"/></td> </tr> <tr> <td>Architectural Significance:</td> <td>Rare <input type="checkbox"/></td> <td>Representative <input type="checkbox"/></td> <td>Group <input type="checkbox"/></td> </tr> <tr> <td>Scientific Significance:</td> <td>Rare <input type="checkbox"/></td> <td>Representative <input type="checkbox"/></td> <td>Group <input type="checkbox"/></td> </tr> <tr> <td>Aesthetic Significance:</td> <td>Rare <input type="checkbox"/></td> <td>Representative <input type="checkbox"/></td> <td>Group <input type="checkbox"/></td> </tr> <tr> <td>Other:</td> <td>Rare <input type="checkbox"/></td> <td>Representative <input type="checkbox"/></td> <td>Group <input type="checkbox"/></td> </tr> </table>		Historic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>	Archaeological Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>	Social Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>	Architectural Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>	Scientific Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>	Aesthetic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>	Other:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>
Historic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Archaeological Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Social Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Architectural Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Scientific Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Aesthetic Significance:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Other:	Rare <input type="checkbox"/>	Representative <input type="checkbox"/>	Group <input type="checkbox"/>																										
Statement of Cultural Significance: This site was associated with sand mining on Nine Mile Beach. It has a low level of cultural significance.																													
Extent of Impact: unknown																													
Recommendations:																													
Heritage Listings/Planning Instruments: AHC <input type="checkbox"/> NAT. TRUST <input type="checkbox"/> HREP <input type="checkbox"/> CLMLEP <input type="checkbox"/> CLMHS <input type="checkbox"/> OTHERS <input type="checkbox"/>																													
Informants:	Photographs:																												
References:																													

APPENDIX G

COUNCIL OF LAKE MACQUARIE
HERITAGE STUDY
SITE INVENTORY CARDS

INVENTORY SUMMARY - LIST OF SITES & ITEMS

RAILWAYS & TRAMWAYS - RT

ITEM No.	DESCRIPTION and LOCATION	TYPE	SIGNIFICANCE
	RAILWAYS & TRAMWAYS - RT		S R L
RT-00	<p>RAILWAY and TRAMWAY CONSERVATION AREAS</p> <p>Belmont Railway & Toronto Railway both have the potential for reconstruction and future re-use as light-rail routes for the growing towns & villages along their routes. The still existing permanent way (minus rails) of other lines to Seaham & West Wallsend or Wangi etc. have potential for re-use as cycle paths and walking trails, for use by local people or tourists. Specific suggestions or recommendations are given for most of the railways listed under RT.</p>	c RT	V
RT-01	<p>WEST WALLSEND STEAM TRAM LINE</p> <p>Recommended that the easement be retained where it still exists, & consideration be given to the development of a cycleway along the route to West Wallsend.</p>	a RT	M H V
RT-02	<p>SPEERS POINT STEAM TRAM LINE</p> <p>Recommended that the tramway easement be retained wherever possible, and consideration be given to the development of a cycleway along the route to Speers Point.</p>	a RT	H V
RT-03	GREAT NORTHERN RAILWAY	w RT	H H V
RT-04	<p>BELMONT RAILWAY</p> <p>Recommended that the complete railway line be retained & restored, & consideration be given to development of a light rail service or (at the least) a cycleway along the permanent way.</p>	a RT	H V
RT-05	<p>BRANCH LINES FROM THE BELMONT RAILWAY</p> <p>Recommended that any remaining structures, including embankments & cuttings, be retained for interpretive purposes. The Dudley track might be used as part of a cycleway.</p>	a RT	M M
RT-06	<p>RASPBERRY GULLY LINE RAILWAY</p> <p>The site of South Waratah Colliery & the route of the former Gulley Line Railway could be interpreted & should be linked to Charlestown by means of signage and markers on a system of future industrial heritage trails.</p>	a RT	L H

INVENTORY SUMMARY - LIST OF SITES & ITEMS

NAME/IDENTITY: **BELMONT RAILWAY**

PREVIOUS/OTHER NAMES OR USES:

Adamstown to Belmont Railway, the New Redhead Estate & Coal Company Railway.

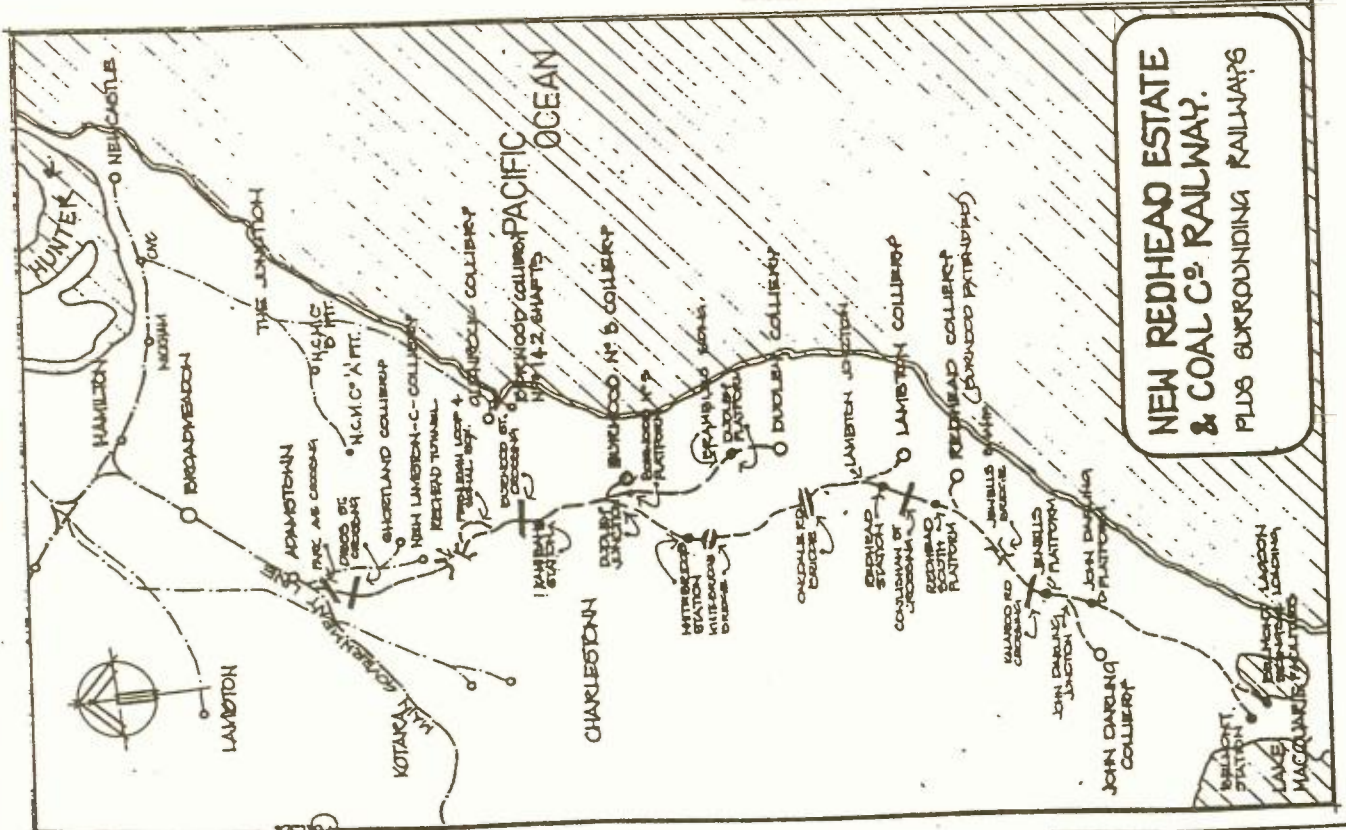
ADDRESS: n/a	S.H.I.P. REF. No.
DATE INSPECTED: 1991 & 1993	
PARISH: COUNTY: Northumberland	BY: partially inspected
PRESENT OWNER(S) (Name & Address):	REAL PROPERTY DESCRIPTION:
	SITE AREA: CURRENT ZONING:
CATEGORY: area/archaeological site	MAP 1:25000 No. -----
SUBCATEGORY: railway line	NAME: WALLSEND & SWANSEA GRID: W 800 530 to S 749 434
HISTORICAL THEMES: S.H.I.P.:	Ref. Nos. for RELATED ITEMS
LOCAL:	

HISTORICAL PERIOD - BUILT: 1876 - 1900 USED: 1892 to 1991

BUILDER: Redhead Coal Mining Company DATE BUILT: 1889 to 1916

ARCHITECT/DESIGNER:

PHOTOGRAPH &/OR SKETCH PLAN (and caption): Reduced copy of a map drawn for "Adamstown to Fernleigh" (see refs.)



Refer to route shown on Suburb Maps:
BM, BN, CT, DL, GH, HF, KH, KS, RH, WH.

NAME/IDENTITY BELMONT RAILWAY

ITEM No. RT - 04

KNOWN HERITAGE LISTINGS:

PHYSICAL CHARACTERISTICS

A single line which leaves the Main Northern Line at Adamstown & travels through steep & rugged country past a number of former coal mines until it gets to the sandhills behind the coastline at Redhead & its terminus at Belmont. The principal geographic features of the railway are a 181 metres long curved tunnel under the Pacific Highway at Adamstown Heights (just inside Newcastle City), and a deep cutting at Whitebridge where the railway passes from the Flaggy Creek catchment to Jewells Swamp catchment. In the past it had significant branches to Burwood Colliery No.3, Whitebridge, Dudley Colliery, Burwood Extended & Lambton Collieries at Redhead and later John Darling at Belmont North. There was a passing loop at Fernleigh just south of the tunnel and about seven passenger stations or platforms at the towns & villages on the route. Most branches & some line has been removed.

