

EIS 775

AB019389

Electricity supply system, Port Stephens Peninsula : environmental impact statement

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SHORTLAND COUNTY COUNCIL

ENVIRONMENTAL IMPACT STATEMENT

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PORT STEPHENS PENINSULA



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February 1988

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ENVIRONMENTAL PLANNING AND ASSESSMENT ACT
1979 (SECTION 77 [3] [d])

ENVIRONMENTAL IMPACT STATEMENT

This Statement has been prepared on behalf of The Shortland County Council.

The Statement supports the Development Application made in respect of the development described as: two 132kV transmission lines.

The Development Application relates to the land described as follows:-

The area enclosed by Tilligerry Creek in the north, Fullerton Cove in the south, Anna Bay to the east and Tomago in the west. Port Stephens Shire, Hunter Region.

The contents of this statement are as required by Clause 34 of the Environmental Planning and Assessment Regulation, 1980.

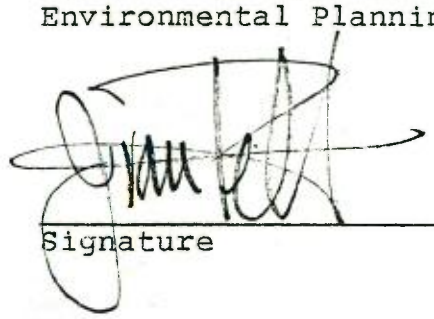
The statement has been prepared by:
John van Pelt AAILA, AIFA, MRAIPR
B Sc (Forestry), Grad Dip Land Design

Forsite Landscape Architects & Planners Pty. Ltd.,
55 Mountain Street,
ULTIMO NSW 2007

Certificate

(As required by Clause 26[1] of the Regulation)

I, John William van Pelt of Forsite Landscape Architects and Planners Pty Ltd, hereby certify that I have prepared the contents of this statement in accordance with Clause 34 of the Environmental Planning and Assessment Regulation, 1980.



Signature

9.4.88

Date

SHORTLAND COUNTY COUNCIL

ENVIRONMENTAL IMPACT STATEMENT

ELECTRICITY SUPPLY SYSTEM
PORT STEPHENS PENINSULA

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Landscape Architects and Planners.

February 1988

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Electricity Supply System Port Stephens Peninsula - EIS

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1.00.0 S U M M A R Y

This Environmental Impact Statement has been prepared to select two suitable routes and assess the effects of two 132kV transmission lines proposed along the Port Stephens Peninsula, within the lower Hunter Region of New South Wales. The Port Stephens Peninsula covers an area of approximately 75 square kilometres with its extremities defined by the mouth of Tilligerry Creek in the north, Fullerton Cove in the south, Anna Bay to the east and Tomago in the west.

The continual increasing demand for electricity within the Port Stephens Peninsula, especially during peak tourist months, is placing increased loads on the present electricity supply system. Overloading or voltage problems are envisaged from summer 1989. Thus, augmentation to the existing electricity supply system and the need for this proposal are justified.

The proposed development encompasses the construction of two 132kV transmission lines - the Tilligerry Peninsula (Western) Line and the Dunal Systems (Eastern) Line. The lines will travel north east from the Electricity Commission of NSW Tomago Bulk Supply Substation, one north and one south of Tilligerry Creek and unite at a substation at Anna Bay. Easement acquisition for the new transmission lines is an integral component of the proposal.

All the existing natural and land use features of the environment were analysed in terms of their capacity for visual absorption, functional absorption and visual sensitivity. Further evaluation of environmental, economic and engineering criteria was completed. The cumulative result identified the most suitable routes for the two transmission lines. That is, routes likely to produce fewer impacts on the environment.

Some impacts will result from the development, however utilising the preferred route options (land of highest

suitability) automatically minimises interactions between the development and the existing environment. Pockets of unsuitable land were crossed in different sections of the routes, in order to link areas of high suitability and hence impacts evolved. Each impact was assessed and examined for possible methods to reduce the effect. Recommendations aim to mitigate any inevitable and potential impacts and provide the basis of management techniques.

The Tilligerry Peninsula Line generally traverses land of high suitability and therefore the impacts generated are low. Crossing Tilligerry Creek is the only section which demands the use of particularly careful construction techniques to avoid disturbance, especially siltation, to the sensitive wetland ecosystem, which is protected under State Environmental Planning Policy 14 - Coastal Wetlands.

Along the length of the Dunal Systems Line, activities within the forested sand dunes require the most detailed safeguards. This area is pristine and a new corridor will be created in the southern section of the route. To avoid detrimental changes careful management is necessary to guard against: soil erosion; a reduction in diversity and quality of vegetation species; the introduction of weed species; disturbance to the archaeological site; and the loss of wildlife habitat.

The routes nominated as the preferred options are considered feasible in terms of balance between the environment and the development.

2.00.0 I N T R O D U C T I O N

2.01.0 OBJECTIVES

This Environmental Impact Statement (E.I.S.) has been prepared for the routes of two proposed 132kV transmission lines on the Newcastle Bight just north of Newcastle from Fullerton Cove to Anna Bay, New South Wales.

The objectives of this E.I.S. are: to fully describe the proposal and nominate the most suitable routes for the transmission lines; to evaluate all impacts resulting from the development and establish measures to minimise them; to identify feasible alternatives to the selected routes and clarify their disadvantages and advantages, and; to give the community, particularly those members directly affected by the proposal, the opportunity to comment on the proposal.

2.02.0 REQUIREMENTS OF THE ENVIRONMENTAL PLANNING & ASSESSMENT ACT

This E.I.S. has been produced in accordance with Part V of the Environmental Planning and Assessment Act, 1979 (E.P.A Act) and Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980 (as amended).

In areas where land uses can accept the presence of a transmission line without significant environmental effects, the determining authority is not required to produce an EIS. An amendment to State Environmental Planning Policy (S.E.P.P.) 4, gazetted in October, 1983, permits this.

Construction of the proposed transmission lines was considered as potentially significant as it alters the land use balance of particular sections within the study area. The preparation and submission of an E.I.S. to the Department of Environment and Planning (D.E.P.) was thus warranted.

In accordance with the New South Wales Government's Energy Policy, an Energy Statement is required as part of the E.I.S. on any major development project. Appendix 2.1 details the use of energy resources for the proposed development.

2.03.0 THE PROPOSAL

Shortland County Council (S.C.C. or Shortland Electricity) propose to construct two 132 kilovolt (kV) concrete or tubular steel, single pole transmission lines using 210 square millimetre conductors to feed from Tomago to Nelson Bay by the year 2005. On completion of construction of the 132kV lines, one of the two existing 33kV lines will become redundant and will ultimately be dismantled where it cannot be economically and physically utilized for the 11kV distribution system.

Several steps are involved, with various time phases, to produce the final electricity supply system of Newcastle Bight (refer to Figure 2.1). The present network encompasses two 33kV wooden, single pole transmission lines - the Road and Sandhills feeders. Construction and commissioning of one proposed 132kV (the Tilligerry Peninsula Line) for operation at 33kV, by summer 1990, will result in three 33kV lines servicing the area. On completion of this feeder, work on the Dunal Systems Line will begin. The present 33kV Sandhills feeder will subsequently be disconnected from the regulator and redundant sections dismantled. A 132kV substation located at a predetermined site in Anna Bay, will be constructed and commissioned prior to capacity and voltage difficulties being experienced. The new feeders will be 132kV and operated at this voltage. The present Road feeder will be maintained with a voltage of 33kV and utilised as an interconnector feeder between the 33kV subtransmission systems of Nelson Bay, Salt Ash and Tea Gardens.

At an estimated cost of $90,000 per kilometre for the transmission lines, a total cost of $5,400,000 is anticipated. However, with the present growth rate of Nelson

Bay and rural Newcastle Bight, the proposed development is clearly justified.

2.04.0 THE STUDY AREA

The project, involving definition of the most suitable routes for the proposed transmission lines, demands a study area capable of encompassing all lands likely to contain appropriate pathways for the development, within economic and engineering limitations. This area is defined as the corridor. Its extremities range from the mouth of Tilligerry Creek in the north to Fullerton Cove in the south and Anna Bay in the east to Tomago Substation in the west (see Figure 2.2).

2.05.0 THE ROUTES & THEIR SELECTION

The study area is generally described as the Port Stephens Peninsula, covering approximately 75 square kilometres in area. The townships of Williamtown, Salt Ash, Bobs Farm and Anna Bay lie within the area (refer to Figure 2.2).

The predominant land uses include Coastal Water Reserves (vested in the Hunter District Water Board) vacant Crown land and agricultural land utilised for grazing and market gardening. In addition, the study area has a landscape quality that is important to the heavy tourist usage within and north of the area.

The selection of the most suitable routes was achieved in three phases: corridor definition, route definition and line design. Initially all the natural and land use features were analysed in the light of the range of possibilities and restrictions on transmission line placement. Areas of non-suitability were excluded from the corridor, such as the Williamtown RAAF base. This defined the corridor suitable for the transmission line.

Route definition is primarily influenced by three factors -

visual absorption capacity, functional absorption capacity and visual sensitivity. The natural and land use features provide information for these factors. The collective evaluation of these three factors produces a suitability rating for the whole corridor. A range of environmental factors were considered at the corridor definition, route selection and line design phases. Highly sensitive environmental areas, e.g. wetlands, were avoided where possible within the corridor. Further considerations of environmental, economic and engineering restrictions as well as health and safety were included to locate the route and alternatives. Final detailed siting of the lines was indicative of the local features of the terrain such as ground conditions, slope, fence lines, isolated pockets of tall forest and natural vegetation community boundaries. In addition, the requests of the property owners were incorporated, where possible, into the final positioning of the transmission lines.

Approximately 60 kilometres of 132kV transmission line will be constructed within the study area.

2.06.0 SCOPE OF THE STUDY

The range of visual, physical, ecological, social, cultural and economical issues that require consideration, have been evaluated in view of the likely short and long term impacts to select the most suitable routes for the proposed transmission lines.

The major issues that were raised and discussed in this statement, centre on:

* The importance of initially selecting areas suitable for the development. The visual absorption capacity, functional absorption capacity and visual sensitivity for each landscape character zone was determined, in conjunction with environmental and engineering restrictions, to select areas of high suitability.

* The reduction of both potential and inevitable impacts through the use of sound construction and maintenance techniques.

* Measures to reduce the visual prominance of the transmission lines.

* Continual liaison with the landowners affected by the proposal.

* The need for the proposal to augment the present electricity supply system.

* The effects of electromagnetic radiation on human health.

* The effect of the proposed development on both the wetland ecosystem of Tilligerry Creek and the dunal ecosystem of Newcastle Bight.

Consultation and correspondance was held with particular government organisations to meet their requirements (listed in Appendix 2.2).

Appendix 2.3 details the project team involved in the compilation of this E.I.S.