INTERPRETATION: none

CONSERVATION ACTIVITY: None yet. Recommend that the line be retained & restored, and consideration be given to development of a light rail service, or (at the least) a cycleway along the permanent way.

PRESENT USE: disused

HISTORICAL NOTES: 1883 - Act permitting construction of a railway to Redhead, followed by much legal action & amending Acts in 1888. Construction began 1889 Tunnel under present Pacific Highway opened 1892 & 1st coal sent to Newcastle. 1st passenger trains for miners 1900. Passenger service operated by NSWGR 1910 Railway extended to Belmont 1916. Passenger service ends 1971. Last coal 1991.

REFERENCES:

. SRA Archives Section, Historical Notes on Railway Lines Vol.1, 1983.
Tonks, Ed. "Adamstown via Fernleigh" pub. NSW Rail Transport Museum, 1988.

EVALUATION CRITERIA:

HISTORIC	Rare ()	Associative ()	Representative ()
AESTHETIC	Rare ()	Associative ()	Representative ()
SOCIAL	Rare ()	Associative ()	Representative ()
SCIENTIFIC	Rare ()	Associative ()	Representative ()
OTHER	Rare ()	Associative ()	Representative ()

STATEMENT OF SIGNIFICANCE:

The Belmont Railway was vital for the transport of coal to Newcastle from some of the richest mines in Lake Macquarie. It was used for coal haulage for ninety nine years. The railway provided a much needed passenger service for many towns and villages on the east side of the Lake, which would otherwise have had no public transport. The passenger service lasted for about 70 years and influenced the growth of Whitebridge, Dudley, Redhead and Belmont before private cars became common. The railway has excellent potential for re-use as a light rail route or as a cycleway & pedestrian path, & as part of a network of industrial heritage trails around Lake Macquarie.

Regional Significance - high
Local Significance - very high

ITEM No. RT - 04

NAME/IDENTITY: BRANCH LINES FROM THE BELMONT RAILWAY

ITEM No. RT - 05

PREVIOUS/OTHER NAMES OR USES:

ADDRESS: various

S.H.I.P. REF. No.

DATE INSPECTED:

PARISH: COUNTY: Northumberland

BY: not inspected

PRESENT OWNER(S) (Name & Address):

REAL PROPERTY DESCRIPTION:

SITE AREA:

CURRENT ZONING:

CATEGORY: Area/archaeological site

MAP 1:25000 No. -----

NAME: WALLSEND & SWANSEA

SUBCATEGORY: Railway

GRID: various

HISTORICAL THEMES:

Ref. Nos. for RELATED ITEMS

S.H.I.P.:

LOCAL:

HISTORICAL PERIOD - BUILT: 1876 - 1900 - 1925

USED: various

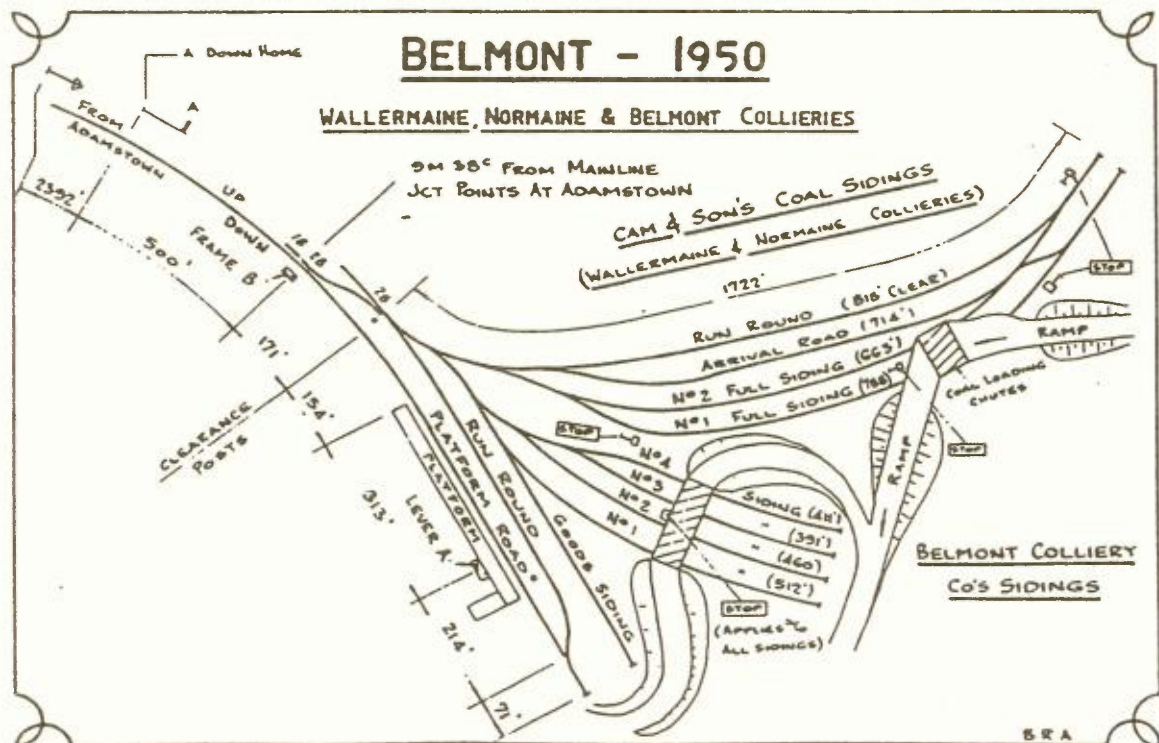
BUILDER: various colliery companies

DATE BUILT: 1889, 1916, 1925

ARCHITECT/DESIGNER:

PHOTOGRAPH &/OR SKETCH PLAN (and caption):

See plan reproduced with inventory Item RT-04 for the location of each of the branch lines. The drawing below is reproduced from "Adamstown via Fernleigh", by Ed Tonks (p.89). It shows the Belmont sidings in 1950 and was drawn by Brian Andrews of Killingworth.



Refer to route shown on Suburb Maps:
BM, BN, DL, RH, WH.

ITEM No. RT - 05

KNOWN HERITAGE LISTINGS:

PHYSICAL CHARACTERISTICS The Adamstown-Belmont Railway is discussed in RT-04. Branch Lines on the Belmont Railway were built for the collieries on the route and usually finished in a number of sidings & shunts leading to the coal bins or screens, the boilers, repair shops etc. The branches were as follows:

- Burwood No.3 Colliery, Whitebridge (1892 to 1982)
- Dudley Colliery, Dudley (1892 to 1939), tracks lifted 1941.
- Lambton Colliery, Redhead (1900 to 1991)
- Redhead Colliery, Redhead (1892 to 1928)
- John Darling Colliery, Belmont North (1925 to 1988)
- Belmont Colliery Sidings, Belmont (1926 to 1971)

As at January 1993, Lambton Colliery was the only branch line to retain its railway tracks in to the site, and some vestiges of sidings & shunts.

INTERPRETATION: none

CONSERVATION ACTIVITY: Recommended that any remaining structures, including embankments & cuttings, be retained for interpretive purposes. The Dudley track might be used as part of a cycleway.

PRESENT USE: all disused

HISTORICAL NOTES: See RT-04 and the description above.

REFERENCES:
 . SRA Archives Section, Historical Notes on Railway Lines Vol.1, 1983.
 Tonks, Ed. "Adamstown via Fernleigh" pub. NSW Rail Transport Museum, 1988.

EVALUATION CRITERIA:

HISTORIC	Rare ()	Associative ()	Representative ()
AESTHETIC	Rare ()	Associative ()	Representative ()
SOCIAL	Rare ()	Associative ()	Representative ()
SCIENTIFIC	Rare ()	Associative ()	Representative ()
OTHER	Rare ()	Associative ()	Representative ()

STATEMENT OF SIGNIFICANCE: The various branches from the Adamstown-Belmont Railway are important to the history of each of the collieries they served, and could be used to assist in the interpretation of that history. The branch lines share in the significance of the Belmont Railway (RT-04) as a whole.

Regional Significance - moderate
 Local Significance - moderate

APPENDIX H

ARCHAEOLOGICAL BACKGROUND OF NSW CENTRAL
COAST AND LAKE MACQUARIE

APPENDIX H

Archaeological background of NSW Central Coast and Lake Macquarie

Archaeological investigations on the NSW Central Coast have been carried out for many years. The majority of the investigations have been development driven and consequently are often limited and site selective. Research in the region has not yet produced a regional model of Aboriginal occupation patterns and population movements.

Within the region, archaeological analysis of sites has tended to concentrate on the coastal strip and plain, including Lake Macquarie. Surveys and investigations in these areas include Bell 1973; Bonhomme 1994a & b; Brayshaw 1981, 1988; Dallas 1983a, b & c, 1986, 1987, 1990; Dallas et al 1987; Dallas & McIntyre 1984; Dallas & Donlon 1988; Dallas & Navin 1991, 1992; Dean Jones 1988; Dyll 1973, 1975, 1977; Dyll & Bentley 1972; Haglund 1986; McIntyre 1985; Navin 1992; Navin, Dallas & McConchie 1993; Navin & McIntyre 1994; Nelson 1994; Ruig 1993.

Haglund (1986) collated the information for sites and archaeological investigations with the Lake Macquarie region available to that date. Known sites in the region include coastal and estuarine shell middens, open campsites distinguishable by surface scatters of stone artefacts, axe grinding grooves, burials, quarries and scarred trees. Middens are the most commonly occurring site type.