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

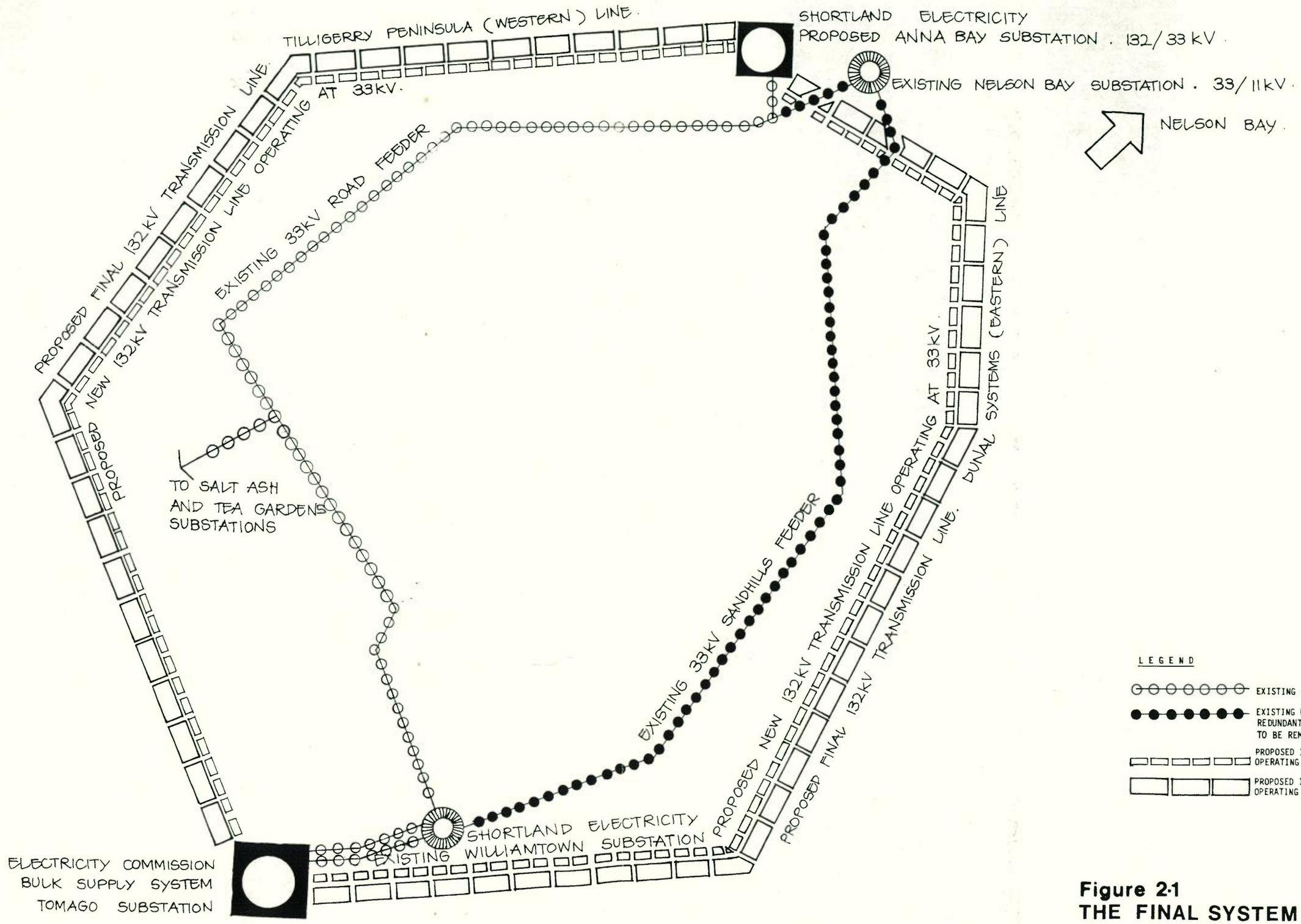


Figure 2·1
THE FINAL SYSTEM

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

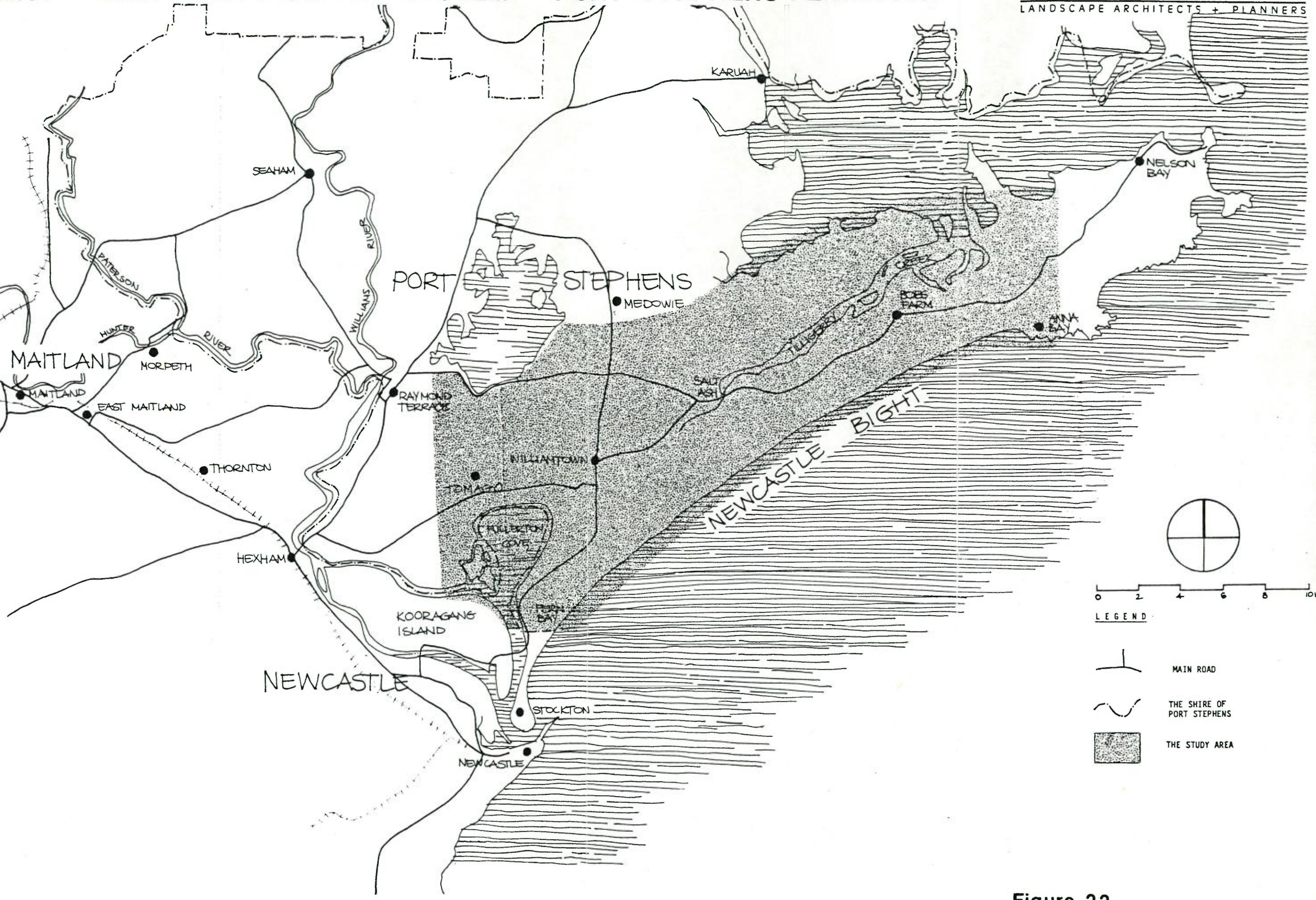


Figure 2.2
LOCAL CONTEXT

3.00.0 B A C K G R O U N D T O T H E P R O P O S A L

3.01.0 PRESENT ELECTRICITY SUPPLY SYSTEM

The Electricity Commission of N.S.W. is responsible for power generation and bulk electricity supply in New South Wales. Power stations in the Hunter Region supply electricity to the N.S.W. state grid, from which substations operating as bulk supply points (BSP), provide power to the relevant distribution authorities - such as S.C.C.

The present electricity supply system in the Hunter Region has been developed by S.C.C. and sourced from various bulk supply points in an area extending from the Lower Mid North Coast south through Newcastle to Lake Macquarie and west to the Hunter Valley. From these bulk supply points power is distributed by a subtransmission network to zone substations. Power is then dispensed to small distribution substations, thence to consumers.

The study area is currently serviced by two 33kV feeders and various 11kV distribution lines.

3.02.0 NEED FOR AUGMENTATION OF SUPPLY

The growth in demand for electricity in the Williamtown to Nelson Bay area is approaching the limit of the existing 33kV S.C.C. system. This situation developed for two reasons - an increase in the population in the rural residential areas of Bob's Farm and an increase in the permanent and semi-permanent (holiday) residents in Nelson Bay and similar foreshores areas of Port Stephens.

By winter 1989, or at the latest summer 1990, it is predicted that the demand for electricity will have grown to the point that the S.C.C. system will not be able to supply the peak loads. To alleviate this situation and provide for further anticipated load growth, the provision of additional transmission capacity to the area is required.

Investigations by S.C.C. have concluded that the establishment of two new 132kV transmission lines traversing the study area is the best solution in terms of economics, provision for future requirements and minimising the proliferation of transmission lines. A new 132kV/33kV substation at Anna Bay is required to provide local capacity for the existing subtransmission system which is to be expanded to match the increasing load centres of Port Stephens.

3.03.0 FUTURE DEVELOPMENTS

The development of the 132kV and 33kV subtransmission system will be staged over a number of years in order to control capital expenditure and to match the incremental needs of the system, thereby achieving greater utilisation of Council's assets.

The staging of the project is planned in the following way:

1. Interim works have commenced with provision for installation of 11kV capacitors during 1988 and 1989 at Nelson Bay, Salt Ash, Williamtown and Tea Gardens. These installations will assist in alleviating voltage problems and provide a reduction in system losses.

2. To provide a reinforcement to the existing 33kV system, the first 132kV line, via Tilligerry, will be constructed and operated initially at 33kV. Completion of this line is required by summer 1990.

3. Having completed the first new line, the existing Sandhills 33kV feeder will be taken out of service to facilitate construction of the second 132kV line through the Dunal System. Sections of redundant 33kV feeder will be removed where reuse at 11kV is not required.

   During this construction phase the 33kV supply to Port Stephens will be via two 33kV lines, the Tilligerry

Peninsula Line and the Road feeder. Again, on completion of the Dunal System 132kV line, the initial operating voltage will be 33kV.

At this stage Council's system will have been expanded to three 33kV lines which would provide increased capacity for a number of years.

4. As the load on the system increases, the Anna Bay 132/32kV substation will be completed and commissioned for operation at 132kV by reconnection of the two 132kV lines at the E.C. of N.S.W. Tomago Bulk Supply Station, and re energising at 132kV.

Under this final system configuration the electrical requirement of this developing peninsula can be met in the foreseeable future.

3.04.0 THE NO BUILD OPTION

Failure to augment the present electricity network from Tomago to Nelson Bay could lead to rationing of power at peak load times, particularly during the summer months, to prevent feeder overloading or voltage problems. If either feeder is out of service during the summer months, increased problems are inevitable.

Overloading or voltage problems are envisaged from summer 1989. As each year passes beyond 1989, the degree of power rationing would increase with the growing demand for electricity, particularly with the long term population growths.

This conclusion is based on current load growth trends allowing for normal system operation conditions.

4.00.0 CHARACTERISTICS OF THE STUDY AREA

4.01.0 THE LOCATION

The study area is defined as the Port Stephens Peninsula (latitude 32°48'S, longitude 151°55'E), which extends from Newcastle in the southwest (120km north of Sydney) to Birubi Point (10km south of Nelson Bay). Williamtown is central to the study area, which is within the Port Stephens Shire on the central coast of New South Wales (see Figure 2.2).

4.02.0 REGIONAL CONTEXT

The study area is located within the coastal zone of the Hunter Region (Lower Hunter Sub-Region), with Newcastle as its regional centre. The Port Stephens Shire administer control upon the study area (see Figure 4.1).

The Hunter Region is second only to Sydney as the State's most populous region with a steady population increase expected (D.E.P., 1982). The Region's most significant industries are power generation and tourism. High quality landscape values, historical features and a well-developed agricultural and industrial base combine to create an area of great diversity and interest.

In conjunction with the population increase, especially in the townships lining Port Stephens, the need for a more substantial electricity supply has resulted. The demands of the future must be effectively co-ordinated to ensure that all services are efficiently and economically provided but planned in an environmentally satisfactory way to minimise physical, social and economic disturbance of electricity supply to the region.

4.03.0 LOCAL CONTEXT

The study area is bounded by Fullerton Cove in the southwest, Anna Bay in the northeast, extending to the shorelines of Grahamstown Lake and Big Swan Bay in the northwest and extending 32km along the coastline of Newcastle Bight. Tilligerry Creek dissects the area, flowing southwest from its mouth (refer to Figure 2.2).

At present, access is via Cabbage Tree Road from Newcastle which joins Nelson Bay Road (Main Road 108) at Williamtown, to lead through the area to Nelson Bay. Marsh Road is the other main arterial road providing access within the study area. A further arterial road has been proposed by the Department of Main Roads (DMR) as a direct link between Fern Bay and Anna Bay.

4.04.0 LAND USE

The two major land use zonings in the study area are Non-Urban 'A' (40 hectacre minimum) and Special Uses 'A' (water supply) (see Figure 4.2). Other Non-Urban zones ('B' and 'C') are prevalent throughout the study area.

The Non-Urban areas, concentrated along Nelson Bay Road, are primarily agricultural grasslands used for grazing cattle. Selective areas of rural residential blocks, many utilised for commercial market gardens, are a major component of the study area's land use.

Encompassing the Non-Urban zones are extensive areas of Crown land gazetted as "Coastal Water Reserves" managed by the Hunter District Water Board. The areas are primarily large tracts of natural vegetation punctuated by primary pumping stations, supplying water to the study area. These areas are zoned 5a on Figure 4.2.

Pockets of land classed Open Space (Recreation) occur throughout the area, concentrated along the foreshores of

Tilligerry Creek and Fullerton Cove. A high proportion of this land use is protected under State Environmental Planning Policy 14 (SEPP14) by the Department of Environment and Planning (D.E.P.) (refer to Section 4.12).

The study area is highly dissected by both major and minor roads and tracks (see Figure 4.3). These service the entire area, allowing access throughout the private properties and pristine vegetation.

4.05.0 POPULATION

The 1981 population of Port Stephens Shire was 28,295, which represents an annual increase of 6.2 percent over the 1976 population. This is 4.8 percent higher than the annual growth rate for N.S.W. (D.E.P., 1983). Table 4.1 presents the projected population distribution for the Shire: 1986 and 2001 figures are endorsed by the N.S.W. Population Projections Group, August 1981 (D.E.P., 1982).

The vast increase can be attributed largely to tourism, recreation and rural/small holding developments in the Shire. This is especially evident in figures for Tomaree Peninsula, with evidence for continued increases. Rural Port Stephens (predominantly the study area) will experience only minor increases through further sub-division from large properties.

Increases in population are generally accompanied by increases in the demand for electricity.

4.06.0 LANDSCAPE CONTEXT

The study area can be described as a combination of rural grasslands along the fertile flood plains and alluvial terraces of Tilligerry Creek and natural tall woodland comprising the coastal dunes of The Bight. The extensive white sands of the mobile dunes along the coast are a major component of the landscape. Small hamlets punctuate the main arterial roadways with isolated homesteads scattered further

TABLE : 4.1

PROJECTED POPULATION DISTRIBUTION
Port Stephens Local Government Area

AREA	YEAR 1976	1986	2001
Total	21,350	29,860	38,160
P.D. 16 (Raymond Terrace)	9,791	12,340	14,790
P.D. 16A (Tomaree Peninsula)	8,566	14,170	19,850
P.D. 16B (Rural Port Stephens)	2,993	3,350	3,520

P.D. = Planning district
Ref: D.E.P. (1982)

from the road. Selected areas, designated for special purposes such as defence, are a major component of the north western landscape amongst the swamplands and large tracts of natural forest.

4.07.0 CLIMATOLOGY

Newcastle Bight experiences a humid temperate climate, predominantly influenced by the Eastern Maritime air mass.

The following figures are referenced from March, 1980 records at the Meterological Station of the RAAF Base at Williamtown. January is the hottest month and July the coolest with average figures of 22.9°C and 12.2°C respectively. The average annual rainfall is 1134 mm: January being the wettest month and September the driest. Local periodic flooding is experienced from this relatively high, localised rainfall.

The most prominent climatological aspect of the study area is the wind regime. Prevailing winds and associated swell waves that are generated in southern parts of the Pacific Ocean are regarded by Roy (1980), Thom (1965) and Thom & Bowman (1980) as significant in the alignment of wave-built coastal deposits along the Newcastle Bight. Figure 4.4 presents the annual wind pattern: strong (sometimes greater than 41km/hr) onshore winds from the east and southeast in summer and strong westerly and norwesterly winds prevail in winter. At all times of the year, southerly busters, usually accompanied by storms, can be expected.

The open coast is influenced by a dominant southeasterly wave climate which generates high energy wave conditions and consequently considerable destruction of beach and foredune areas (Roy, 1980; Thom, 1965).

4.08.0 TOPOGRAPHY

The study area consists of a generally flat to gently undulating landscape with scattered small hills (11-20m

A.S.L.) bordered in the east by a complex dune system (up to 40m A.S.L. with a slope up to 30 percent), prominent due to the flatness of the surrounding country.

Four distinct landforms are recognised in the study area, these include outer barrier, estuarine system, inner barrier and bedrock (see Figure 4.5).

The outer barrier, or dune system, generally occurs east of Nelson Bay Road and extends to the coastline. Two units are identified within this complex system - active transgressive dunes and older, stabilised dunes. The fine grained, well-sorted sands (H.D.W.B., 1983) form a series of diurnally mobile dunes, extending the length of the coastline. Movement of these dunes is downwind and sand is presently covering swamps and some vegetated areas (H.D.W.B., 1983). This is demonstrated at Anna Bay. The Soil Conservation Service is currently implementing a programme of dune stabilisation to minimise the quantities of aeolian sand covering this area. Instability is also obvious through the presence of two large blowouts in the southwest of this unit. Inland of the prior dunes lie a series of parallel, vegetated, stable dunes and low profile sand sheets that support a dry sclerophyll forest.

The estuarine system forms an interbarrier flat between the inner and outer barrier systems, extending from Fullerton Cove to the mouth of Tilligerry Creek. This was once an extensive low-lying swampland but is presently a partially drained and developed grazing land (D.E.P., 1983).

Landward of Nelson Bay Road features an inner barrier ancient dune system that extends from Tomago to Mallabula. This comprises a series of partly eroded beach ridges, swales and modified dunes, parallel to those of the outer barrier, all of which are vegetated and stabilised (P.S.S., 1983).

The fourth landform consists of windblown sands that have been trapped around bedrock in the Nelson Bay-Anna Bay area (P.S.S., 1983).

4.09.0 GEOMORPHOLOGY

The study area forms the eastern fringe of the Tomago Basin, a geomorphological unit resulting from the late Palaeozoic diastrophism (H.D.W.B., 1983). Subsequent large scale folding created a syncline (trough) - the axis extending roughly north through the present centre of the Tomago Sandbeds and south through the Stockton sand dunes.

Folding during the Pleistocene era affected all the low lying land between Port Stephens and Newcastle, creating a large bay. Into this bay entered the waters of the Hunter, Williams and Karuah Rivers, depositing their sediments into the sea (H.D.W.B., 1983). This regime of sand deposition, in conjunction with wave and current action and various sea recessions, formed the present sandbed formation.

A comprehensive record of coastal environmental change and landform evolution during Recent times is resultant from the combined erosive forces of the sea and wind and reflected in the periodic transfer of sands and other sediments from free-moving mobile surfaces to vegetated dune ridges (D.E.P., 1983).

4.10.0 GEOLOGY & SOILS

Five geological units are identified in the study area (see Figure 4.6). The primary geological formation (covering approximately 80 percent) is Quaternary sand with gravel, silt, clay, "Waterloo" rock and marine and freshwater deposits. Minor areas of Carboniferous Nerong Volcanics outcrop in the northeast. The northwest of the study area, west of Big Swan Bay, consists of the Braxton Formation (undifferentiated sandstone, siltstone and tillitic conglomerate), Mulbring Siltstone (siltstone, sandstone and conglomerate) and the Tomago Coal Measures (shale, mudstone, siltstone, tuff and coal). These three are of Permian age.