A site location model for coastal and estuarine environments has been postulated by Sullivan (1982) for the NSW coastal landscape. her criteria for factors affecting midden occurrence are:

- suitable rock type supporting shellfish populations
- proximity to freshwater
- available shelter from the prevailing winds
- soft or sandy dry deposit to camp on

Given these condition middens vary in content, structure, diversity and in location within the landscape.

Along the NSW central coast, rocky shore, beach and estuarine environments are all exploited, although the densest and most diverse remains are along the coast with sporadic and short term estuarine exploitation possibly using freshwater swamps as the key resource zone (Dallas, Menses, Rola-Wojciechowski 1987; Dyll 1973).

Sullivan (1982:80:1) observes that coastal and estuarine middens can be generally distinguished by the differences in shell content and other cultural remains. She notes shell middens which consists primarily of rock platform species usually contain more bone and stone artefacts than are found in estuarine or beach middens. These equations between various midden content, diversity and volume and Aboriginal occupation may be summarised as:

Large complex sites = group gatherings at base camps

Less complex sites = small numbers of people at transient camps.

For the central coast, particularly Lake Macquarie, detailed archaeological investigation has refined these equations. Dyall and Bentley (1972) excavated an Aboriginal cemetery and occupation site on the south side of the Swansea Channel (3.5 km south of the current survey area) on Reids Mistake Headland. The site (now largely destroyed) is located at the entrance to the lake with views west across the channel and Lake and north to Red Head. It was probably the largest repeatedly occupied site in the area. The burials were associated with later levels of the deposit. A radiocarbon base date of $7,850 \pm 100$ B.P. was obtained for the occupation deposit, but the clarity of the association and the integrity of the deposit has been disputed.

Although a final report has not been produced, Dyall (1973, 1975) postulates a predominantly coastal exploitation of marine resources. No mudflat or weed zone fish such as Luderick and mullet were present in the deposit. These fish are common, and from the site mullet shoals can today be observed migrating through the channel.

The Swansea burial and occupation site (NSW NPWS Site #45-7-37), at the present stage of analysis suggests a long and highly localised exploitation of immediately available foods and stone resources.

The estuarine middens also appear to be localised events, highly selective in shellfish exploitation, generally small, or consisting of shallow deposit with little diversity. Occasional or seasonal visitation and exploitation of resources is often argued for these types of midden (Sullivan 1982). Dallas and McIntyre (1984) compared the data available for the lakeside middens and coastal midden sites (including the Swansea midden sites) with that derived from midden deposit at Green Point, Belmont (Dallas 1983).

The major difference between the coastal and estuarine middens is the degree of selectivity in the dietary remains. Some of the lakeside middens especially those on the western side, would appear to be mealtime camps or single meal event, others have a wider range of activity in evidence - such as tool making. It is likely that certain sections of the lake were selected for more than transient occupation, perhaps over a season. These areas could provide a convenient base camp from which to exploit the estuarine resources, the hinterland with its freshwater creeks and the numerous swamps around the Lake's margin.

The evidence for seasonal shifts of population and the size of these groups is inconclusive though if it occurred it is most likely to have centred on the coast in winter and around the eastern side of the Lake in summer. The eastern side is totally exposed to strong cold westerly winds in autumn and winter, and southerlies in the summer. The densest areas of midden deposit at Green Point for example are located towards the southern ends of the inlets on the northern sides of the hillslopes ie the best location to shelter from summer southerlies. In addition, cockle spawn in summer and at this time contain 20% more meat (Sullivan 1982:33).

Bonhomme (1994a) tested several subsistence strategy models in relation to the NSW Central Coast. These models are described in Bonhomme's report (pp14, 15) and comprised:

1. High residential mobility
2. Seasonally scheduled mobility based within the Central Coast
3. Seasonally scheduled mobility based outside the Central Coast
4. Minimal residential mobility based within the Central Coast

Bonhomme concluded that given the patterning, seasonality and reliability of resources in the region, the strategies which may be applicable to the Central Coast are models 2 and 3, with model 2 providing the best fit for the data for the region (p15).

One of the most significant factors in the understanding of Aboriginal occupation of the Lake Macquarie/Belmont-Redhead area is the depletion of the archaeological resource. Substantial areas and lengths of the coast and foreshore have been developed and sites severely damaged or destroyed. Significant changes in the recorded condition of many sites are known to have taken place within the last ten years.

APPENDIX I
HERITAGE ASSESSMENT CRITERIA FOR
ABORIGINAL & HISTORIC SITES

Aboriginal Sites

In general, Aboriginal archaeological sites are assessed using five potential categories of significance:

- * significance to contemporary Aboriginal people,
- * scientific or archaeological significance,
- * aesthetic value,
- * representativeness, and
- * value as an educational and/or recreational resource.

Many sites will be significant according to several categories and the exact criteria used will vary according to the nature and purpose of the evaluation. Cultural significance is a relative value based on variable references within social and scientific practice. The cultural significance of a place is therefore not a fixed assessment and may vary with changes in knowledge and social perceptions.

Aboriginal significance can be defined as the cultural values of a place held by and manifest within the local and wider contemporary Aboriginal community. Places of significance may be landscape features as well as archaeologically definable traces of past human activity. The significance of a place can be the result of several factors including: continuity of tradition, occupation or action; historical association; custodianship or concern for the protection and maintenance of places; and the value of sites as tangible and meaningful links with the lifestyle and values of community ancestors. Aboriginal cultural significance may or may not parallel the archaeological significance of a site.

Scientific significance can be defined as the present and future research potential of the artefactual material occurring within a place or site. This is also known as archaeological significance.

There are two major criteria used in assessing scientific significance:

1. The potential of a place to provide information which is of value in scientific analysis and the resolution of potential research questions. Sites may fall into this category because they: contain undisturbed artefactual material, occur within a context which enables the testing of certain propositions, are very old or contain significant time depth, contain large artefactual assemblages or material diversity, have unusual characteristics, are of good preservation, or are a constituent of a larger significant structure such as a site complex.
2. The representativeness of a place. Representativeness is a measure of the degree to which a place is characteristic of other places of its type, content, context or location. Under this criteria a place may be significant because it is very rare or because it provides a characteristic example or reference.

The value of an Aboriginal place as an educational resource is dependent on: the potential for interpretation to a general visitor audience, compatible Aboriginal values, a resistant site fabric, and feasible site access and management resources.

The principle aim of cultural resource management is the conservation of a representative sample of site types and variation from differing social and environmental contexts. Sites with inherently unique features, or which are poorly represented elsewhere in similar environment types, are considered to have relatively high cultural significance.

The cultural significance of a place can be usefully classified according to a comparative scale which combines a relative value with a geographic context. In this way a site can be of low, moderate or high significance within a local, regional

or national context. This system provides a means of comparison, between and across places. However it does not necessarily imply that a place with a limited sphere of significance is of lesser value than one of greater reference.

Historic Significance

An item may be associated with and effectively illustrate the evolution and pattern of cultural political, social, economic, industrial or technological development of its area, region or state.

Scientific Significance

Scientific significance relates to an item's ability to reveal information which will contribute to the development of research on particular or various subjects.

Cultural Significance

Cultural significance pertains to those items which reflect the aspirations, values and changes in contemporary tastes of society.

Social Significance

Social significance relates to the way in which an item can illustrate social life - the working and living conditions, often of past eras, but also of contemporary life.

Archaeological Significance

Archaeological significance requires an item to have the potential to define or expand knowledge of earlier human occupation, activities and events through archaeological research.

Archaeological significance has been further defined as pertaining to a site's research potential if the following questions can be answered:

Does the site

- (a) contribute knowledge which no other resource can?
 - (b) contribute knowledge which no other site can?
- and
- (c) is the knowledge relevant to general questions about human history or other substantive problems relating to Australian History, or does it contribute to other major research questions?³²

Architectural Significance

An item may have architectural or technical significance as a notable, rare, representational or early example of vernacular building...

Aesthetic Significance

An item may demonstrate important creative accomplishments that influence or challenge standards of beauty or refinement recognised by connoisseurs, a cultural group or community.

³² Quoted from Bickford, A. & S. Sullivan, *Assessing the Research Potential of Historic Sites* in Sullivan and Bowdler, *Sites Surveys and Significance Assessment in Australian Archaeology*, 1984, p.23.

APPENDIX J

**RECOMMENDATIONS FROM "AN ARCHAEOLOGICAL
SURVEY OF BELMONT SANDS, BELMONT, NSW"**

1994

By Theresa Bonhomme

Sand mining has destroyed or re-distributed stone artefacts, faunal remains and the matrix in which they were contained. Horizontal and vertical integrity have been destroyed, as have any features or clusters that may have been present. There is no reliable information that can be derived from this material, except to say that the wetland margins, as predicted in the model, were a focus of activity and that the sites created there appear to have been small field camps. This would need to be tested against sites in a similar environment, which has not been disturbed by mining.

6.0 Recommendations

All Aboriginal sites are afforded protection under the National Parks and Wildlife Act (1974 as amended). It is an offence to knowingly damage, deface or destroy an Aboriginal Relic without the prior written consent of the Director-General of the National Parks and Wildlife Service.

The following recommendations are based on an understanding of the landscape history of the area, the results of the background literature search, the survey results, discussions with representatives of the Bahtabah Local Aboriginal Land Council and consideration of the Aboriginal and scientific significance of the material remaining in the study area. Artefacts which represent destroyed sites were found along the margin of the Jewells Wetland and in locations on the sand mined dunes overlooking the extraction pits.