Soils are either of the Newcastle Bight Dunal Association or

Non Dunal Association (see Figure 4.6). The Dunal Association covers an extensive area - from Tomago and Fern Bay in the south to Karuah and Port Stephens in the north. P.S.S. (1983) assumes two major and various minor soil types within this association. Alluvial soils are resultant from either marine or river deposition, the latter forming more significant deposits in the study area. The flood plains and low-lying areas surrounding Tilligerry Creek are Hexham: dark heavy, sometimes peaty, acid swamp and meadow soils in low lying areas. Aeolian (wind blown) soils within the study area are Duck Hole, Hunter Fluviatile, Avicennia and Nesta. Duck Hole is a landform of dunes and undulating sand sheets consisting of fine to medium grained, moderate to well-sorted and reworked sand forming aeolian regosols and some humus-iron podsols. An inherent feature of these soils is their unstable nature once disturbed, as evidenced by the diurnal mobility of the dunes and the extensive blowouts in the southern portion of Newcastle Bight. Hunter Fluviatile soils occur on flood plains and alluvial terraces and form the basis of most viable agricultural land. A wide range of soils are featured including cracking clays, dark coloured chernozenic, solonetzic and podzolic soils and regosols. Avicennia soils are waterlogged, saline, heavy brown clays which take the form of tidal mud flats (generally mangrove areas). The permanently moist or wet black peaty meadow soils of recent marine days are Nesta soils.

The Non Dunal soils in the study area occupy the northwest and are sedimentary based soils. A variety of soils exist: degraded black earths, shallow earths, skeletal soils and cracking clays interspaced with podzolic and solonetzic soils.

4.11.0 HYDROLOGY

The study area is divided into two natural catchments: drainage north into Port Stephens (primarily Tilligerry Creek) and south in the Hunter River (primarily Fullerton Cove; with areas of 22 and 15 km^2 respectively (D.E.P.,

1983). Overlap between these natural catchments occurs during periods of peak rainfall or severely impeded drainage, resulting in Tilligerry Creek draining south to Fullerton Cove. Drainage to the coast is impeded by the dunal system. The highly impeded drainage of the swampy backbarrier flat is compromised with the construction of a multitude of drainage channels. This area also experiences local periodic flooding due to the long distance to the nearest outlets, in conjunction with the high localised rainfall. Various floodbanks have been constructed to meet the capacity of the 1:100 year flood (see Figure 4.7).

The Tomago coastal sandbeds are an important source of good quality groundwater, with an average estimated quantity of 42,828 Ml (over a ten month period from 15th September, 1976 to 13th July, 1977) (P.S.S., 1983). The majority of the land is Crown land, sections of which have been set aside as Coastal Water Reserves vested in the Hunter District Water Board. The Reserves are generally parallel to the coast with the eastern boundary approximately 400m from the shoreline and the western boundary abutting private lands on the western side of the sand dunes (H.D.W.B., 1983). An extension of the existing reserves covering the dunal area, to Birubi Point in the northeast has been proposed. Further reserves occur in the outer barrier system containing 20 primary pumping stations which supply water to a central treatment plant at Tomago, where water is treated and pumped to reservoirs for distribution (see Figure 4.7).

4.12.0 WETLANDS

Lining both banks of Tilligerry Creek and circling Fullerton Cove, are extensive wetlands which are gazetted as Coastal Wetlands under State Environmental Planning Policy 14 (S.E.P.P. 14) (see Figure 4.8). Wetlands gazetted under this policy are resultant from the serious loss and continuing threats to that wetland area from various forms of development along the coastal zone (Browne, et.al, 1986).

The introduction of S.E.P.P. 14 in December, 1985, was the first major step towards documentation of wetland sites along the New South Wales coastline and the provision of obligations to those concerned with development projects to minimise and control impacts (Adam, Sim, Urwin and Weiner, 1985). The policy was amended in 1987 to clarify certain aspects and remove anomalies from the wetland maps. Interpretation of 1986 aerial photography, augmented by field checking of botanical communities delineated the wetland boundaries.

S.E.P.P. 14 requires that for identified areas, any development which requires draining, dredging, filling or constructing a levee upon, is regarded as a designated development under Section 29 of the E.P.A. Act, 1979. Such development requires the consent of the Council and the concurrence of the Director of the Department of Environment and Planning. S.E.P.P. 14 however, does not prohibit development within the mapped wetlands, but rather requires that a proponent should seek approval for any development likely to reduce the wetland's natural values.

These wetlands have evolved in response to the regular patterns of water movement and salinity distribution in Tilligerry Creek and exist within this equilibrium. Interference to this hydrological regime alters this balance and generates ecological change.

National Parks and Wildlife Service (1980) identify, in simple terms, four main functions of wetland systems:

a) The absorption of large quantities of water in times of excess flow and slow release of it in times of low flow; in other words, they function as natural flood mitigation areas.

b) The absorption, internal cycling and release of nutrients, although large quantities may be deposited in the substrate. In this way wetlands also function

as a sink, not only for nutrients, but for any water-transported substance from the surrounding catchment. The global importance of wetlands in providing reducing environments in which mineral cycles, especially of nitrogen and sulphur, are completed cannot be too strongly emphasised.

c) The provision of habitats for an enormous diversity of fauna, becoming strategic refuge areas in times of drought.

d) The filtering of water, with the capacity to improve water quality. The time that a body of water remains in a wetland system is long enough to allow bacterial decay, silt deposition, re-oxygenation and a degree of nutrient stripping. Water leaving wetlands is thus, from a human point of view, cleaner and therefore of greater value and potential use.

4.13.0 VEGETATION

The vegetation cover throughout the study area reflects the spread of agriculture seeking the richer soils of the valley floors and gentler slopes (P.S.S., 1983). Native forest remains on steeper slopes and ridges and the dunal systems, which provide little use for agriculture.

Six major vegetation communities are identified and mapped in Figure 4.9: Eucalyptus Tall Mixed Woodland; Eucalyptus Dry Sclerophyll Forest; Eucalpytus Savanna Woodland; Fen (Swamp) Vegetation; Mangrove Community; and Heath. Appendix 4.1 records the plant species within each community.

Eucalyptus Tall Mixed Woodland, as described by P.S.S.(1983), covers extensive areas in the north and northwest of the study area and typically consists of gums, ironbarks and stringybarks to approximately 15m in height or greater. Species and density varies according to location and aspect. A sub-group of this classification is Open Eucalyptus Tall

Mixed Woodland, which occurs within close proximity to Lemon Tree Passage Road and to the RAAF bases. This sub-group has the same genetic base as Eucalyptus Tall Mixed Woodland but differing in physical structure. The more open canopy was probably created through selective clearing.

The dunal systems forming the stable outer barrier support Eucalyptus Dry Sclerophyll Forest, consisting of at least 36 families of vascular plants being represented by more than 100 species (in totally undisturbed areas) (H.D.W.B., 1983). The upper stratum reaches 15m in height. Areas immediately adjacent to Nelson Bay Road have suffered from high fire frequency. This has lead to the depauperate understorey being dominated by Pteridium undulatum (bracken fern) and Imperata cylindrica (blady grass). Some swale wetlands are recorded (P.S.S., 1983). Small areas of Chrysanthemoides moniliferum var. rotundata (bitou bush) occur on disturbed edges of the dunes and in blowouts.

Through much of the southwest of the study area, Eucalyptus Savanna Woodland, of a reduced tree height (10m), occurs (P.S.S., 1983). This community is generally an extension of the Eucalyptus Tall Mixed Woodland, differing due to a predominantly cleared substratum of semi-improved and improved pastures.

Fen (Swamp) Vegetation approximately coincides with the interbarrier flat incorporating Tilligerry Creek and the Tomaree Peninsula in the north. P.S.S. (1983) noted that significant species variety occurs according to physical location. Areas peripheral to Eucalyptus Savanna Woodland have also been altered through various farming practices.

Stands of pure mangrove communities line Tilligerry Creek and Fullerton Cove, with the later being the largest remaining mangrove swamp on the Hunter River (D.E.P., 1983 and P.S.S., 1983). Hence they are declared as a Coastal Wetland by the D.E.P. under S.E.P.P. 14.

Small heath communities predominantly occur north of Tilligerry Creek, neighbouring the Defence Bases and northwest of Fullerton Cove. The families Proteaceae, Leguminosea and Epacridaceae form the low shrubland.

4.14.0 WILDLIFE

The extensive areas of pristine vegetation, particularly the dunal systems of Newcastle Bight and Fullerton Cove are invaluable as wildlife habitats. Isolated pockets of forested land are also vital, to provide links between neighbouring areas for hunting, foraging and resting.

A total of 38 native (see Appendix 4.2) and 9 introduced mammals are expected to occur within the study area (D.E.P., 1983, Fox and Andrew, 1982). The forested dunes are particularly suited to aboreal and ground-dwelling species. Included is Isoodon obesulus (short-nosed bandicoot) which is of uncertain status, although not yet classed as endangered (D.E.P., 1983).

The D.E.P. (1983) has recorded 66 species of birds (with a further 91 species expected to occur), mostly within the forested dunes. A high proportion, particularly migratory waders, are an integral part of the Fullerton Cove, and other wetland ecosystems. The majority of bird species are common with 7 species being uncommon (though each have been tentatively recorded in Myall Lakes). One species, Platycercus adscitus (the pale-headed Rosella) was observed in the study area in 1970 and has not been recorded elsewhere in the Lower Hunter area.

Herpetofauna is common in both the wetlands and forested woodlands. Acanthophis antarcticus (the common death adder) has been considered endangered but is locally common.

4.15.0 ARCHAEOLOGY

The pattern of archaeological remains in the study area fits neatly within the pattern of site occurrence known for the New South Wales north coast. The main features of this pattern are thin stratifications of pipi midden in foredunes, pipi midden/open sites landward of the foredunes, small to substantial midden deposits adjacent to rock platforms and substantial midden deposits at the intersection of open coast and estuarine environments (refer to Sullivan, 1982 and Byrne, 1986).

The Newcastle Bight area has attracted considerable archaeological interest in the past few decades, though the site recording efforts have been fragmented and the results sketchy.

The National Parks & Wildlife Service's Site Register includes a number of sites on the sand barrier. These are reviewed from west to east. Starling (1974) recorded a long exposure of pipi midden in the foredune west of Freshwater Lagoons and another to the east. These are sites 38-4-54 and 38-4-62 (NPWS Site Register) respectively. They are up to two kilometres seaward of the western end of the proposed transmission line route. Also in the Freshwater Lagoon area, Sullivan (1980) investigated stratified midden exposures (sites 38-4-57 and 38-4-56) adjacent to the lagoons themselves. These consisted mostly of pipi shells and included flaked-stone artefacts to a density of 15:1m^2. A preliminary report on site 38-4-57 was also filed by Dyall (1980) who noted the presence of 414 unretouched flakes, 12 cores and 45 retouched items in an area of 75m^2. This site is approximately 300 metres seaward of the western end of the proposed route. Dyall (1980) also reported a site at Williamtown (38-4-53), disturbed in the course of runway construction for the RAAF base, which consisted of a thin scatter of artefacts and shell (mostly estuarine).

To the east Dyall (NPWS Site Record) recorded a number of

middens (collectively 38-4-63) in the foredune area near Boyces Track. These were pipi middens with a low density of flaked-stone artefacts. The sites are approximately one kilometre seaward of the proposed transmission line route. A further midden (contents unspecified) was recorded by a NPWS Ranger in a deflation area behind the foredune in the Boyce's Track area. Again, this site (38-4-66) is about one kilometre seaward of the proposed route.

Several sites are on record in the Morna Point area at the eastern end of the Bight (e.g., 38-5-37, 38-5-35, 38-5-16). Dyall excavated the Birubi midden (38-5-16) and filed a detailed report on the fauna (beach, estuarine, and rock platform shellfish along with a large number of fish species) and artefacts (including bone points and fish hooks). A basal date of 1240±80 years BP was obtained (Dyall 1979).

With the exception of 38-4-63 all the above sites were recorded piecemeal rather than by systematic survey. The 38-4-63 middens were recorded during a survey on foot carried out by Dyall in 1975 between Boyces Track and Birubi Point (information from 38-4-63 site file). Coverage seems to have been confined to the foredune.

Systematic surveys have been carried out in the general area of Newcastle Bight. These are the investigation by Brayshaw (1982) of the Williamtown RAAF base extensions, Brayshaw's (1981) survey of the aluminium smelter site at Hexham and Cubis' (1981) survey of a housing sub-division at Lemon Tree Passage. Neither of Brayshaw's surveys produced any sites. Cubis' recorded an estuarine midden (38-5-74) in the course of his Lemon Tree Passage survey.

Clearly, only a fraction of existing sites have yet been recorded in the study area. The specific archaeological site potential would seem to be restricted to pipi middens and open sites (stone artefact scatters). It will be noted that to date all middens on the Holocene sands have been recorded seaward of the proposed routes. Most obviously this would

seem to reflect proximity of the beach with its shellfish and fish resources. The possibility of such sites as far inland as the survey area, however, can by no means be eliminated. Various non-marine food resources are available in the survey area (e.g. small mammals, Macrozamia nuts, bracken fern rhyzome), however, the potential density of sites here is probably less than in the area seaward.

Several land claims have been granted to the local aboriginal tribes due to their archaeological importance. Numerous land claims are still under investigation. Appendix 4.3 lists all the claims within the study area.

4.16.0 VISUAL CHARACTER

Differing from the strong industrial image of the Hunter Region in general, the study area contains considerable tracts of natural and agricultural land, creating an attractive inherent character within the corridor. Particular landscapes include the diurnally mobile sands of Newcastle Bight, the vegetated stablised dunal system, the ancient volcanic remnants, the wetlands of statutory quality surrounding Tilligerry Creek and the open farm lands of Williamtown, Salt Ash, Bobs Farm and Anna Bay.

The study area forms a backdrop to most of the views north of metropolitan Newcastle and attributes to the high tourist value of the region. Hence, conservation of this visual character is vital.

The above landscapes, as observed from the major travel zones, are an important visual resource to this tourist area. Seven landscape character zones are identified - coastal forest on the dunal system, tall woodland on the Tomago Sandbeds, agricultural lands on the interbarrier flat, hydrological units and their associated wetlands, heath on low-lying terrain, rural residential lining travel zones and industrial/commercial areas. Each is individual in visual character and hence its ability to accept the proposed development.