It is recommended that

1. for Site 45-7-51 a consent to destroy be applied for with condition of prior collection of artefacts by the Bahtabah Local Aboriginal Land Council
2. a consent to destroy be applied for the portion of 45-7-130 recorded within BHP lands. A Bahtabah representative should be on site to monitor and collect material.
3. any earth moving activity along the wetlands margins should be monitored by a member of the Bahtabah Local Aboriginal Community
4. a NPWS consent to destroy be applied for over the scatters and isolated artefacts described in this report with the condition that the Bahtabah Local Aboriginal Land Council has the opportunity to collect items of interest prior to destruction
5. If human skeletal material is located during earth moving works all activity at that locations should cease and the Bahtabah Local Aboriginal land Council and the NSW NPWS should be contacted
- 6 the Bahtabah Local Aboriginal Land Council be asked to participate in the development where it concerns sites and their protection, their interpretation or display of aspects of Aboriginal culture and history. The developer should discuss the possibility of the construction of a keeping place for artefact, if considered appropriate by the Bahtabah Land Council, from the area.

A copy of this report should be sent to

Michael green
Co-ordinator
Bahtabah Local Aboriginal Land Council
P.O. Box 480
Belmont 2280

APPENDIX K

RESPONSES FROM AGENCIES CONSULTED



HUNTER WATER CORPORATION LIMITED A.C.N. 053 102 837

PO Box 5171B, Newcastle West, NSW 2302, Australia
Telephone (049) 26 7267 DX7858

Reference: C5/23169
Enquiries: Jeff Hamilton
Telephone: 267410

466/LP/JEFF/AG6

23 June 1995

Hassell Pty Ltd
1 Kent Street
SYDNEY NSW 2000

ATTENTION: LEONE DENNIS

Dear Sir/Madam

**RE: BELMONT - REDHEAD
LOCAL ENVIRONMENTAL STUDY**

The Corporation has no objection to the proposed development of the land.

Water and sewerage facilities are available that may be extended/upgraded to meet future demand requirements.

The Corporation will be able to nominate suitable points of connection to its existing system, however it would be the developer's responsibility to determine internal infrastructure and lead-in work required to link with the existing systems.

The land under consideration abuts the northern boundary of Hunter Water's Belmont Wastewater Treatment Works (WWTW).

The Department of Planning recommends that a 400m buffer zone be established around the WWTW and in agreement with this recommendation the Corporation advises that the Department of Planning Circular No. E3 be taken into consideration when determining any development proposal.

Yours faithfully

Jeff Hamilton
Subdivision Planning
Co-ordinator

HASSELL PTY LTD ARCHITECTS	
RECEIVED	28/6/95
FILE REFERENCE	9188
LD	



Environmental Planner
Hassell Pty Ltd
1 Kent Street
SYDNEY NSW 2000

NSW DEPARTMENT OF MINERAL RESOURCES
Minerals and Energy House, 29-57 Christie Street
(P.O. Box 536), St Leonards, NSW 2065, Australia
Phone (02) 901 8888 · Fax (02) 901 8777
DX 021 901 8888
Your Ref: 9188

Attention: Ms Michelle Johnstone

Re: Belmont - Redhead Local Environmental Study
(Parish of Kahibah County of Northumberland)

I refer to your letter dated 3rd April 1995 in respect of this matter.

I can advise you that the area under consideration for this study shown by red edge on the accompanying diagram contains important construction sand deposits and may also have some further potential for heavy mineral sand resources. The extent of the known sand deposits is indicated by orange edge.

At the present time Hymix Industries P/L extract construction sand for the Newcastle-Lake Macquarie building and construction industry from dunal sand deposits largely situated on the eastern side of the current access road. Hymix estimate that the subject area contains at least 5 million tonnes of construction sand with a possible extraction life of 5 to 10 years.

Part of this area near Jewells Swamp was previously mined for heavy minerals by Rutile & Zircon Mines P/L during the 1960's and 1970's. The extent of past and present extraction in the study area is as shown by black hatch on the diagram. RZM has also recently applied for an exploration licence (ELA 24 Singleton) over the majority of the study area shown by blue edge on the diagram. The company presumably will explore the economic potential of tailings left from their previous operation or for deeper heavy mineral sand deposits not previously extracted during the original mining.

In its resource statement provided to the Department Hymix are of the opinion that the sequential nature of the extraction of the available resources can be incorporated in any development plan and carried out with benefit to both the environment and the community. This Department supports this view as it considers that urban development on areas containing recoverable sand resources should not proceed without prior extraction of the sand.

In addition it might be noted that the subject area is within both John Darling Colliery owned by BHP Company Ltd and Lambton Colliery owned by Oceanic Coal Australia Ltd shown respectively by green and yellow edge on the diagram (that small part of Lambton affecting the site is currently subject of cancellation action). The mining leases in the study area have been granted to

mine the coal only however BHP also holds freehold title to the surface over the affected part of its colliery holding.

Coal under the study area has been extensively mined by John Darling Colliery in the now discontinued Fassifern and Borehole seams. The area is within the Lake Macquarie Mine Subsidence District and the Mine Subsidence Board would need to be referenced in order to obtain the necessary building development approvals and advice on possible subsidence in the area prior to any development taking place.

If any further information is required regarding this matter please initially contact the undersigned on (02) 901-8245.

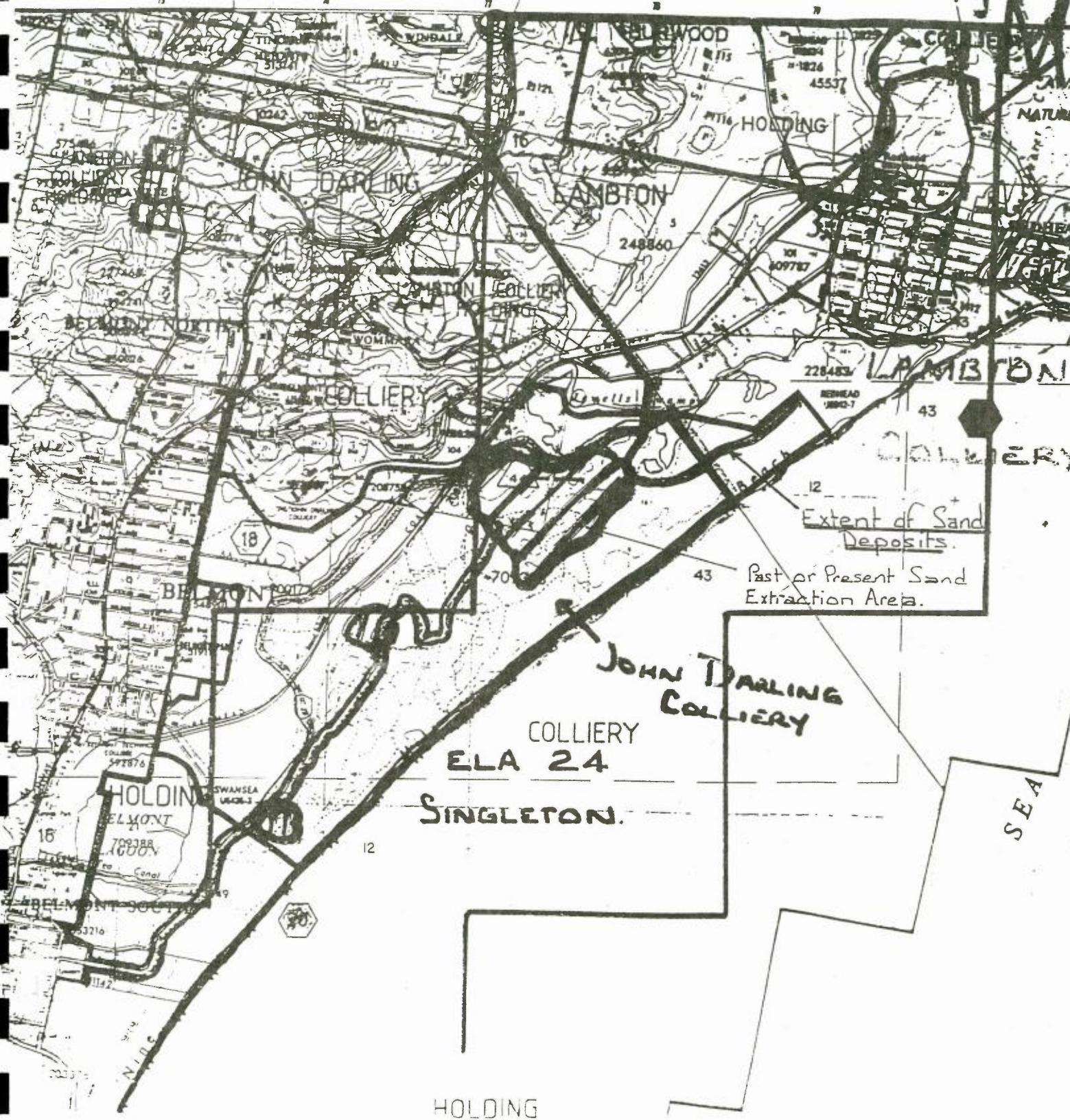
J O'Neill 14/6/95.
J O'Neill
for DIRECTOR-GENERAL

HASSELL PTY LTD ARCHITECTS	
RECEIVED	19.6.95
FILE REFERENCE	
MJ	

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10

NEWCASTLE

DUDLEY



Extent of Sand Deposits.

Past or Present Sand Extraction Area.

JOHN DARLING COLLIERY

COLLIERY
ELA 24

SINGLETON.