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

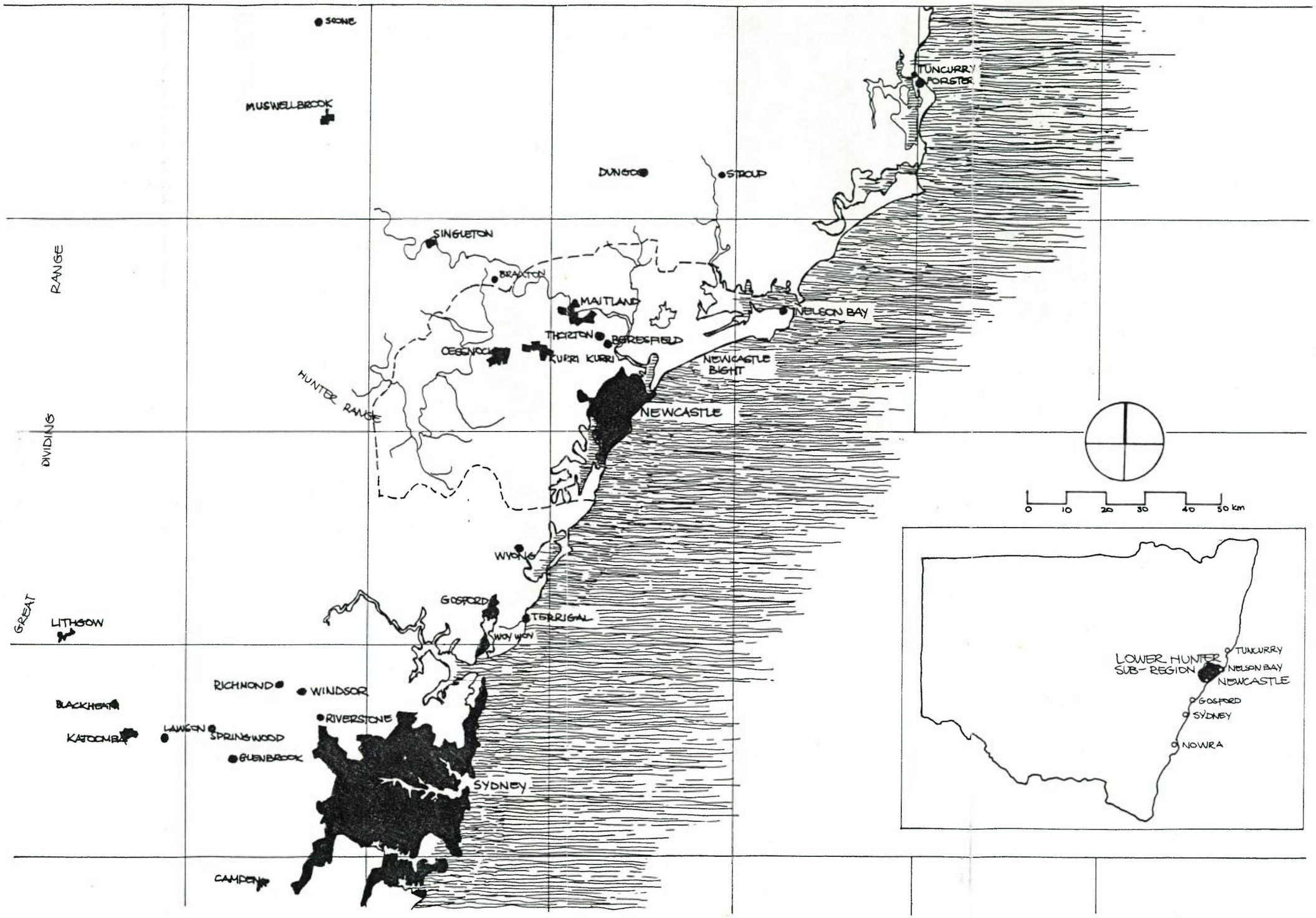


Figure 4.1
REGIONAL CONTEXT

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMS TOWN LAKE
MOFFATS SWAMP
Bombing Range
Williamtown RAAF Air Base
SALT ASH
WILLIAM TOWN
TOMAGO SUBSTATION
CABBAGE TREE ROAD
FULLERTON COVE
STOCKTON BEACH
NEWCASTLE BIGHT

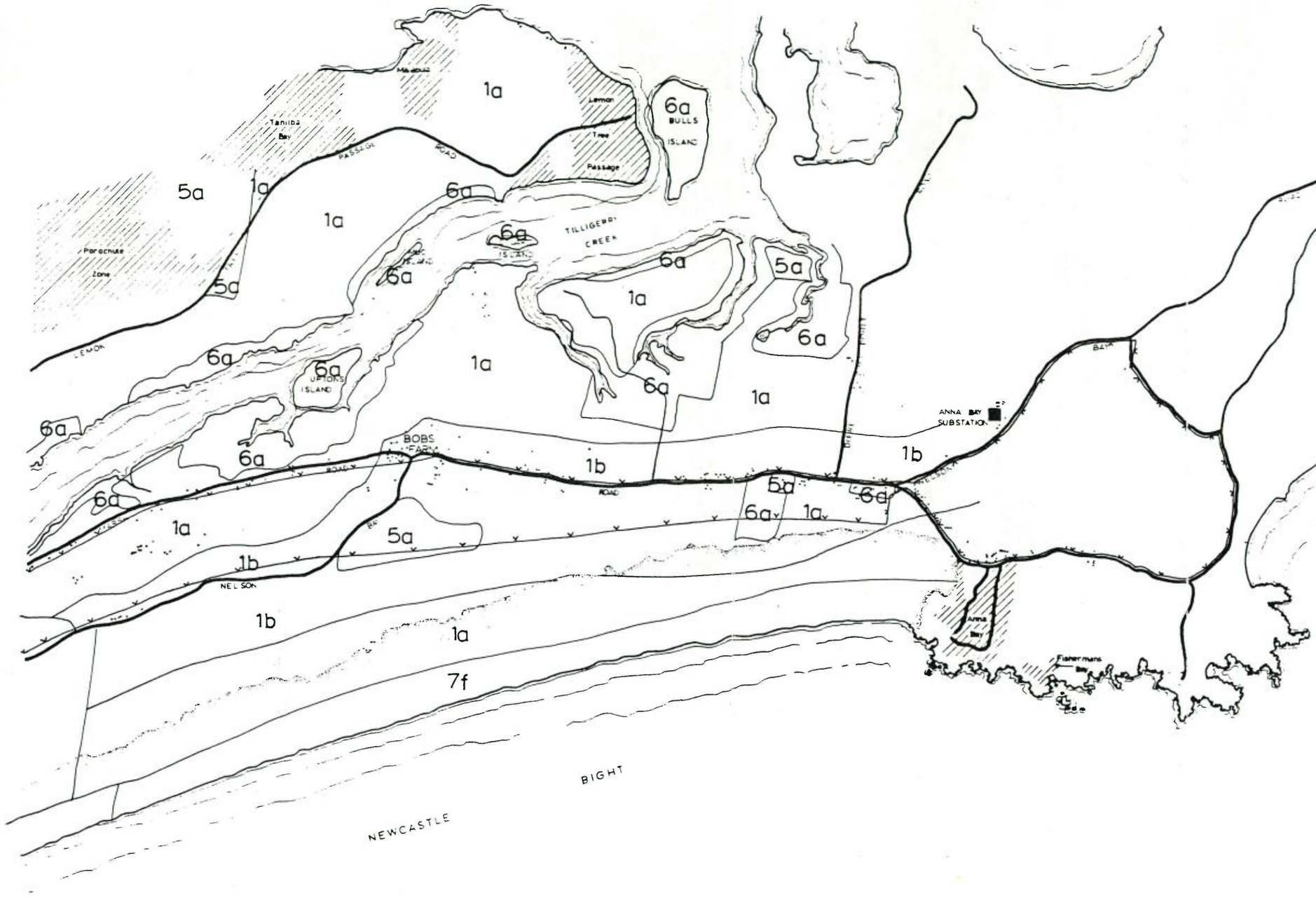
LEGEND

- 1a NON-URBAN 'A' (40 HA MIN.)
- 1b NON-URBAN 'B' (40 HA MIN./REST)
- 1c NON-URBAN 'C' (FLOODPLAIN)
- 2a RESIDENTIAL 'A'
- 2e RESIDENTIAL 'E' (VILLAGE)
- 4c INDUSTRIAL (WATERFRONT)
- 5a SPECIAL USES 'A' (SCHOOL, HOSPITAL, WATER SUPPLY)
- 6a OPEN SPACE (RECREATION)
- 6b SPECIAL PURPOSES
- 7f RURAL ENVIRONMENTAL PROTECTION (COASTAL LANDS PROTECTION)

Figure 4.2A
ZONING

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



LEGEND

1a	NON-URBAN 'A' (40 HA MIN.)
1b	NON-URBAN 'B' (40 HA MIN./REST)
1c	NON-URBAN 'C' (FLOODPLAIN)
2a	RESIDENTIAL 'A'
2e	RESIDENTIAL 'E' (VILLAGE)
4c	INDUSTRIAL (WATERFRONT)
5a	SPECIAL USES 'A' (SCHOOL, HOSPITAL, WATER SUPPLY)
6a	OPEN SPACE (RECREATION)
6b	SPECIAL PURPOSES
7f	RURAL ENVIRONMENTAL PROTECTION (COASTAL LANDS PROTECTION)

Figure 4.2B
ZONING

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

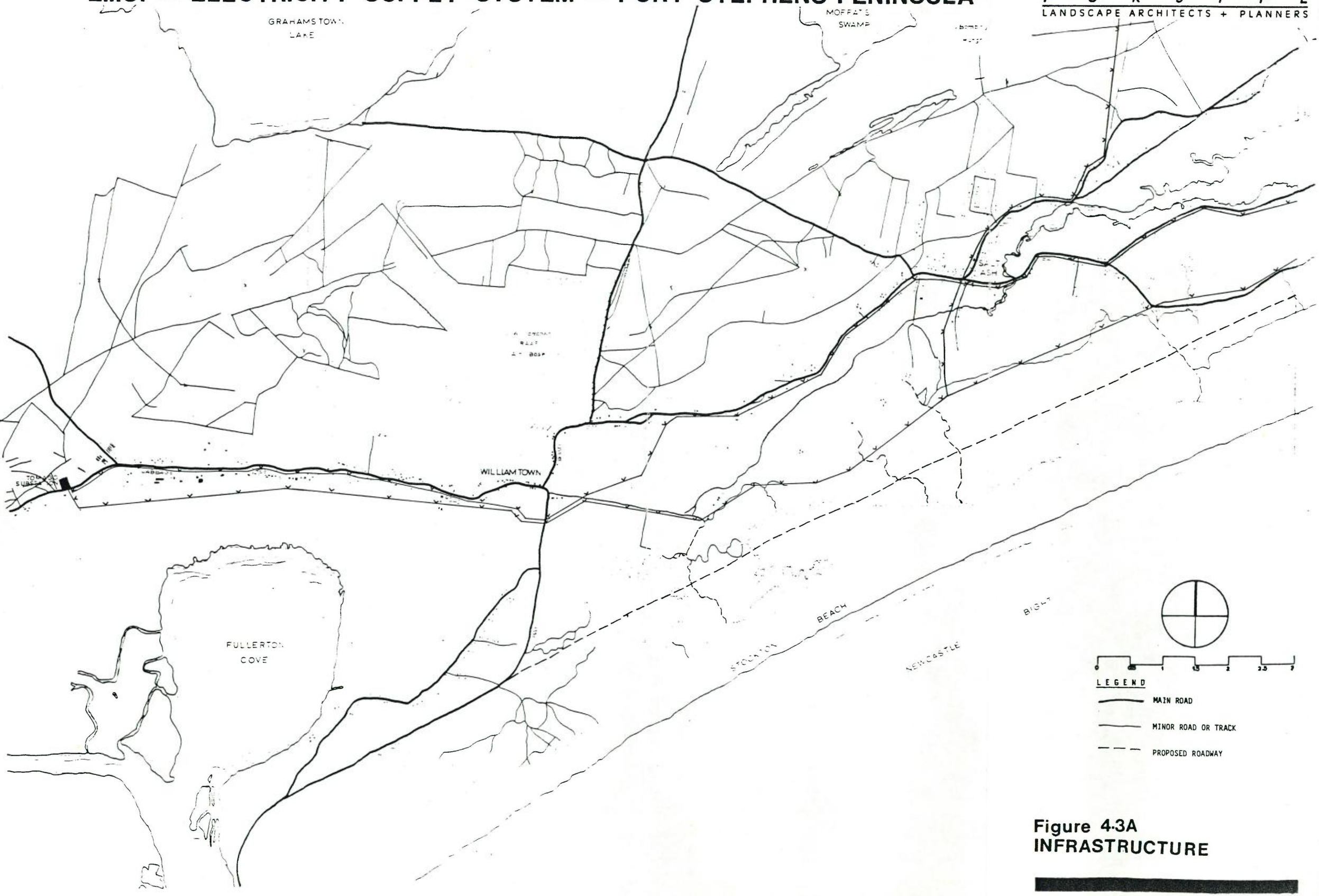
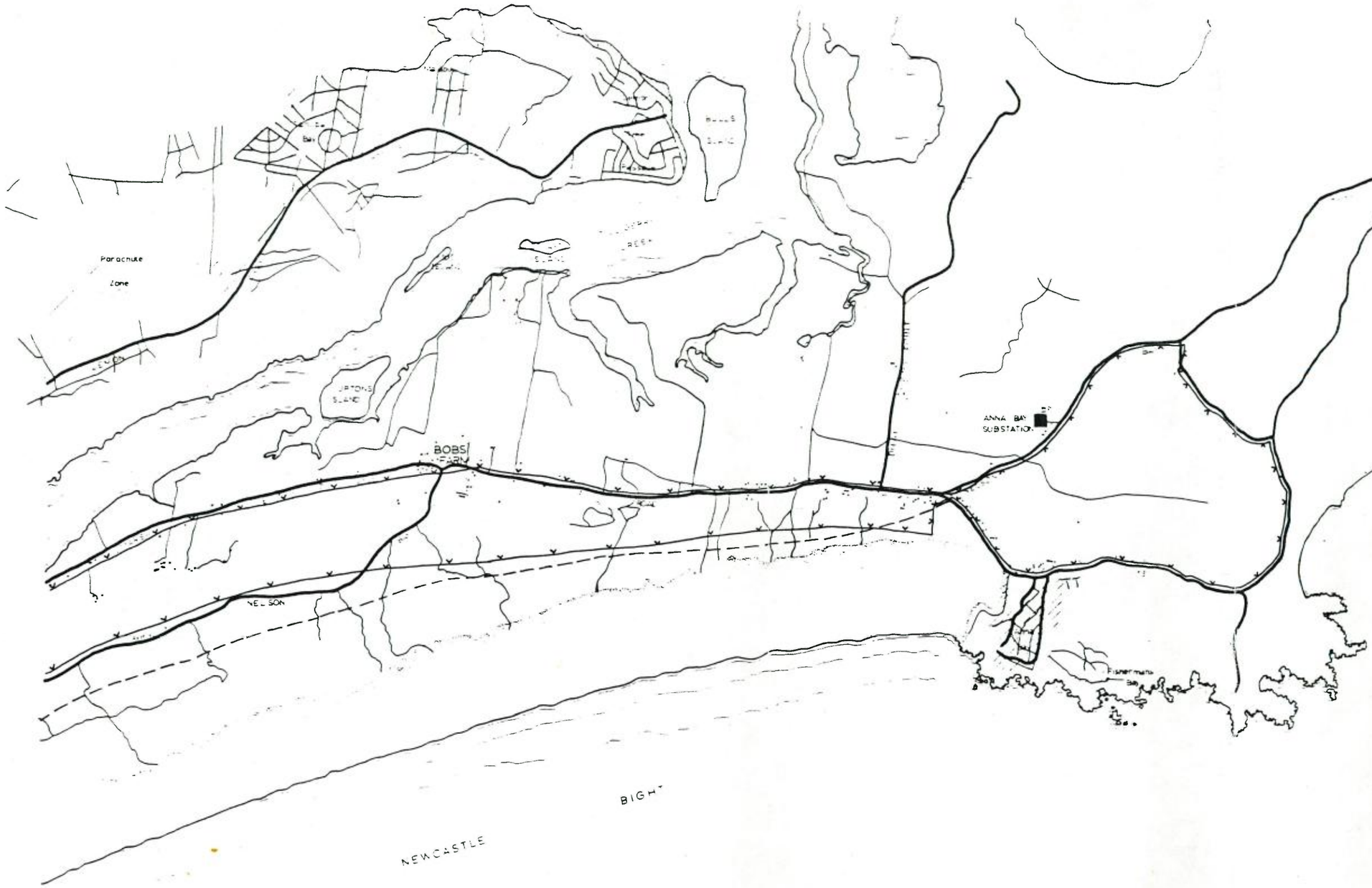