HOLDING

SEA

HYMIX INDUSTRIES PTY. LIMITED

53 Cross Street, Double Bay, N.S.W. 2028
P.O. Box 84, Double Bay, N.S.W. 2028
Telephone: 02 328 6311 Fax: 02 328 7272
A.C.N. 000 582 221

21st April 1995

Mr John Whitehouse
NSW Department of Mineral Resources
P O Box 536
ST LEONARDS NSW 2065

Dear Mr Whitehouse,

re: BELMONT - REDHEAD L.E.P.

As a follow on from your request on the 11th April, 1995 and subsequent telephone discussions, we bring the following points to the attention of the NSW Department of Mineral Resources Geological Survey for BHP's Jewells Crossing land holding: (Belmont-Redhead)

- * Within the boundaries of the subject site, the available sand reserves are of premium quality and of significant importance to the building and construction industry in the Newcastle/Lake Macquarie area.
- * Limited alternative resources are available in the Stockton Bight area. However, the sand is of lesser quality and there has been considerable environmental conflict and debate in recent years between the processors, council and the environmentalists, which has clouded the Stockton Bight area as a reliable source for long term supply.
- * The subject site could provide 5 million plus tonnes of a valuable highly sought after construction material. We believe this fine aggregate can be processed in a practical, cost effective and environmentally sensitive manner.

We feel that our managed extraction would be best concentrated to the portion of the site on the eastern side of the current access road.

This process could be co-ordinated with the site preparation and civil construction of the proposed future development. As the previously mined areas are prepared and rehabilitated for the future proposed development, any excess sand can be removed and processed by us in restoring the dunes back to their original state. At the same time, satisfying a genuine demand in the construction and building industry for a high quality consistent fine aggregate.

- * We believe it would be in the community's best interest that our current sand processing and supply to the building industry (and community at large) be extended over the longest period of time possible i.e. 5 - 10 years. The restoration of the previous workings, revegetation and the ongoing sand processing could be planned and co-ordinated with the proposed rezoning and development of the total area. It would be

practical and economically viable, if the need arose, to remove and stockpile the sand in other areas for processing some time in the future

- * **Environmental importance:** During the 60's and 70's, the subject site at Jewells Crossing was extensively mined by Rutile & Zircon Mines who carried out major dredging and relocation of all the dunes. Following this, 6 independent sand suppliers began operations on small leases on the site. Most of these suppliers did not have processing plants and extracted only easily won clean sand which left the areas in an unrehabilitated state.

We believe the Hymix sand processing operation, which has been on site for 12 years, could become a safeguard to ensure that both the environment and the community benefit from the future restoration and development of the subject site. We suggest that with Hymix recycling all previously discarded unsuitable sand and turning it into a specification fine aggregate (as opposed to land fill), we would extend the supply of a rapidly diminishing highly sought after construction material to the community at large.

- * The major alternative sand mining reserves at Stockton are natural, undisturbed dunes with considerable vegetation, and therefore there is greater potential for environmental damage and fauna carnage. At present, there is a lot of emotional environmental debate and conflict between miners and environmentalists as to whether the dunes should be sand mined and therefore the viability of this resource is under question. As previously stated, the Belmont site has been extensively mined by Rutile & Zircon Mines who, in the 60's and 70's, carried out major dredging and relocation of all dunes to extract mineral sands with no restoration to speak of and therefore the subject site is less environmentally sensitive.

SUMMARY

We would like to take this opportunity to record with your Department that the Hymix Group is a community minded and environmentally aware company, who is genuinely interested and aware of its neighbours best interests. It is a policy of Hymix to do everything viably practical to achieve the best possible outcome for all parties including the environment. We therefore endorse the owner/developer's proposed end use for the development of the subject site to be in the community's best interest. It is our honest belief that our sand processing operation would ensure the site preparation and civil development is carried out in an environmentally beneficial manner. We have no hesitation in supporting the zoning changes sought by the owner/developer.

Yours faithfully,



MARK SPENCER
Area Manager Newcastle

Environmental Planner
Hassell P/L
1 Kent St
Sydney NSW 2001

Facsimile: (065) 43 4164
Telephone: (065) 42 1222
P. Hancock

Your ref. MJ: 9118 C0437
Our Reference:

Dear Sir/Madam,

re: Belmont-Redhead Local Environmental Study

The Department of Water Resources has responsibility for management of groundwater within the tidal zone of New South Wales. The Belmont-Redhead Local Environmental Study should make specific reference to groundwaters, both in terms of quantity (for recharge, discharge or groundwater movement) and groundwater quality.

The changes in the local groundwater regime resulting from urban development is potentially highly significant. Changes in groundwater recharge from changes to surface water discharge should be included in the study in addition to the risk of groundwater contamination from urban development. The study should also incorporate an assessment of the contribution of groundwater volume and quality to surface water bodies

The assessment should be directed to areas of groundwater recharge and discharge, groundwater depths and gradients and groundwater quality. The assessment should indicate present groundwater conditions and changes to groundwater regime resulting from developments proposed within the LES.

The Department holds information the quantity and quality of registered bores and wells within the precincts of Lake Macquarie Council and should be referred to in the study.

For further information, please contact Hemantha de Silva, Regional hydrogeologist at the Muswellbrook office of the Department.

Yours faithfully



per EDDIE HARRIS
MANAGER, RESOURCE MANAGEMENT
HUNTER REGION

March 7, 1995

(g. resmgt develop piny)

HASSELL PTY LTD ARCHITECTS	
RECEIVED	5/4/95
FILE REFERENCE	0188
LD	<i>[Signature]</i>

Department of Planning

HUNTER AND CENTRAL COAST REGIONAL OFFICE

Ms M Johnstone
Environmental Planner
Hassell Pty Ltd
1 Kent Street
SYDNEY NSW 2000

20 Auckland Street, Newcastle 2300
P.O. Box 5135
Newcastle West 2302
Telephone: (049) 25 2566 Ext:
Fax No: (049) 25 1529

Contact: A Stephens
Our Reference: N90/718
Your Reference: 9118c 0437

Dear Ms Johnstone

BELMONT - REDHEAD LOCAL ENVIRONMENTAL STUDY

I refer to your letter of 24th March, 1994 and advise the Department has no record of having received your letter of 28th February or attached map.

In response to your request I advise that because the Department will be preparing a report to the Minister for Planning on the proposals, provided the draft plan is progressed to that stage, all of the issues listed as study criteria in the Council's draft brief for the environmental study and forming the Director of Planning's notified specifications for the study's preparation, pursuant to S74(2)(b) of the Environmental Planning and Assessment Act, 1979, are of concern to the Department.

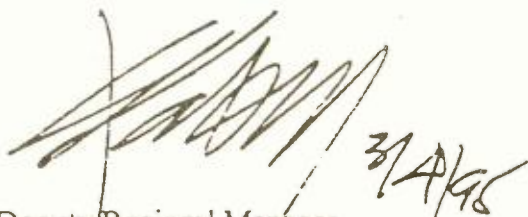
In particular and as required by the specifications, the Department seeks the specific addressing of its "Hunter Coastal Urban Settlement Strategy" 1994 (including the discussion of Potential Urban Areas at pp.36-37), and the implications of the NSW Coast-Government Policy, 1990; the Draft Revised Coastal Policy is also expected to be taken fully into account in the environmental study, as is the Minister's related S.117(2) Direction No. S26.

Because a SEPP 14 designated wetland is involved and the Director has a concurrence role under that instrument, the study should carefully examine potential developmental effects on the wetland, in alignment with the aims, objectives and provisions of the Policy.

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FILE REFERENCE	9188
MJ	

I trust the foregoing to satisfactorily address your request. Please contact Mr Tony Stephens of this office if requiring clarification of the above.

Yours sincerely,

A handwritten signature in black ink, appearing to be 'J. A. Stephens', written over a vertical line. To the right of the signature, the date '31/1/95' is written.

Deputy Regional Manager,
Hunter & Central Coast Regions.



18/4

Leone Dennis
The Senior Planner
Hassell
1 Kent Street
SYDNEY NSW 2000

Environment
Protection
Authority
New South Wales

NSW Government Offices
117 Bull Street Newcastle West NSW 2302
PO Box 488G Newcastle NSW 2300
Tel .049. 25 9971 Fax .049. 29 6712

Our Reference: 270149A46 SN:MC

Your Reference LD:lp 9188.c0334

12 APR 1995

Contact: Shaun Northard

Dear Ms Dennis

BELMONT-REDHEAD LOCAL ENVIRONMENTAL STUDY

Thank you for your letter dated 28 February 1995 inviting the Environment Protection Authority (EPA) to make comment on issues to be addressed in the Belmont-Redhead Local Environmental Study. The following comments are submitted for your consideration.

Environmental Constraints

SEPP No 14 Wetlands

The EPA considers that wetland systems are an important natural resource and that development in this catchment should be compatible with the protection of its natural values. Three SEPP No 14 wetlands have been identified on the study site. The lands subject to this policy are described as areas number 867, 866 and 861. These areas are shown on Coastal Wetlands Map 51, prepared by the Department of Planning.

If wetland values are to be adequately protected, the interface between the natural and proposed development areas within the site will require particular attention. There should a buffer zone between the described wetlands and the proposed urban areas. The management of the buffer zone is important if it is to provide effective protection for the wetland margin. We do not regard roads as adequate buffers to wetland areas, as they facilitate access for rubbish dumping and other activities. Ideally the buffer zones should be fenced at the margin of the developed area, with the objective of excluding domestic pets, bikes and rubbish/garden dumping waste. The value of the buffer zone for habitat and water quality protection should be recognised and it should not be regarded as unused open space. Gross pollutant traps and water quality control ponds should be located outside the buffer, within the developed area.