Figure 4.3A
INFRASTRUCTURE

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



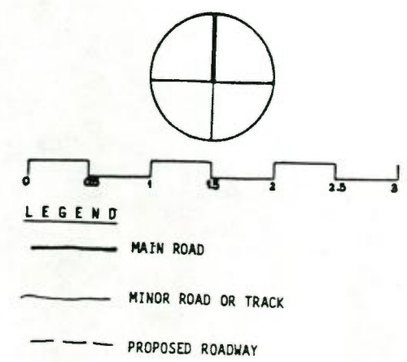
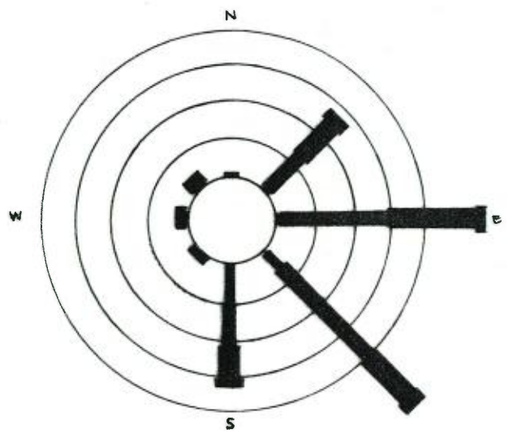


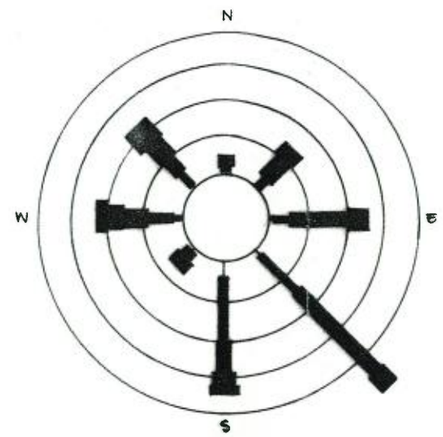
Figure 4.3B
INFRASTRUCTURE

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

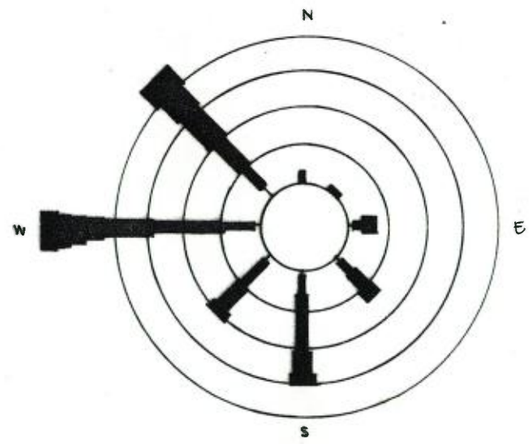
F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS



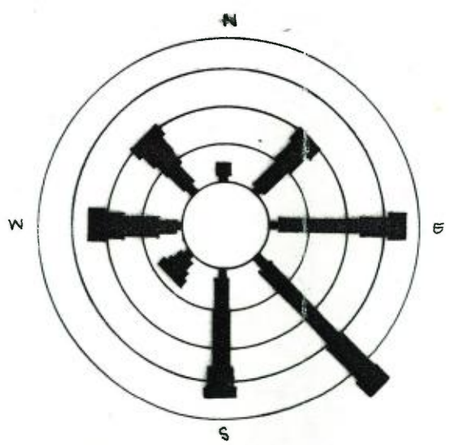
SUMMER



AUTUMN



WINTER



SPRING

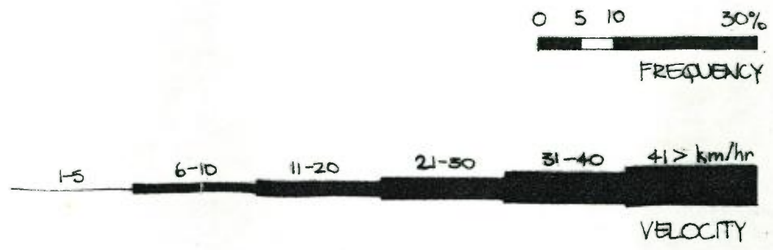


Figure 4.4
WIND SPEED AND DIRECTION

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMSTOWN LAKE

MOFFATS SWAMP

TOMAGO SUBSTATION

WILLIAM TOWN

FULLERTON COVE

STOCKTON BEACH

NEWCASTLE BIGHT

0 .25 .5 1 1.5 2 2.5 3

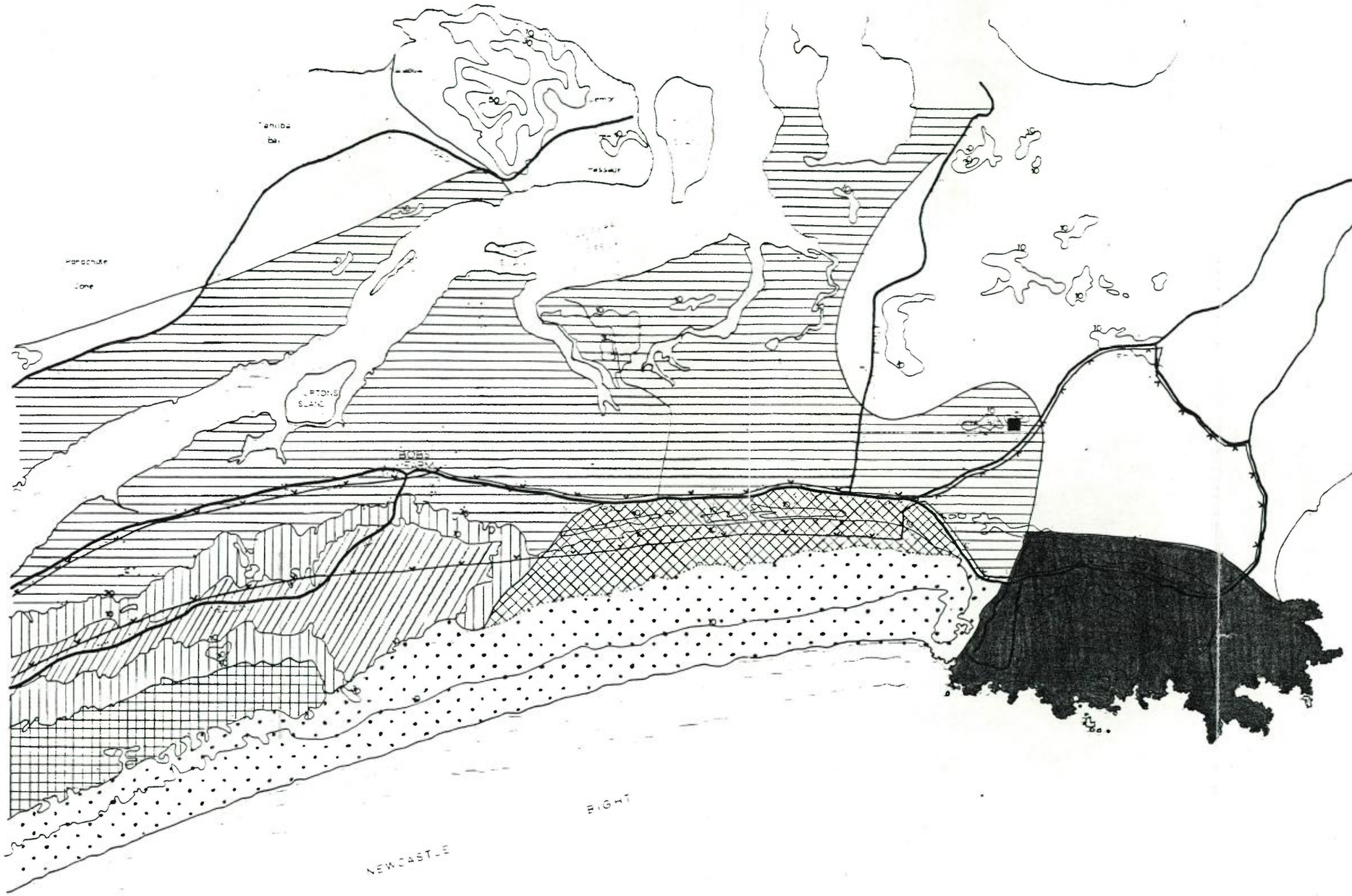
LEGEND

- PLEISTOCENE INNERBARRIER SAND DUNES
- QUATERNARY INTERBARRIER FLAT
- HOLOCENE STABILISED TRANSGRESSIVE DUNES
- HOLOCENE SOUTH-WESTERN LOW STABILISED DUNES
- HOLOCENE INNER STABLISED DUNES
- HOLOCENE OUTER STABILISED DUNES
- HOLOCENE BEACH RIDGES
- HOLOCENE SOUTH-WESTERN BLOWOUT
- HOLOCENE ACTIVE TRANSGRESSIVE DUNES
- BEDROCK

Figure 4.5A TOPOGRAPHY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



0 .5 1 1.5 2 2.5 3

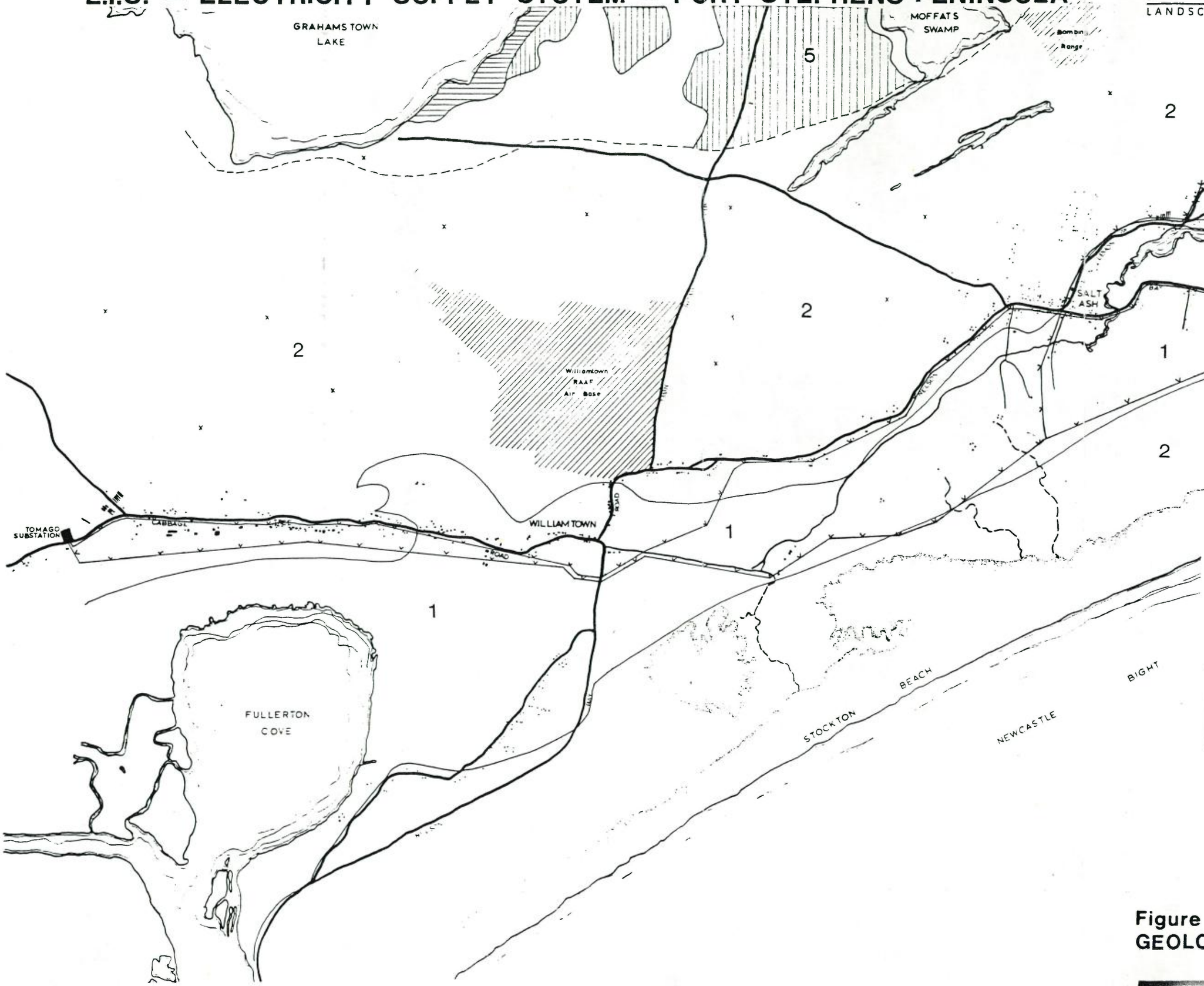
LEGEND

- PLEISTOCENE INNERBARRIER SAND DUNES
- QUATERNARY INTERBARRIER FLAT
- HOLOCENE STABILISED TRANSGRESSIVE DUNES
- HOLOCENE SOUTH-WESTERN LOW STABILISED DUNES
- HOLOCENE INNER STABLISED DUNES
- HOLOCENE OUTER STABILISED DUNES
- HOLOCENE BEACH RIDGES
- HOLOCENE SOUTH-WESTERN BLOWOUT
- HOLOCENE ACTIVE TRANSGRESSIVE DUNES
- BEDROCK

Figure 4.5B TOPOGRAPHY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS



LEGEND

GEOLOGY

QUATERNARY - ALLUVIUM.
GRAVEL, SAND, SILT, CLAY,
MARINE & FRESHWATER DEPOSITS

PERMIAN - BRAXTON FORMATION.
UNDIFFERENTIATED SANDSTONE,
SILTSTONE, TILLITIC CONGLOMERATE

PERMIAN - MULBRING SILTSTONE.
SILTSTONE, SANDSTONE, CONGLOMERATE

PERMIAN - TOMAGO COAL MEASURES.
SHALE, MUDSTONE, SANDSTONE,
TUFF, COAL

CARBONIFEROUS - NERONG VOLCANICS.
TOSCANITE, DACITE, ANDESITE,
IGNIMBRITE, CONGLOMERATE, SANDSTONE

SOILS

DUNAL ASSOCIATION

1 ALLUVIUM SOILS HEXHAM

2 AEOLIAN DUCKHOLE/NESTA
HUNTER FLUVIATILE/AVICENNIA

NON-DUNAL ASSOCIATION

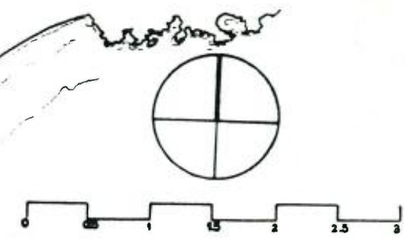
5 SHALE, SANDSTONE/CONGLOMERATE

Figure 4.6A
GEOLOGY AND SOILS

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS





LEGEND

GEOLOGY

QUATERNARY - ALLUVIUM. GRAVEL, SAND, SILT, CLAY, MARINE & FRESHWATER DEPOSITS

PERMIAN - BRAXTON FORMATION. UNDIFFERENTIATED SANDSTONE, SILTSTONE, TILLITIC CONGLOMERATE

PERMIAN - MULBRING SILTSTONE. SILTSTONE, SANDSTONE, CONGLOMERATE

PERMIAN - TOMAGO COAL MEASURES. SHALE, MUDSTONE, SANDSTONE, TUFF, COAL

CARBONIFEROUS - NERONG VOLCANICS. TOSCANITE, DACITE, ANDESITE, IGNIMBRITE, CONGLOMERATE, SANDSTONE

SOILS

DUNAL ASSOCIATION

1 ALLUVIUM SOILS HEXHAM

2 AEOLIAN DUCKHOLE/NESTA HUNTER FLUVIATILE/AVICENNIA

NON-DUNAL ASSOCIATION

5 SHALE, SANDSTONE/CONGLOMERATE

Figure 4.6B
GEOLOGY AND SOILS

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMS TOWN LAKE
MOFFATS SWAMP
Bombing Range
SALT ASH
Williamtown RAAF Air Base
TOMAGO SUBSTATION
CABBAGE TREE ROAD
WILLIAM TOWN
FULLERTON COVE
STOCKTON BEACH
NEWCASTLE BIGHT

0 .5 1 1.5 2 2.5 3

LEGEND

- CREEK
- DRAIN
- WATER BODY
- X PUMPING STATION
- FLOOD BANK
- TOMAGO SANDBEDS
- PROPOSED EXTENSION TO TOMAGO SANDBEDS

Figure 4.7A
HYDROLOGY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



Figure 4.7B
HYDROLOGY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

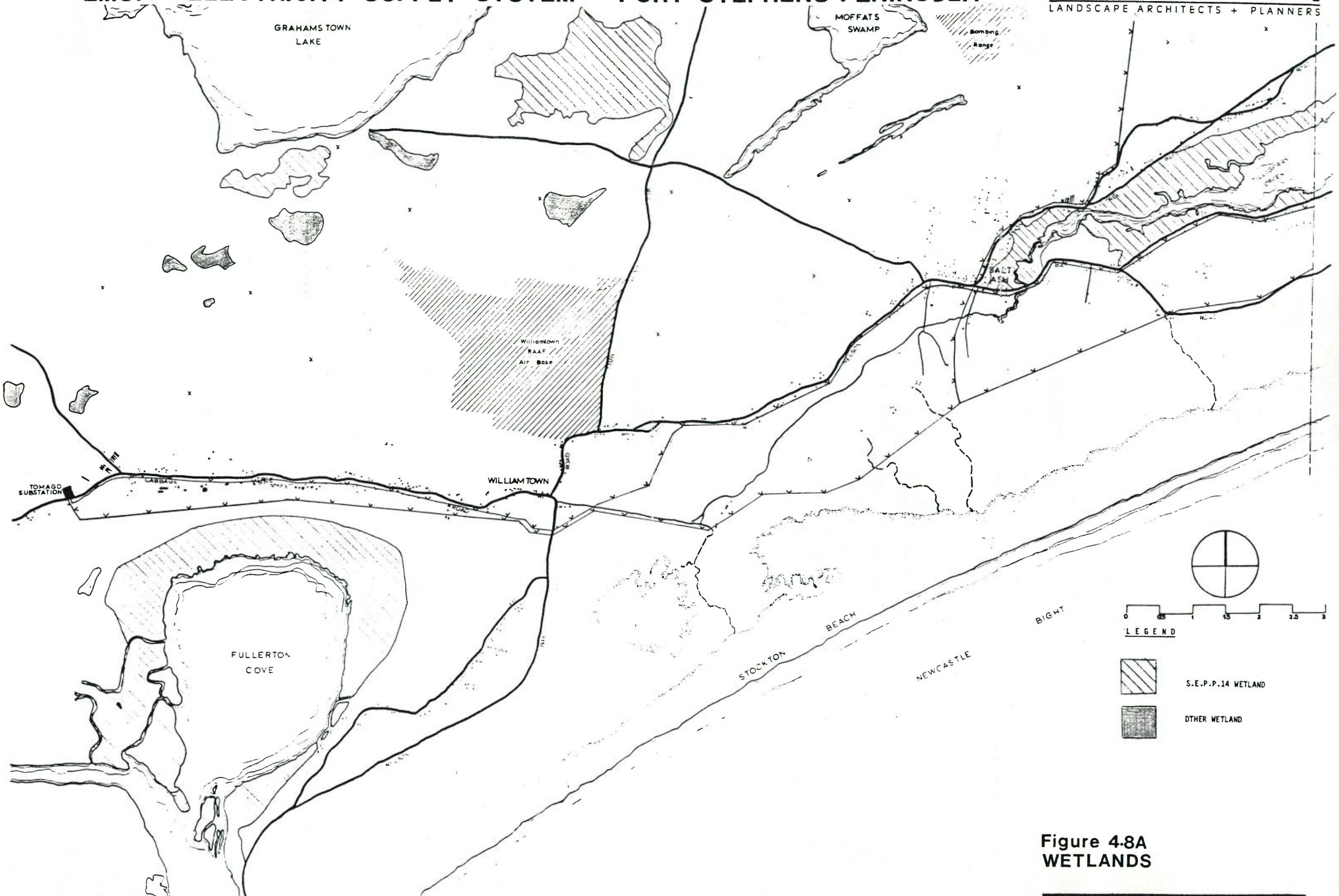


Figure 4.8A
WETLANDS

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



Figure 4.8B
WETLANDS

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



Figure 4.9B
VEGETATION COMMUNITIES

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMS TOWN
LAKE

MOFFATS
SWAMP

RAAF
Air Base

WILLIAM TOWN

FULLERTON
COVE

STOCKTON
BEACH

NEWCASTLE
BIGHT

0 .5 1 1.5 2 2.5 3

LEGEND

- EUCALYPTUS TALL MIXED WOODLAND
- OPEN EUCALYPTUS TALL MIXED WOODLAND
- EUCALYPTUS DRY SCLEROPHYLL FOREST
- EUCALYPTUS SAVANNA WOODLAND
- FEN (SWAMP) VEGETATION
- HEATH
- MANGROVE COMMUNITY
- ROW OF TREES IN EUCALYPTUS SAVANNA WOODLAND
- C CLEARED - VOID OF VEGETATION

Figure 4.9A
VEGETATION COMMUNITIES

5.00.0 D E S C R I P T I O N O F T H E P R O P O S A L

5.01.0 GENERAL

The proposal encompasses the construction of two 132kV transmission lines from the Tomago Substation to a substation site at Anna Bay. The lines will travel northeast from the supply point, one north and one south of Tilligerry Creek, to unite at the delivery point (approximately 1.4km along Nelson Bay Road, beyond the Anna Bay turn-off). Easement acquisition for the new transmission lines is necessary and hence is included in the proposal.

Various phases are incorporated within the proposal: environmental reconnaissance; route selection; line design; construction; restoration and maintenance. The Route Selection Procedure identifies the approach in selecting the route options. Further considerations produce the most suitable routes. Final line design relates to the onsite situation and the constraints imposed by the physical components of the development. Construction involves clearing, structure erection, stringing and restoration. Periodic maintenance will sustain the safety and duration of the development.

Public relations is an integral component of the development. Continued liaison with the properties owners enables their requirements to be respected during all phases of the development.

The Environment Assessment Manual (1985) prepared for S.C.C. by FORSITE Landscape Architects and Planners, provides complete guidelines for the entire proposal procedure.

5.02.0 ROUTE SELECTION PROCEDURE

Route selection involves environmental evaluation and definition of the route corridor to determine the optimum route zone within which the final location of the line will

occur. Natural and land use factors were evaluated to determine the visual sensitivity, visual absorption capacity and functional absorption capacity. Environmental factors were also considered.

5.02.1 Corridor Selection

The initial step of route selection involves the definition of a corridor : the broadest possible enclosure of land likely to contain a suitable route. The point of delivery and point of supply determine the extremities of the corridor. Numerous natural and cultural elements were considered in light of the range of possibilities and restrictions occurring within the vicinity of the likely corridor.

The bulk supply substation at Tomago, 0.8 kilometres along Tomago Road west of its junction with Cabbage Tree Road, will be the supply point-where both lines commence. The site of the Anna Bay substation, approximately 1.4 kilometres along Nelson Bay Road beyond the Anna Bay turn-off, will be the point of delivery. This site was selected by S.C.C. to be the most suitable to inject the increased system capacity into the existing network.

The study area was then assessed by maps and aerial photography to view natural and land use factors at the broadest scale, so that environmental advantages or disadvantages could be considered against one another. Areas for exclusion from the corridor were : Williamtown RAAF and civil aircraft facilities; Salt Ash parachute and bombing range; Stockton Beach, including the diurnally mobile sand dunes; H.D.W.B. primary pumping stations; glass sand mining leases directly south of Big Swan Bay; the urban residential areas of Lemon Tree Passage, Mallabula, Tanilba Bay, Anna Bay and Fisherman's Bay; and extensive areas of the forested dunal system with a slope in excess of 18 degrees. Further delineation of areas of low preference include the Coastal Wetlands (S.E.P.P. 14) bordering Tilligerry Creek and

Fullerton Cove and the large tracts of dry sclerophyll forest covering the apexes of the Stockton Beach foredunes due to their high scenic value.

Final corridor definition is on the basis of engineering and economic considerations. Figure 5.1 shows the completed edge of the corridor - approximately 35 kilometres in length and up to 15 kilometres wide.

5.02.2 Route Selection

The defined corridor contains a range of conditions which influence the suitability of a route for the transmission line. Route selection within the defined corridor is completed in a number of separate steps. These encompass:

- resource evaluation of corridor;
- delineation of landscape character zones;
- definition of each zone's
  * visual absorption capacity
  * functional absorption capacity
  * visual sensitivity;
- delineation of suitability areas;
- definition of other environmental constraints;
- final route selection.

Resource Evaluation

Relevant resource factors were evaluated to determine the suitability of each parcel of land within the corridor for the transmission lines. The topography, vegetation, geology, soils, earth resources, hydrology, infrastructure, rural land capability, land use zoning as well as conservation recommendations from the Department of Environment and Planning (D.E.P.) and the National Parks and Wildlife Service (N.P.W.S.) were mapped (listed in Appendix 5.1). Each resource factor is described in Section 4.00 and illustrated in the associated figures.

Landscape Character Zones

Through the consideration of various resource factors, landscape character zones can be created. These zones represent areas of relatively homogenous appearance, generated through a combination of natural and land use elements. For the purpose of transmission line route selection, the structure of the character zone rather than its geographic location or its ecological make up is important.

For the purposes of this study, the landscape character zones were primarily based on a combination of vegetation, topography and land use factors. Newcastle Bight is a mosaic of the following landscape character zones.

* Coastal forest on the dunal system.
* Tall woodland on the Tomago Sandbeds.
* Agricultural lands on the interbarrier-flat.
* Hydrological units and their associated wetlands.
* Heath on low-lying terrain.
* Rural residential areas lining travel zones.
* Industrial/commercial areas.

Within each landscape character zone, sub-groups can be identified due to elements within each zone being insufficient in size or visual character to be designated a new zone. Such sub-groups tend to be specific to the zones and hence are included. Within the dry sclerophyll forest on the dunal system are swales, hillslopes, ridge tops and peaks as well as foredunes and hind-dunes; together they form the one landscape character zone.

Visual Absorption Capacity

Visual absorption capacity (VAC) is a measure of the ability of a parcel of land to minimise the visual intrusion of the transmission line. VAC is influenced by both natural elements of the landscape (in particular topography and vegetation) and the visual character of land use features such as buildings and fences.

The study area was assessed for VAC and recorded in Table 5.1 and Figure 5.2. The individual VAC scores for topography and vegetation were summed, however the hydrological units and roadway scores remained separate. A character unit with a score : less than 9 has a high VAC;
: between 9 and 16 has a moderate VAC;
and : greater than 16 has a low VAC.

It is important to note that many zone boundaries have a transition zone of VAC: a zone that provides a partial screen for the transmission line against the background vegetation. Transition zones that were particularly evident occur between the dunal dry sclerophyll forest and agricultural land utilitised for grazing (see Figure 5.2).

The viewing line plays an important role in VAC assessment. In general, if the transmission line is at right angles (90 degrees) to the viewing line, a high VAC was scored and if parallel to the viewing line, a low VAC was scored. Approximately 1.5 kilometres from the eastern Marsh Road turn-off, along Nelson Bay Road, the 33kV "sandhills" line crosses the road, creating an avenue parallel to the viewing line. Hence, a low VAC was allocated.

Topography influences the VAC. A topographically prominent area becomes visually exposed, reducing the VAC. The foredunes of Stockton Beach have a lower VAC than the hinddunes due to their proturberance from the Newcastle Bight coastline. The swale between the two major forested dunes provides excellent concealment of a transmission line.

Many aspects of vegetation dictate the VAC value. The structure of vegetation communities is the most important aspect when considering transmission line placement. Vegetation communities that include large trees to visually integrate the line, and an understorey capable of regrowth to provide partial screening of poles have a high VAC. Both the Eucalyptus Dry Sclerophyll Forest and Eucalyptus Tall Mixed

TABLE : 5.1 VISUAL ABSORPTION CAPACITY

VAC RATING	HIGH	MEDIUM	LOW
ELEMENTS	<8	8-16	>16

NB: All boundaries have a transition zone of visual absorption capacity: for example boundaries between tall vegetation systems and wetlands, or agricultural land create a good background screen for a transmission line when positioned against the tall forest (Subtract 4 from value).

HYDROLOGY		small water body surrounded by trees	15	Fullerton Cove	25
				Grahamstown Lake	25
		small wetland bordered by trees	15	Moffats Swamp	24
				Tilligerry Creek	24
				Stockton Beach	24
				blowout	24
				small creek in open country	17
				large wetland	16
TOPOGRAPHY & VEGETATION	Dry Sclerophyll forest on dunal system within swale between two major dunes (<10m a.s.l.).	Heath community of low-lying land (<10m).	14	large sand pit or quarry void of vegetation.	20
	5	Dry Sclerophyll and Tall Mixed Woodland boundaries with other vegetation systems which provide suitable background screening for line.	14	islands within Tilligerry Creek comprised of wetland systems.	19
	Tall Mixed Woodland on Tomago Sandbeds 5			Dry Sclerophyll Forest on dunal system when parallel to viewing line.	19
	Tomago Sandbeds Water Supply Works (<10m a.s.l.) 3				

TABLE : 5.1 VISUAL ABSORPTION CAPACITY

VAC RATING / ELEMENTS	HIGH <8	MEDIUM 8-16		LOW >16	
TOPOGRAPHY & VEGETATION (cont)		small sand pit or quarry with surrounding natural vegetation.	13	rural residential blocks/ hobby farms on semi-cleared areas (10m a.s.l.)	18
		Fenninghams Is. Caravan Park on banks of Tilligerry Creek.	12	savanna woodland composing agricultural lands on low lying areas (<10m a.s.l.)	18
		Caravan Park on Tilligerry Creek north east of Mud Island.	12	Dry Sclerophyll Forest or Tall Mixed Woodland on ridge or hill top (>30m a.s.l.)	17
		Open Tall Mixed Woodland north of Tilligerry Creek and neighbouring RAAF bases (<10m.s.a.l.)	12	dune system between Marsh Rd. and Nelson Bay Rd.	17
		Dry Scleophyll forest covering foredunes of Stockton Beach (<10m a.s.l.)	12		
		large storage areas of farming equipment/ produce.	11		
		small commercial/industrial developments enveloped with natural tall vegetation.	11		

TABLE : 5.1 VISUAL ABSORPTION CAPACITY

VAC RATING / ELEMENTS	HIGH <8		MEDIUM 8-16		LOW >16	
TOPOGRAPHY & VEGETATION (cont)			Dry Sclerophyll Forest on dune or hill slope.	11		
			Dry Sclerophyll forest covering hind-dunes of Stockton Beach. (10-30m a.s.l)	11		
			mangrove communities along Tilligerry Creek & Fullerton Cove flood plains.	10		
			isolated pockets of dry sclerophyll forest and tall mixed woodland within cleared land.	10		
ROADWAYS	Nelson Bay Rd (from Fenninghams Is. Rd to Anna Bay turn-off).	7	Marsh Road	15	Cabbage Tree Rd.	19
	Masonite Road	7	Lemon Tree Passage Rd. (from NE Rookes Rd. turn-off to Tanilba Bay)	13	Nelson Bay Rd. (from edge of dunal system to Lavis Lane).	19
	Main Road 518	6	Tomago Road	12	Lavis Lane	19
					Janet Parade	18

TABLE : 5.1 VISUAL ABSORPTION CAPACITY

VAC RATING / ELEMENTS	HIGH <8		MEDIUM 8-16		LOW >16	
ROADWAYS (cont)	Nelson Bay Rd. (from edge of dunal system to Fern Bay).	6	Lemon Tree Passage Rd. (from Nelson Bay Rd. turn-off to SW Rookes Rd. turn-off).	11	Fullerton Cove Rd.	18
	Fenningham Is. Road.	6			Nelson Bay Rd. (from Lavis Lane to Marsh Rd) (from Anna Bay turn-off to edge of wetland comm-unity).	18
	Nelson Bay Rd. (opposite Marsh Rd).	5			Oakfield Tk	18
	Richardson Rd.	5			Lemon Tree Passage Rd (opposite Rookes Rd)	18
	unsealed, unnamed roads within Tomago Sandbeds.	5				
	Macs Tk.	4				
	Boyces Tk.	4				
	Oakfield Tk.	4				
	Mareba Tk.	4				
	unsealed, un-named tracks within dunal system.	4				

Woodland provide suitable visual absorption. Isolated patches of tall trees and rows of trees within areas of medium to low VAC, can be utilised for background or partial screening within the area.