Odour - Belmont Waste Water Treatment Plant

The EPA is concerned about urban development proximate to sewerage treatment works. Our particular concerns relate to odour and aerosol emissions. In the past the EPA has adopted a buffer zone of 400 meters around sewerage treatment plants for odour protection. However, the EPA is currently recommending that odour and aerosol impact assessments be undertaken to determine appropriate buffer zones and management practices.

Any modelling undertaken should use site specific emission and meteorological data. For your information, the Belmont Waste Water Treatment Plant is to undergo augmentation in the future. I recommend you consult with Hunter Water Corporation for specific details. It is envisaged that any modelling must reflect projected augmentation.

Acid Sulphate Soils

Acid sulphate soils have caused environmental degradation in several coastal areas in NSW. Some areas within the study area may have potential acid sulphate soils. The EPA recommends that the potential for acid sulphate soils within the study area be investigated. For further information about these issues, I refer you to the EPA publication "Draft Environmental Guidelines for the Assessment & Management of Coastal Land Developments in Areas of Acid Sulphate Soils", 1993.

Contaminated Land

Landuse activities such as mineral sand extraction and coal mining have the potential to contaminate land. Both these activities have been undertaken on the subject land. I suggest the LES detail the potential for contaminated land within the study area based on past and present landuse activities. I refer you to the "Guidelines on the Assessment and Management of Contaminated Sites", ANZECC & NHMRA, 1992.

Noise

Future urban development has the potential to cause noise impacts on existing urban areas proximate to the study area. Sand mining activities and future traffic generated along the proposed bypass route also have the potential for noise impacts on proposed residential development within the study area. I suggest that the potential for noise impacts be assessed in the LES and the findings be reflected by the design of the planning strategy. I draw your attention to the EPA publication "Environmental Noise Control Manual" which the EPA is using as its current standard for noise. In particular, I refer you to Chapter 21 'Planning for Noise Control'.

Water Pollution

The EPA is concerned that both surface and groundwater is protected from pollution. The main potential sources of pollution of waters associated with urban development in the study area are stormwater runoff, overflows from sewerage pump stations and infiltration of nutrients and chemicals to the groundwater. The EPA will not condone the discharge of untreated stormwater either to any of the wetlands & associated waterways or to the ocean.

Water Quality Management

Any proposed water quality strategy for the study area should consider the following:

Hydrological Studies & Water Quality Monitoring - the EPA recommends the quality of groundwaters and surface waters be clearly established before development. This information will later serve as baseline data for assessing the performance of the water quality strategy and give an indication of the current state of water quality within the study area. A site specific detailed hydrology study should also be undertaken. I suggest water quality be addressed in the general objectives for the planning strategy.

Water Quality Control Ponds - if water quality control ponds are being considered, they should be designed to prevent any urban runoff from discharging directly into waterways. Water quality control ponds would need to be designed such that water discharged from the system contains less than 50 mg/L non filterable residues (NFR). They should be effective in reducing the concentration of organic matter, nutrients and trace metals, and bacterial levels. Water from non-urban areas should be diverted away from urban areas to prevent contamination.

Experience has shown that lack of effective pond maintenance severely limits the ability of the ponds to operate usefully. Consideration needs to be given to the long term management of the water quality control ponds, if they are incorporated into any water quality control strategy.

Erosion & Sediment Runoff Control - I refer you to the Department of Housings document "Soil & Water Management for Urban Development, Second Edition, 1993" which the EPA is using as its current standard for erosion and sediment control for residential developments.

Riparian Buffers - to prevent erosion and sedimentation of waterways, vegetated riparian buffer zones should be maintained. These zones not only provide increased aesthetic value to the site but also help decrease sedimentation, erosion and the entry of excess nutrients into waterways. Riparian buffer zones should be clearly defined in the planning strategy.

Planning Strategy

The following comments relate primarily to the development of the proposed planning strategy. The planning strategy is given specific consideration because it aims to create an appropriate overall framework for future use of the study area.

Environmental Sustainability

The planning strategy should provide a sound basis for the preparation of plans that facilitate ecologically sustainable development. The planning strategy should contain overarching general objectives to guide the land use strategy as a whole. The EPA considers that the principles of ecologically sustainable development can only be effectively applied within a total framework. The setting of overall objectives for the planning strategy is essential for the facilitation of holistic environmental management and is imperative to address cumulative environmental impacts.

The continuing urbanisation of the New South Wales Coast is causing concern. Ribbon development is often raised as an issue that needs to be addressed. The community has a general concern over the continuation of ribbon development along our coastlines. This is reflected by the EPA in our advice to Councils on scattered, linear unsustainable urban forms. I am concerned that substantial urban development in the study area could further facilitate the coastal ribbon development that has already occurred along this section of the coast. You may wish to consider this issue in the development of the planning strategy.

Land Use Options

In large complex development areas, where there are several key players with diverse interests, and where conflicting choices must be weighed, community decision making is facilitated by the generation of alternate planning strategies. The EPA is aware that the development of alternate planning strategies is expensive in both time and effort. However, the generation of alternate strategies is a preferred environmental management practice. Through comparison and evaluation of alternate strategies, there is enhanced potential to produce and improve an environmental management plan for future land use. I strongly recommend that alternate planning strategies be developed for the study area.

Identified Land Uses

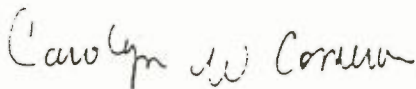
The EPA recognises that the planning strategy will propose several landuses and that the strategy is not intended to be as detailed as a development control plan (DCP). Consequently, it may not seem necessary to quantify any proposed landuses. It is recognised that this approach may afford some flexibility in the preparation of the draft DCP. However, it severely limits appraisal and comparison of identified landuses.

The omission of basic land use data such as land use allocations, anticipated dwelling numbers & densities, population estimates etc. has serious implications. In essence the strategy cannot be considered in any meaningful manner. Council, government agencies and the public are unable to decide from the planning strategy when, where and/or how much development will occur. The EPA is quite concerned that it will be unable to provide value added comment on possible cumulative impacts; or give guidance on integrated environmental management once the LES has been completed. I therefore recommend the inclusion of basic land use data in the planning strategy. Precinct level landuse estimates would be considered a suitable level of resolution.

Adjacent Landuses - Existing activities should be considered to ensure that conflicts between use(s) do not occur. This applies to noise, odour and visual impact.

Thank you for the opportunity to provide some guiding comments for the development of the Belmont - Redhead Local Environmental Study. Should you wish to discuss any of the issues raised, please contact Shaun Northard on (049) 269997.

Yours faithfully



CAROLYN CAMERON
A/Regional Manager, Hunter
for Director-General

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FILE REFERENCE	9188
LD	134



464 King St
PO Box 5166
Newcastle West NSW 2302

Phone (049) 29 4346
Fax (049) 29 6364

6th April 1995

Leoné Dennis
HASSELL
1 Kent Street
SYDNEY NSW 2000

Dear Leoné

Re: BELMONT-REDHEAD LOCAL ENVIRONMENTAL STUDY

Further to our discussion on Tuesday 4th April regarding matters for inclusion in the LES, I would like to reiterate some of the comments made at that meeting.

While this is by no means a comprehensive list of issues, they will cover the generic issues of significance identified at this time. Review of your document will prompt other matters perhaps of a more specific nature.

Rehabilitation of the dunal system is a major issue which will require significant technical input during design and undoubtedly, financial input during rehabilitation. The stability of this system is paramount to the long term sustainability of any landward development.

I have previously discussed CaLM's involvement in this process with both Rod Pegus (Pedal Thorpe & Co) and Kevin Chase (BHP Engineering). While no matters have been resolved to date, I remain willing to discuss any matters pertaining to this sensitive area.

The location of the final outlet for the Jewells Wetland is also a concern. The sustainability of the current outlet must be questioned and I would not be surprised to see a recommendation to change the outlet back to its original location further north. The final landform of the site needs to take into account not only the cost of land forming, but the creation of low relief catchments and the ease of their drainage. Construction of pseudo-natural landforms, especially where relief is minimal should be an objective.

The impact of increased runoff volumes and concentration of same need to be considered in the design of small urban catchments, the development of water sensitive urban design, impact on the adjoining wetland, design of erosion, sediment and pollution control structures and impact on stability of the wetland outlet to the ocean should also be considered.



The Department of Conservation and Land Management incorporates: the Soil Conservation Service, Crown Lands Service, Land Information Centre, Valuer-General's Office, Land Titles Office and Forestry Policy Unit.

Vegetation retention is another obvious consideration, as discussed, will you attempt to set development standards, to cover area of tree cover, either as a proportion of total area, of developed area, in relation to adjoining land, as visual or environmental buffers, as wildlife corridors or as passive open space.

Maintenance of diversity in vegetation, not only in the upper storey, but understorey, including native grasses, where they exist may be an option worth considering.

Without having walked the entire site, or had the opportunity to review any resource inventory of the site, I can only conclude by suggesting that there appears to be opportunities within the site to align seemingly incompatible land uses without endangering the long term viability or sustainability of the area.

This is an excellent opportunity to produce a truly contemporary urban development sympathetic to many of the environmental considerations overlooked in past developments.

Once again if you have any further queries please do not hesitate to contact me.

Yours faithfully

A handwritten signature in black ink, appearing to be 'S Russell', written over a large, stylized number '2'.