The VAC of a hydrological unit is very low because water bodies are flat and allow long views on to the transmission lines as crossing occurs. The VAC is a function of the width of the river and the quantity of riverside vegetation. Tilligerry Creek is too wide for riverside vegetation to form a complete or even partial canopy producing long sight lines from the water and shorelines. The surrounding topography is floodplain yielding long views from all directions onto any transmission line. A low VAC was assigned.

Roadways are also scored in relation to the amount of vegetation suitable for screening the transmission line from view. A major arterial road slicing cleared land utilised for cattle grazing, such as Nelson Bay Road from Lavis Lane to Marsh Road, has little vegetation suitable for screening and hence a low VAC. The unsealed, unnamed roads and tracks within the Tomago Sandbeds and the dunal system have a high VAC due to the high quantity of vegetation present along the length of the track, which suitably reduces the visual impact of a transmission line.

Functional Absorption Capacity

The functional impact can be measured by establishing the functional absorption capacity (FAC) of each parcel of land within the study area. The FAC of a parcel of land is a measure of its ability to accept a development without loss in its capacity to carry out the function for which it is being used. FAC is dependant on the land use, its production and management characteristics and the nature of the development. Table 5.2 describes the rating of each character zone within the study area: high - 1 to 3; medium - 4 to 6; low 7 to 10 (see Figure 5.3).

TABLE : 5.2 FUNCTIONAL ABSORPTION CAPACITY

RATING / ELEMENT	HIGH		MEDIUM		LOW	
	1 - 3		4 - 6		7 - 10	
LAND USE	Tall Mixed Woodland of Tomago Sandbeds (north west)	3	proposed urban residential	5	Stockton Beach and foredunes	9
	agriculture/ grazing	3	Dry Sclerophyll Forest of dunal system	4	agricultural/ market gardens	8
	small isolated pockets of Dry Sclerophyll Forest and Tall Mixed Woodland	2			Fenningham Is. Caravan Park	8
	Heath	2			Rose Farm	8
	Wetland systems not declared as "Coastal Wetlands"	2			Oakvale	8
	Open Tall Mixed Woodland	2			Caravan Pk. on Tilligerry Creek north east of Mud Island	8
	Department of Agriculture Research Station	1			rural residential blocks & farms	7
	industrial developments (including sand quarries and pits)	1			"Coastal Wetlands" as described in S.E.P.P.14	7
ROADWAYS	minor unsealed unnamed roads within Tomago Sandbeds	3	Tomago Road	6	Nelson Bay Rd	9
			Masonite Road	6	Marsh Rd.	8
			Lavis Lane	5	Lemon Tree Passage Rd.	8

TABLE : 5.2 FUNCTIONAL ABSORPTION CAPACITY

RATING / ELEMENT	HIGH	MEDIUM		LOW	
	1 - 3	4 - 6		7 - 10	
ROADWAYS (cont)		Oakfield Lane	5	Fullerton Cove Road	8
		Brownes Road	5		
				Cabbage Tree	
		Rookes Road	5	Road	7
		Steel Street	4	Richardson Rd.	7
		Coxs Lane	4	Diere Pt. Rd.	7
		Macs Track	4	Fenninghams Island Road	7
		Boyces Track	4		
				Main Road 518	7
		Oakfield Tk.	4		
				road to Anna Bay	7
		Mareba Track	4		
		unsealed, unnamed tracks within dunal system	4		

Rural residential blocks of less than 40 hectares in area deployed for commercial market gardens were rated with a low FAC. The functional impact on these blocks, such as those mid-way along Nelson Bay Road (opposite Marsh Road), would be high due to the imposed restrictions resultant from the transmission line and accompanying easement (Appendix 5.2). Space within these smaller blocks is vital and is utilised to a maximum. Hobby farms similarily have a low FAC due to the space restrictions on the living and recreational areas.

Land use areas with a role in tourist attraction such as The Rose Farm, Oakvale and Fenningham Island Caravan Park, were scored with a low FAC. A transmission line would be incompatible with the function of the recreation area, as the tourists hold expectations in relation to the natural environ-ment in which they relax.

The wetlands lining Tilligerry Creek and Fullerton Cove are considered of conservation importance and hence gazetted as "Coastal Wetlands" (D.E.P., 1985). Consent is required to clear, fill, construct or build a levee upon and stringent management controls are implemented by the D.E.P. Hence a low FAC was scored.

The dry sclerophyll forest of the dunal system is vacant Crown land, sections of which have been set aside as Coastal Water Reserves vested in the H.D.W.B. This area has a limited role as a recreational and visual resource. A transmission line would partially alter the expectations of the land implemented by tourists and naturists. Hence a medium FAC was allocated.

The tall mixed woodland of the Tomago Sandbeds has similar uses to the dunal dry sclerophyll forest, less the recreation role and hence is classified as a high FAC.

Agricultural land used for cattle grazing has a high FAC as no restrictions are imposed with the addition of a transmission line and easement (Appendix 5.2).

The many small isolated pockets of remnant forest are either vacant land or vegetation deliberately retained for a specific function (e.g. a windbreak). The purpose of such vegetation can be retained with the presence of a transmission line and thus was nominated a high FAC.

Small industrial areas have a high FAC as minimal functional change will occur with a transmission line development. Such areas are already incompatible with the natural environment and have low visual restrictions.

Main arterial roadways are scored according to their usage. Nelson Bay Road, the major road, has a low FAC as it is the major linkage to Port Stephens. This arterial road has a functional role to both tourists and locals and thus visual and safety issues are important. Minor roads have a score that is approximately synonymous with that of the land they dissect.

Visual Sensitivity

Visual sensitivity (VS) is a measure of how critically people will view a development. The length of viewing time, what a person is doing and the distance between the person and the development are factors that influence sensitivity. These factors were considered through land use and distance. Each land use was assigned a value (see Table 5.3) and then distance zones were scored, e.g. foreground (<250m : +15) and middleground (250-1000m : +7). Only foreground boundaries were mapped (see Figure 5.4) as this provided the critical data for evaluation. Where sensitivity scores overlaped, the highest sensitivity score was mapped. For areas of less intensive land use (and hence low foreground score), the highest middleground score from a neighbouring zone was mapped. Zones with a score greater than 25 have a high VS, between 10 and 25 a medium VS and less than 10 a low VS.

The main arterial roadways have a high VS and in many cases, the high foreground score takes priority in score over

TABLE : 5.3 VISUAL SENSITIVITY RATING

RATING / ELEMENT	HIGH		MEDIUM		LOW	
	20 - 5		9 - 1		4 - 1	
TRAVEL ZONES	Nelson Bay Rd.	18	Main Road 518	9	Steel Street	4
	Lemon Tree Passage Rd.	15	Tomago Road	6	Coxs Lane	3
			Masonite Road	6	Macs Track	3
	Fullerton Cove Rd.	12	Lavis Lane	5	Boyces Track	3
	Marsh Rd.	12	Rookes Road	5	Oakfield Track	2
	Cabbage Tree Rd.	11	Brownes Road	5	Mareba Track	2
			Oakfield Lane	5	unsealed,unnamed roads within	
	Richardson Rd.	11				
			Janet Parade	5	dunal system (or minor recreat-	
	Diere Point Rd.	11			ional purposes.	2
	road to Anna Bay	11			unsealed,unnamed roads within	
	Fennington Is. Rd.	10			Tomago Sandbeds.	1
RECREATION	Stockton Beach	20	Newcastle Bight Dunal Forest	9		
	Rose Farm	18				
	Oakvale	18	backwaters of Tilligerry Ck.	9		
	mouth of Tilligerry Ck.	15				
	Fenninghams Is. Caravan Park	14				
	Caravan Park on Tilligerry Creek north east of Mud Is.	14				

TABLE : 5.3 VISUAL SENSITIVITY RATING

RATING / ELEMENT	HIGH		MEDIUM		LOW	
	20 - 5		9 - 1		4 - 1	
URBAN RESIDENTIAL	Lemon Tree Passage	17	proposed urban residential	9		
	Mallabula	17				
	Tanilba Bay	17				
	Anna Bay	17				
	Fishermans Bay	17				
RURAL RESIDENTIAL	Salt Ash	17	entrance roads to homesteads	8	agricultural/ grazing lands	3
	unnamed rural residential	17				
	Williamtown	15				
	Majors Flat	15				
	Bobs Farm	15				
	Medowie	15				
	Rural homesteads	15				
COMMERCIAL/ INDUSTRIAL AREAS			Department of Agriculture Research Station	8	small industrial	1
					sand quarrying	1
DISTANCE	<250m foreground		250-1000m middleground		>1000m background	
SCORE IN ALL FACTORS	>25 HIGH		25 - 10 MEDIUM		<10 LOW	

features lining the road. Roadways feeding urban residential areas also have a high VS. Secondary roads supplying industrial areas or small residential areas, that are only used by those working or residing along the road, have a medium VS. The unsealed, unnamed roads and tracks within the dunal system and also within the Tomago Sandbeds have low VS due to the infrequency of people using the roads.

Areas of high recreation use scored a high VS: a transmission line in The Rose Farm, Oakvale, Fenninghams Island Caravan Park or at the mouth of Tilligerry Creek would be critically viewed by visitors. The dunal forest of Newcastle Bight has a lesser visitor population, as do the backwaters of Tilligerry Creek and hence a medium VS was allocated.

Residential areas were, in general, rated with a high VS, and proposed residential areas with a medium VS. Rural homesteads also have a high VS.

Industrial areas such as small industries and small quarries were assigned low VS values as it would be unlikely that the workers would view a transmission line critically.

Suitability Rating

To delineate areas suitable for transmission line development from the above factors, a sum of the VAC, FAC and VS is calculated. The total score within each defined area produces the Suitability Rating (SR). The most important factor is VS, as it measures the public's reaction to a development, followed by VAC and least important is the FAC. To achieve the correct relativity between factors, a different numerical weighting was given to each. The final scores are summed to produce a mosaic of scores (see Figure 5.5). The range of scores were analysed and categorised into low, medium and high suitability for simplicity (see Figure 5.6).

Areas of high suitability are defined as those areas

potentially least altered by the transmission line within that area. Through evaluation of all the relevant characteristics of the land, the impacts on areas of high suitability resulting from the development can be regarded as least damaging.

Further Constraints on Route Selection

The routes with the least impact will realistically utilise those areas of highest suitability within the corridor while considering further environmental constraints not integrated into the three factors. Slope, for example, is the major causal force of erosion and hence is an important environmental constraint. A slope greater than 18 degrees would require side cutting to achieve suitable gradients for a transmission line and maintenance track. Removal of vegetation for the development, particularly ground cover, increases the exposure of soil particles to the natural elements such as wind and water, increasing the erosion risk. A longer length of slope also has a higher erosion hazard.

Engineering, safety and economic constraints also influence route selection and hence were included.

Thus, elements that are not large enough, or too variable, to be expressed as a landscape character zone, but are of importance in the selection of the final route, were incorporated within the process. The final route and suitable alternatives are presented in Figure 5.7.

5.03.0 ROUTE OPTIONS

5.03.1 Introduction

Through implementation of the Route Selection Procedure, areas most suited to transmission line development evolved and were defined. The two most feasible options for each feeder were selected and are presented in Figure 5.7. Option

1, within each route, is the most preferred option and Option 2 is a feasible although a less desirable environmental alternative.

This section describes each option fully to allow identification of the exact route.

5.03.2 Description of the Preferred Options

The Tilligerry Peninsula Line (The Western Route)

The preferred route for the Tilligerry Peninsula Line is the Western route on Figure 5.7, presented as a striped line incorporating the transmission line and 30 metre easement.

The new line will leave in a northerly and then noreasterly direction, from Tomago Substation along existing unsealed roads on the periphery of the Tomago Sandbeds Water Supply Works. Masonite Road will be bisected at right angles, and the line will continue in an approximate noreasterly direction along the easement of a 132kV ELCOM transmission line, within close proximity to the south eastern boundary of a sand quarry. The ELCOM easement and structures will be used for approximately 5km to the junction with a small unsealed road.

ELCOM have approved the construction of a new 132kV transmission line from Tomago Substation to Taree. Shortland County Council also intend to acquire the existing easement and structures, from the above junction to Medowie for future use as a 33kV supply to Medowie.

From this junction of the unsealed road, a new corridor directly east through the woodland is necessary to meet an existing corridor controlled by the Hunter District Water Board. The line will move south east along this corridor for 1km, effectively avoiding the RAAF Base flight zone, and then resume its noreasterly direction.

The tall canopy of the mixed woodland on the Tomago Sandbeds provides suitable visual absorption and the H.D.W.B. corridors are suitable cleared pathways for the line. This woodland is utilised to the edge of the Parachute Drop Zone, Tanilba Bay.

One kilometre from Main Road 518, which is crossed at a perpendicular angle, the line alters direction (north nor-

easterly), still within the H.D.W.B. corridor, to bypass Moffats Creek and eventually, the Parachute Drop Zone. Lemon Tree Passage Road is crossed at an acute angle, utilising a dense patch of woodland on the northeast aligned bend, 2.5km from the turn-off to Tanilba Bay. The line advances south east through Eucalyptus Tall Mixed Woodland to Tilligerry Creek.

Tilligerry Creek will be crossed approximately 7.5km from its mouth, utilising Upton Island as a "carry-over" point (refer to Figure 5.8C). From the water's edge, the line will continue in its south-easterly direction to the southern bank, crossing in a straight line. Two alternatives remain within this section: an overhead transmission line (which requires a structure on Upton Island to assist in supporting the conductors across the creek's span) or submarine transmission cables (which require termination structures on each bank).

From the southern bank of the creek, the line's direction is east utilising isolated patches of remnant forest within the agricultural land for background screening. From the last forest pocket the line, continuing in an easterly direction, approximately coincides with the border of the "Coastal Wetlands" to Fenninghams Island Road, which is bisected at right angles. This direction continues for 3km, and then the line reorientates north-east, in a straight line. The route remains approximately along the wetland boundary. Diere Point Road is crossed, the line then continues east along an artificial drain for 1km. At this point this line continues in a noreasterly direction, to the Anna Bay Substation site.

The Dunal Systems Line (The Eastern Route)

The preferred route for the Dunal System Line is the eastern route on Figure 5.7.

From Tomago Substation, the 132kV line will cross Cabbage Tree Road at right angles and travel south east and east, approximately coinciding with the present 33kV line. This represents the most feasible route for a transmission line: settling ponds from rutile and zircon mining lie to the south and homesteads along Cabbage Tree Road are in the north. The proposed line will run along this alignment for 6km in an approximate easterly direction.