Stuart Russell
District Manager - Newcastle

Ref: RUSSELLICORRC604
C597

Our Ref: SL.PLK 32/05 01
Your Ref:
Ph: (049) 21 4831
Fax: (049) 21 4818



HUNTER HEALTH
Improving Health in the Hunter

5 April, 1995

Ms M Johnstone
Hassell Pty. Ltd.,
1 Kent Street,
SYDNEY NSW 2000

Dear Ms. Johnstone,

Belmont Redhead - Local Environmental Study

Thank you for the opportunity to make submission to this Study.

It is not expected that the impact of the proposed development as discussed would be significant for Belmont Hospital. Obviously, there would be some increase in demand but not such as to cause problems nor any different to population growth in proximity to the Hospital.

With regard to Community Health Services, the position is different. A substantial growth in this area will alter the population distribution in Belmont and may necessitate the establishment or relocation of health infrastructure requirements e.g. early childhood, pre-school, community health centres. This requirement should be taken into consideration in the proposal for any development of the area.

Yours sincerely,

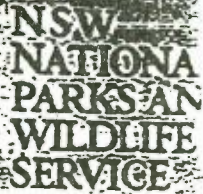
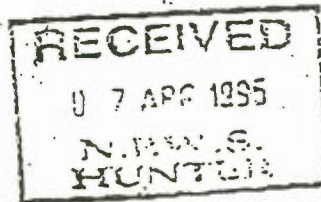

Stewart Leeman
Manager, Capital Works and Physical Resources

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FILE REFERENCE	9188
M.J.	7/4
	14/4

*Hunter Area Health Service,
Lookout Road, New Lambton,
Locked Bag No. 1, New Lambton 2305.
Phone (049) 21 4960, Fax (049) 21 4969.*

23 March 1995

Leone Dennis
Senior Planner
Hassell Pty Ltd
1 Kent Street
SYDNEY NSW 2000



NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE

Our reference: CR/1769
Your reference:

Dear Ms Dennis

RE: BELMONT - REDHEAD LOCAL ENVIRONMENTAL STUDY

I refer to your letter of 28 February 1995 in which you consult with the National Parks and Wildlife Service on the abovementioned proposal.

The National Parks and Wildlife Service is responsible for the care, control and management of all lands dedicated as national parks, nature reserves, state recreation areas, Aboriginal areas, historic sites and game reserves. In addition, the Service is responsible for the protection of native fauna and native plants throughout New South Wales and with the protection and care of the state's Aboriginal sites and relics.

With regards to the area under consideration in the local environmental study, the Service is particularly interested in:

- areas of native vegetation;
- areas of potential value as habitat for native fauna with special reference to the value of habitat for rare or endangered species; and
- areas of archaeological potential.

If any areas within your study area possess or are expected to possess attributes such as those identified above, the Service recommends that detailed surveys be undertaken to determine the ecological and/or the cultural significance of the area.

The following information is considered necessary to enable the assessment of the natural and cultural value of an area:

- description and mapping of all vegetation communities and fauna habitats of the area;
- identification of any communities which are of local, regional or statewide significance;
- description of known or expected faunal assemblages with particular reference to rare or endangered (Schedule 12) species and their habitat; and

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Fax: (02) 585 655
Tel: (02) 585 644

R. G. [Signature]
7/4/95
Australia made 100% recycled paper

- mapping of the location of all Aboriginal sites and relics and assessment of the significance of these within the study area.

Of particular significance to this study are the number of State Environmental Planning Policy No. 14 wetlands which occur in or adjacent to the study area and the potential for the occurrence of a number of flora and fauna species of conservation significance.

In reference to State Environmental Planning Policy No. 44 - Koala Habitat Protection, Lake Macquarie local government area is within the distributional range of koalas. Clause 15 of this policy states that any council listed in Schedule 1 should:

- " (a) survey the land within its area so as to identify areas of potential koala habitat and core koala habitat; and
- (b) make or amend a local environmental plan:
 - (i) to include land identified as a core koala habitat within an environmental protection zone; or
 - (ii) to identify land that is a core koala habitat and apply special provisions to control the development of that land; and
- (c) give consideration to preparing an appropriate development control plan for land that is or adjoins a core koala habitat.

The National Parks and Wildlife Service has these databases which may provide information of use to you in your study. These are the Wildlife Atlas which identifies the registered fauna recordings in New South Wales. The ROTAP database holds records of the rare or threatened Australian plant species. Records are available from these databases upon written application and receipt of the appropriate fee. Information regarding these systems can be obtained by contacting Ms Annie Etheridge, Technical Officer, Information Technology Division, on (02) 585 6423.

Also available are records from the Aboriginal sites register. Records from this database can also be obtained upon written request and payment of the appropriate fee. Information on this service can be obtained by contacting Mr Bill Eliwood, Cultural Heritage Services Division, on (02) 585 6471.

If you have any questions regarding the contents of this letter, please contact Lisa Mitchell, Environmental Planning Officer, Sydney Zone on (02) 585 6676.

Yours faithfully



Russell Coole
Manager Sydney Zone

APPENDIX L

STUDY TEAM

STUDY TEAM

Hassell

David Ashton (Project Director)
Leoné Dennis (Project Manager)
Michelle Johnstone
Alex Martin

Patterson Britton & Partners (Engineering)

Mark Tooker
Ian Rowbottom
Peter Kurras

Arup Transportation Planning

Andrew Hulse
David Baber

Antcliff Ecological Surveys

Paul Burcher

Navin Officer Archaeological Resource Management

Kerry Navin
Mary Casey

Robert Luke (Bushfire Consultant)



Mr Leon'e Dennis
Senior Planner
Hassell Pty Ltd
1 Kent St
Sydney 2000 NSW

Our Ref: HB (C): 3421

24 March 1995

RE: Local Environmental Study Belmont-Redhead

Dear Mr Dennis

Thank you for your letter dated 28 February 1995, requesting information for the preparation of the above study. Activities within the study area should be developed in line with the new NSW Fisheries Management Act (1994) and Regulations. NSW Fisheries policy and areas of concern are listed in the attached document, *Estuarine Habitat Management Guideline*.

For further information on the above, please contact John Holliday, acting Habitat Biologist, on (049) 821232.

Yours faithfully,

John Holliday
for
Paul Crew
Director NSW Fisheries

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Michelle,

Please review document & note any issues likely to impact on the proposed development of the Belmont-Redhead site.

CENTRAL REGION



7 April 1995

Ms Leone Dennis
 Senior Planner
 Hassell Pty Ltd
 1 Kent Street
 SYDNEY NSW 2000

Dear Ms Dennis

Thank you for your letter of 28 February 1995 concerning the Belmont-Redhead Local Environmental Study.

In the first instance I would draw your attention to the Hunter Region Tourism Development Strategy and Lake Macquarie Local Tourism Plan.

More specifically we would suggest that consultants take into account the potential tourism role of the land. Given its beachfront attributes and 7(a) zoning, it would also be feasible to look at establishing educational interpretative facilities in the wetland component of the site. Another factor to consider would be the construction of boardwalks in the area.

Further information can be obtained from the Information Resource Centre and information on tourism trends can be obtained from Market Research Division on (02) 931 1111.

Yours sincerely

Lawrence Franklin
PROJECTS CO-ORDINATOR

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Hunter Area Health Service

PUBLIC HEALTH UNIT



30 March, 1995

Leone Dennis
Senior Planner
Hassell Pty Ltd
1 Kent Street
SYDNEY NSW 2000

HASSÉLL PTY LTD ARCHITECTS	
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FILE REFERENCE	9185.
LD	3/4
AO	3/4.

Irene Hall Pacific Street,
NEWCASTLE NSW 2300
Phone: (049) 29-1292
Fax No.: (049) 29-4037

Dear Ms Dennis,

Re: **Belmont - Redhead Local Environment Study**

I refer to your letter dated 28 February, 1995. As the attached plan lacks topographic detail and covers a relatively large area, the points raised can only relate to the general area.

Current Use

The area is currently available for recreational use. Its value as such is likely to increase considerably given the recently revised population projections for the Newcastle/Lake Macquarie region. An added concern, for this sensitive coastal environment, would be the trend towards higher residential densities, generally. This trend will result in added pressure and demand for recreational land-use, as well.

Coastal Concerns

Important issues have already been raised in regard to Australia's east coast, generally, particularly metropolitan coastal areas, and specifically, to the Pinny Beach and Stockton Bight proposed developments. Matters raised in these contexts should be referred for their relevance to this proposed development. The concurrence of these three proposals has regional and wider relevance and this study should include this wider regional frame of reference.

Water Management

There is a high ground water table. During heavy rain and king tides the low-lying area provides a water retention basin till the water can get away. With residential development local flooding could occur. Mosquito breeding poses a problem in such areas.

Habitats

The area is a habitat for varieties of flora and fauna, already affected by sand-mining and surrounding development. Consultation should occur with conservation groups.

Stability and Exposure

Factors relating to coastline stability, the possible effects of wind and sea action, destabilisation of dunes, possible subsidence, and earthquakes would need to be addressed.

Urban Runoff

Because of the high ground water table, extra care and monitoring of the ingress of surface contaminants would be needed. The potential effects of the cumulative load of contaminants from residential run-off on such highly water-charged areas should be considered.

Waste Disposal

Waste management has been a recent concern for east Lake Macquarie with issues raised about the transfer station; and there is a longer term problem of adequate landfill sites for Lake Macquarie as a whole. How will further residential consolidation in east Lake Macquarie add to this yet unresolved problem?

Environmental Health Risk Concern

Sand-mining has occurred in the area since the 1950's. Concern was expressed in 1991 that the incidence of cancer for local residents may have been higher than 'expected' as a result of exposure to radioactive waste in mine tailings, and in the ground water.

A preliminary investigation did not indicate that cancer levels exceeded the 'expected'.

In 1991, the Public Health Unit sampled bore water in Jewells Crossing area to assess the environmental health risk from possible radioactive contamination of the ground water.

The conclusion was that the low levels of radioactivity would not present a health risk to any person using the bore water for household laundry, garden or swimming pool purposes.

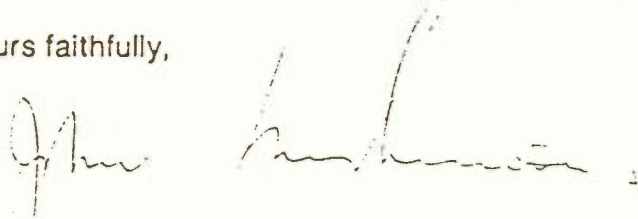
Levels of beta activity did exceed the NH&MRC level of 0.1 becquerel per litre for drinking water in all samples; and levels of alpha activity, in 3 samples. Eleven samples were taken. However, bore water is not normally consumed and these levels, if found in drinking water, were not considered to be hazardous (Fleischmann A W, Radiation Health Services (1992).

The waste radioactive monazite material was removed in 1991.

We consider that you need to be aware of previous community concerns in the Redhead area about this issue. For example, is it likely that bore water will be sought by residents in this proposed development? If so it may be wise to consider having it tested.

We would be happy to discuss further if you wish.

Yours faithfully,



DR JOHN STEPHENSON
Director
Hunter Public Health Unit

JS:lh 247/1

c.c. Dr T Smyth CEO-HAHS



and Ferry Services

P.O. Box 466, Hamilton NSW 2303
Telephone (049) 618933 Facsimile (049) 618999

EVC04/044i

13 March 1995

MR L DENNIS
SENIOR PLANNER
HASSELL PTY LTD
1 KENT STREET
SYDNEY NSW 2000

Dear Mr Dennis,

RE: BELMONT - REDHEAD LOCAL ENVIRONMENTAL STUDY

Newcastle Bus and Ferry Services welcomes residential industrial and tourism infilling within its contracted area.

As the development is only in the planning stages and we are not privy to its concept it is not prudent to comment past the above.

Newcastle Bus and Ferry Services is always willing to discuss the possibilities of intergrading any development into our Newcastle and Lake Macquarie bus network.

However, this should be discussed in the planning stages with a view to provide a suitable bus road system into the subdivision.

Yours sincerely,

CLARRIE MOORE
MANAGER, CUSTOMER SERVICE

HASSELL PTY LTD ARCHITECTS

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FILE REFERENCE	9188
	LD. 15.3.95

LJS:njs

27 March 1995

Hassell Pty Limited
1 Kent Street
SYDNEY 2000

Attention: Ms L Dennis

Dear Ms Dennis

HASELL PTY LTD ARCHITECTS		
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FILE REFERENCE	9188	
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MJ		

I am writing in response to your letter of 28 February 1995 concerning the Belmont Redhead Local Environmental Study.

I understand your company has the task of undertaking a local environmental study for the land known as Belmont-Redhead adjacent to Nine Mile Beach at Belmont. This land is well removed from existing health services in the area and therefore development of this site is not expected to have an immediate environmental effect on our service.

However, residential and industrial development on this site has significant potential for our service in the population increase of the area and associated activities. Please be advised that local hospital services are limited to a 100 bed district general hospital at Belmont.

The Hunter Area Health Service is particularly interested in developments of this type as they provide opportunities for intersectorial co-operation in planning health service delivery. The Health Service would be pleased for its involvement in planning for development on this site at its earliest stages and, at this point, wishes to be kept informed of progress.

Yours sincerely



LYNDON J SEYS
GENERAL MANAGER

In reply please send to: Speers Point

Our reference: BB:KS

Your reference:

Contact:

Hassell Pty Ltd
1 Kent Street
SYDNEY 2000

Attention: Leone Dennis

7th March 1995

RE: BELMONT - REDHEAD LOCAL ENVIRONMENT STUDY

In response to your letter dated the 28th February 1995, you are advised as follows.

The subject area is partially undermined by abandoned mine workings, all the workings are at a substantial depth and mine subsidence is not expected.

The subject area is not located within a Proclaimed Mine Subsidence District.

Yours faithfully,

Brian Burton
District Supervisor

CLASSIFIED	TO: H.C. RECIS
RECEIVED	10/3/95
FILE REFERENCE	
LD	ARC
	② J13



The Mine Subsidence Board
OFFICES:

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Ground Floor,
NSW Government Offices,
117 Bull Street,
Newcastle West 2302
Postal Address:
PO Box 488G,
Newcastle 2300
Telephone: (049) 26 9750
Facsimile: (049) 29 1031
DX 4310 Newcastle West

SPEERS POINT
143 Main Road,
Speers Point 2284
Postal Address:
PO Box 9 Boclano 2284
Telephone: (049) 50 8088
Facsimile: (049) 50 8101
DX 7820 Newcastle

WYONG
Suite 3 Fiddwin Court,
30 Hey St,
Wyong 2259
Postal Address:
PO Box 157, Wyong 2259
Telephone: (043) 52 1646
Facsimile: (043) 52 1757
DX 73 7 Wyong

SINGLETON
Joint Coal Board Building
1 Civic Avenue,
Singleton 2330
Postal Address:
PO Box 524, Singleton 2330
Telephone: (043) 72 4344
Facsimile: (043) 72 4504
PICTON
PB Middleton
Admin. Centre,
Picton 357
Postal Address:
PO Box 40, Picton 357
Telephone: (046) 77 1347
Facsimile: (046) 77 2044



Please Reply To

and Quote

17 March 1995

Senior Planner
Hassell P/L
1 Kent Street
Sydney NSW 2000

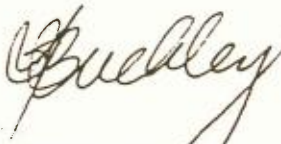
Dear Sir/Madam

Belmont - Redhead Local Environmental Study

Thank you for your letter date d28 February 1995 about the local environmental study at Belmont - Redhead.

The Joint Coal Board has no comments to make on the issues raised in your letter.

Yours faithfully


Sharon Buckley
Manager Administration

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LD	3/4

**General Manager
Hassell P/L
1 Kent St
Sydney NSW 2000**

Facsimile: (065) 43 4164
Telephone: (065) 42 1222

Ext: **F. Hancock**
Contact Name:

Our Reference:

Your ref. LD:lp 9188.c0334

Dear Sir/Madam,

re: **Belmont - Redhead Local Environmental Study**

The Department of Water Resources has responsibility for management of groundwater within the tidal zone of New South Wales. The Belmont - Redhead Local Environmental Study should specifically make reference to groundwaters in terms of identifying groundwater recharge flux and recharge locations, discharge flux and locations, and groundwater movement through the area. Issues of groundwater quality should also be addressed, particularly in relation to any risk of acid sulphate seepages or iron mobilisation from the area.

The changes in the local groundwater regime resulting from urban development is potentially highly significant. Changes in groundwater recharge from changes to surface water discharge should be included in the study in addition to the risk of groundwater contamination from urban development. The study should also incorporate an assessment of the contribution of groundwater volume and quality to surface water bodies.

The Department holds information the quantity and quality of registered bores and wells within the precincts of Lake Macquarie Council and should be referred to in the study.

For further information, please contact Hemantha de Silva, Regional hydrogeologist at the Muswellbrook office of the Department.

Yours faithfully

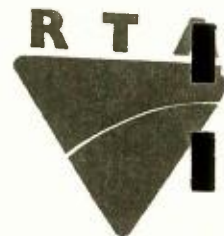


**EDDIE HARRIS
MANAGER, RESOURCE MANAGEMENT
HUNTER REGION**
March 17, 1995.
(g: resmg/develop/bel)

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252.5390;4
Mr C Nunn
(049) 240 331

New South Wales



Hassell Pty. Ltd.
1 Kent Street
SYDNEY NSW 2000

Zone Planning Section
59 Derby Street
Locked Bag 30
Newcastle
New South Wales 2300
Telephone (049) 240 331
Facsimile (049) 24 0342
DX7813 Newcastle

Attention Ms Leone Dennis

CITY OF LAKE MACQUARIE. BELMONT - REDHEAD ENVIRONMENTAL STUDY.

Dear Ms Dennis

It is considered that the Local Environmental Study for the area shown on the sketch attached to your letter of 28 February 1995 will need to address the **impact of any proposals for the area on the efficiency and safety of the existing road system.**

In addition any impacts on the reserved arterial road corridor through the study area will need to be evaluated. While the construction of a road along this route is not programmed in the near future the reserve will be retained as a controlled access road.

Appropriate traffic studies to determine possible **traffic volumes, peak flows, travel desire corridors, accident rates** and possible **intersection arrangements** should be undertaken to ensure minimal impact on the major roads in the study area.

If you wish to discuss these matters further please phone Mr Colin Johnstone on (049) 240 332

Yours faithfully

Mr C Nunn
Zone Planner

27 MAR 1995

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MJ	2513

belred

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APPENDIX L

STUDY TEAM

STUDY TEAM

Hassell

David Ashton (Project Director)
Leoné Dennis (Project Manager)
Michelle Johnstone
Alex Martin

Patterson Britton & Partners (Engineering)

Mark Tooker
Ian Rowbottom
Peter Kurras

Arup Transportation Planning

Andrew Hulse
David Baber

Antcliff Ecological Surveys

Paul Burcher

Navin Officer Archaeological Resource Management

Kerry Navin
Mary Casey

Robert Luke (Bushfire Consultant)