Nelson Bay Road is bisected at right angles from which the line proceeds with a noreasterly direction to Lavis Lane, along another acquired easement. It then follows Lavis Lane, on the southern side, to the forested footslopes of the dunal system.

From the end of Lavis Lane, the line follows the present 33kV line along the existing residential road of the property Por. 13, 75, 76 and 101 (J.H. & O.H. Towers) to the owners open-cut sand mining plant. From this point, the line will be positioned on the footslopes of the dunal system, with all poles placed on the seaward side of the road.

Approximately 1.0km along this road the line enters the first swale seaward of the private properties and remains in this natural, stable depression for approximately 12km, where it meets the present 33kV Sandhills Feeder. It therefore avoids the rural residential land adjacent to Nelson Bay Road (refer to Figure 5.8A). The line is orientated approximately north east, parallel to the coastline. It will utilise existing small tracks within the forest with this orientation (refer to Figure 5.8B). It dissects Mareba and Oakfield Tracks within 0.5km of the natural junction between cleared agricultural land and eucalyptus forest. Boyces Track is crossed 500m south of its entry onto Nelson Bay Road. From

this track, the new line continues parallel to Nelson Bay Road, approximately 200m from it and still within the swale.

Approximately 1.5km from the eastern junction of Nelson Bay Road with Marsh Road, the new line meets the present 33kV line. The preferred route follows the existing easement for its entire length, to the Anna Bay cross-over (refer to Figure 5.8D). Nearing the cross-over, property boundaries will be utilised as much as practical. The new line crosses Nelson Bay Road at right angles, following a boundary line between two properties. The remainder of the line will accompany the Tilligerry Peninsula Line (Option 1A) to the substation.

5.03.3 Description of the Alternative Options

The Tilligerry Peninsula Line (The Western Route)

The most feasible alternative to Option 1A of this feeder is Option 2A, defined on Figure 5.7 as a stippled line which incorporates both the transmission line and accompanying easement.

From Tomago Substation, this option begins with an approximate northerly orientation along existing corridors in natural vegetation surrounding the industrial developments between Cabbage Tree Road and Tomago Road. Approximately 0.25km from the cross-over of Tomago Road, the line adjusts to a north-noreasterly direction utilising an existing cleared corridor for 3.5km. Remaining within the Tomago Sandbeds, this option travels almost directly east through both undisturbed forest and along unsealed roads.

Approximately 0.25km back from Richardson Road, a north east direction is taken. The route follows an irregular boundary between Fen (Swamp) vegetation and the two Eucalyptus Tall Mixed Woodland communities.

Directly south of the Parachute Zone, Tanilba Bay, this

option crosses Lemon Tree Passage Road, perpendicularly, and travels southeast for 0.75km. From this point, the line proceeds for approximately 5km in a north east direction through tall mixed woodlands. At this point, the line re-orientates to a south east direction and proceeds to the creekline, remaining 0.25km from the Caravan Park in the east and utilising a break in the S.E.P.P. 14 wetlands.

The crossing of Tilligerry Creek, 5km from its mouth, utilises Stuarts Island. Due to the width of the creek, a structure is necessary on the western sector of the island. From the water's edge, the line will continue for approximately 1.5km in its south easterly direction along the S.E.P.P. 14 boundary, utilising pockets of remnant forest for visual screening.

From this point, the line reorientates to an easterly direction continuing in a straight line for 3.5km, through isolated patches of coastal forest and bisecting Fenninghams Island Road at right angles. For 2.7km, this option coincides with the preferred option for the transmission line. Within 0.5km from this road, the line reorientates to an approximate noreasterly direction moving through a new corridor within wetland communities, which are dominated by Casuarina glauca. From Diere Point Road, the line borders agricultural land (primarily orchards) for 1km, at which the line turns south east and progresses to the Anna Bay Substation.

The Dunal Systems Line (The Eastern Route)

The most suitable alternative is Option 2B on Figure 5.7, which is presented as a stippled line incorporating both the transmission line and easement.

From Tomago Substation the line follows presently acquired easements across private properties, approximately midway between Cabbage Tree Road and the mangrove community for 3.5km. This route then diverges to travel south east for

3km marking the northern edge of the remnant rutile and zircon settling ponds. South of this route the ground is too unstable for the transmission line structures.

From the edge of the settling ponds to the footslopes of the dunal system, the feeder moves directly east, crossing Nelson Bay Road at right angles, dissecting numerous properties. From this point, to the end of Lavis Lane, a noreasterly direction is maintained along the coastal forest footslopes.

The line will cross Lavis Lane, at right angles, and travel along the paddock boundary, marked by a row of Casuarina glauca (between Por. 152 and Por. 76 J.H. & O.H. Towers). This direction will continue for approximately 1km. From this point, the line travels in an approximate noreasterly direction, midway between Nelson Bay Road and the forested footslopes of the dunal system, within private properties. At Oakfield Lane, the line reorientates south east, travelling for 0.5km to meet the forested footslopes. The line will continue along this natural topographic break until it is within 0.5km of Nelson Bay Road. From here the line opens a new corridor in the coastal forest south east to Boyces Track.

From Boyces Track, the line will be located approximately 100m south of Nelson Bay for 6.5km. At the break of the forest and hence the junction with agricultural land, the line will again travel at the footslopes of the dunes. After a distance of approximately 4km, the line will move directly north, crossing Nelson Bay Road in its path, along a minor unsealed road within property D.P. 585665. From this point, the line will travel east long the preferred Option (1A) for the Tilligerry Peninsula Line to the Anna Bay Substation (refer to Section 5.03.2 for details).

5.04.0 TECHNICAL ASPECTS OF THE DEVELOPMENT

5.04.1 The Physical Components

General

The transmission lines will consist of supporting structures, carrying conductors and earthwires located within easements. The easements will be predominantly 30 metres wide to permit construction, maintenance and safe operation of the transmission lines. They will not be fenced allowing normal agricultural activities to proceed. Appendix 5.2 presents a detailed list of acceptable and prohibited uses within easements. Easement clearing will only occur when necessary for construction, maintenance, access and safe operation of the lines. S.C.C. will require access to the lines after completion of construction, for maintenance purposes. This may be achieved along the easements where practical or from pre-existing roads and tracks.

Supporting Structures

The supporting structures for the proposed lines will comprise low maintenance poles constructed of either concrete or steel. Two types of structures will be used, intermediate and termination structures.

(a) Intermediate structures are designed to carry the weight of the conductors plus the forces imposed by wind pressure on both the poles and conductors. They are used for relatively straight sections of the line and the proposed structure consists of a single pole with horizontal line post insulators to support the conductors.

They will have a nominal height above ground level of approximately 21 metres, as detailed in Table 5.4, to maintain specific minimum conductor clearances. A drawing of a typical intermediate structure is shown in Appendix 7.1.

TABLE : 5.4 SPECIFIED MINIMUM CONDUCTOR CLEARANCES

Location	Minimum Clearance (metres)
Distance from ground in any direction	7.5
Height above highest recorded flood level	7.5
Height over roads	
(a) Main Roads	13.5
(b) Council Road and Tracks	12.0
Height over railway tracks	12.0
Height over existing power lines	4.0
Height over telephone lines	4.0

b) Termination structures may be of multiple pole construction, being designed to support additional loads due to conductor tension particularly at turning points and end points along the route. Due to their strength requirements, larger numbers of poles and the need to provide ground anchors and guys, termination structures can create greater disturbance. They are also more expensive to construct and therefore a route with few changes in direction is technically and economically appealing. Termination structures are also more visually intrusive due to the large number of poles and additional insulator strings and fittings required, so visual impacts can also be contained by limiting their occurrence on the line. Depending on final design loadings, angle of line deviation and foundation conditions, a single pole structure may be possible thus minimising any visual impact.

The distance between supporting structures over flat ground would be approximately 250 metres. This separation would vary according to local terrain, structure height and other practical considerations.

Conductors and Insulators

The main current carrying conductors will be of steel-cored aluminium approximately 21mm in diameter. There will be three single conductors, arranged to provide a three phase power circuit. A smaller conductor will be strung from the top of the pole to act as an earthwire. This earthwire is also intended to carry an integral fibre optic cable to provide for Council's future control and communication system.

The conductors will be insulated from the support points of the pole by horizontal insulators approximately 1.8m in length.

5.04.2 The Construction Process

Four main construction activites will exist, as follows :

* access and clearing
* structure erection
* stringing
* restoration.

All four activities may be applied simultaneously at various places along the easement depending on the planning of the work programme and the scheduled time of completion.

Access and Clearing

To allow the efficient installation of line structures, access for vehicles, plant and equipment is required to all structure locations along the line. In addition, it is desirable, where terrain or conditions permit, to have continuous vehicular access along the easement to facilitate easement clearing and conductor stringing.

As far as practicable, access to individual structures will be by means of public roads or existing private roads and tracks or open spaces where permission to enter has been arranged with the property owners and/or occupiers or relevant public authorities.

Access tracks will be sited in consultation with the landowner generally to follow natural contours and remain inconspicuous wherever practical. In bushland areas tracks are often made discontinuous along the line route to avoid providing thoroughfares for unauthorised users. In addition, gates are installed across tracks where necessary and locked when not in use. Where property owners require access through normally locked gates, Council will arrange for the insertion of a privately supplied lock in series with the chain to enable independent access by either party.

The civil works contract provides for the installation of culverts and causeways on access tracks when crossing watercourses and specifies the manner in which these will be constructed.

To limit the extent of ground disturbance, particularly on pasture and cropping land, provision is made for confining vehicle movements to one route and confining the activities of bulldozers and similar plants to a minimum, consistent with reasonable practical requirements.

Easement clearing is required to establish the necessary electrical clearance from the line to earthed material such as vegetation and must make allowance for expected conductor "blowout" during strong winds, and increased conductor sag resulting from expansion of the metal at times when the line carries its full electrical loading. An additional margin of clearance is required to allow for expected regrowth on the easement during the periods between scheduled reclearing operations by maintenance staff.

Clearing during the construction phase will primarily involve bulldozers pushing over trees and stumps although hand clearing, including the use of chainsaws, may be used where access is difficult or in sensitive areas such as steeply sloping land, crossing of watercourses or roadways and in the vicinity of residences.

Easement clearing carried out at the time of line construction is adequate to allow the transmission line to be safely placed in service. However in some areas the additional margin of clearance necessary to allow for regrowth could be less than that ultimately adopted to suit maintenance requirements. It has become normal practice when constructing lines to err in areas of doubt by carrying out less clearing rather than more. This policy delegates greater responsibility to maintenance staff who will reassess clearing practices on a span by span basis.

Structure Erection

The poles will be delivered on site by a semi-trailer and unloaded using a mobile crane. A hole will be bored for each pole and the poles erected by using the mobile crane. The poles are held in position and backfilled with ready mixed concrete around the butts. The small quantity of excavated material is subsequently spread evenly across the site.

For the termination and angle structures it may be necessary to bore additional holes which are subsequently filled with concrete to form a ground anchor to guy the structure.

Stringing

The stringing operation will involve the assembly and attachment to the structure of insulators and the installation of the conductors. A technique known as "tension stringing" will be used for these transmission lines. This requires that the conductor drums be mounted on trailers behind truck-mounted braking machines and the conductor pulled out by winches using a draw wire over sheaves mounted at the structure head, enabling the conductor to be kept clear of the ground. The stringing plant will include conductor delivery trailer, tensioning machine and pulling machine.

To implement this "tension stringing" procedure, it will be necessary to establish sites at intervals of three or more kilometres along the route where conductor drums can be delivered or where the pulling machines can be set up. It is preferred that naturally flat ground be used for the tensioner and puller locations.

The stringing of overhead earthwires is carried out concurrently with the conductors and in a similar manner.

Restoration

When conductors have been strung, tensioned, and secured, areas such as access tracks, embankments and structure sites which have lost some of their natural vegetation cover will be rehabilitated where necessary and new plant growth encouraged to prevent surface erosion. Revegetation will be carried out using suitable techniques which may include sowing seeds, planting trees and shrubs, and brush matting. The revegetation procedures adopted would be in accordance with Soil Conservation Service recommendations.

5.04.3 Line Maintenance

On completion of construction, minor ongoing activites are necessary to maintain the line in safe working order.

The line will be periodically inspected from either the ground, using light four wheel drive vehicles or the air, using either light planes or a helicopter. These inspections are necessary to check for evidence of vandalism, identify potential hazards to the line such as threatening vegetation growth, identify any unauthorised developments beneath or near the line which may present a hazard to the line or life or property and assess damage from events such as fire or flood.

Similarly, there will be a requirement for periodic maintenance vegetation clearing or control within the easement. This work is necessary to ensure the continued safe and reliable operation of the transmission lines. Trees will not be allowed to grow so close to the line conductors as to create a hazard to the lines or the general public. The need to maintain an acceptable appearance at crossings of roads, railways, ridge tops, large bodies of water and in proximity to residences will also be taken into account.

5.04.4 Public Relations

The detailed siting of the route was carried out in consultation with owners of the private properties scattered through the study area. S.C.C. initially approached owners to discuss the location of the transmission line over their properties and to obtain their agreement to carry out a survey of the route. Each owner was subsequently and independently interviewed by FORSITE Landscape Architects and Planners Pty, Ltd., to evaluate their requirements and determine interactions between the proposed development and the land uses. Appendix 5.3 summarises the results of the interviews. Attention was commonly drawn to the planned future development of the property or to specific areas where it was preferred structures not be located. Such matters were accommodated wherever practical.

Following survey of the route centreline with easement boundaries and assessment of the interviews with the owners, plans will be drawn and the transmission line designed. Structures will be located having due regard to the matters previously raised by property owners. In general, the routes were selected utilising the following situations. In open country it is desirable that a line should not pass unnecessarily close to residences. Where practical, property boundaries are followed or at least parallelled and the line is kept clear of shade or ornamental trees on a property. There is a general preference for alignments that will not require substantial clearing of timber. Similarly, since changes in direction of transmission lines are expensive and can be less favourable aesthetically, there is a preference for maximising the length of straight runs in a transmission line. Where terrain permits, line routes are located to allow good use of existing tracks and to avoid, where practicable, the need for track construction in sensitive areas.

When the stage is reached where it is possible to indicate on the ground where the transmission line structures will be

located, property owners are again approached and, having viewed the plans, are asked to give consent for construction to proceed. There may be minor adjustments to a few structure locations arising from this second formal contact. Owners are also asked to indicate any particular requirements which should be observed during construction such as where new tracks (if any) should be sited, where new gates in fences should be located, and the preferred manner for disposal of debris arising from the clearing operation. In conjunction with detailed design of the lines, property negotiations are commenced to create the easements for the transmission lines. This is the usual and preferred procedure. Individual problems are dealt with from time to time in a fashion specifically suited to the circumstances of the case which may include resumption of easement rights.

As construction work on the line approaches and is about to commence on a particular property, the owner is advised by the line contractor or S.C.C. Close liaison will be maintained during the construction period.

During line maintenance, the frequency of reclearing and the methods employed will again be determined in consultation with the property owner and, if necessary, modified.

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMS TOWN LAKE
MOFFATS SWAMP
Bombing Range
Williamtown RAAF Air Base
TOMAGO SUBSTATION
CABBAGE TREE ROAD
WILLIAM TOWN
FULLERTON COVE
SALT ASH
NELSON BAY ROAD
STOCKTON BEACH
NEWCASTLE BIGHT

0 0.5 1 1.5 2 2.5 3

LEGEND

THE DEFINED CORRIDOR

EXCLUSION AREA

Figure 5-1A
THE DEFINED CORRIDOR

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

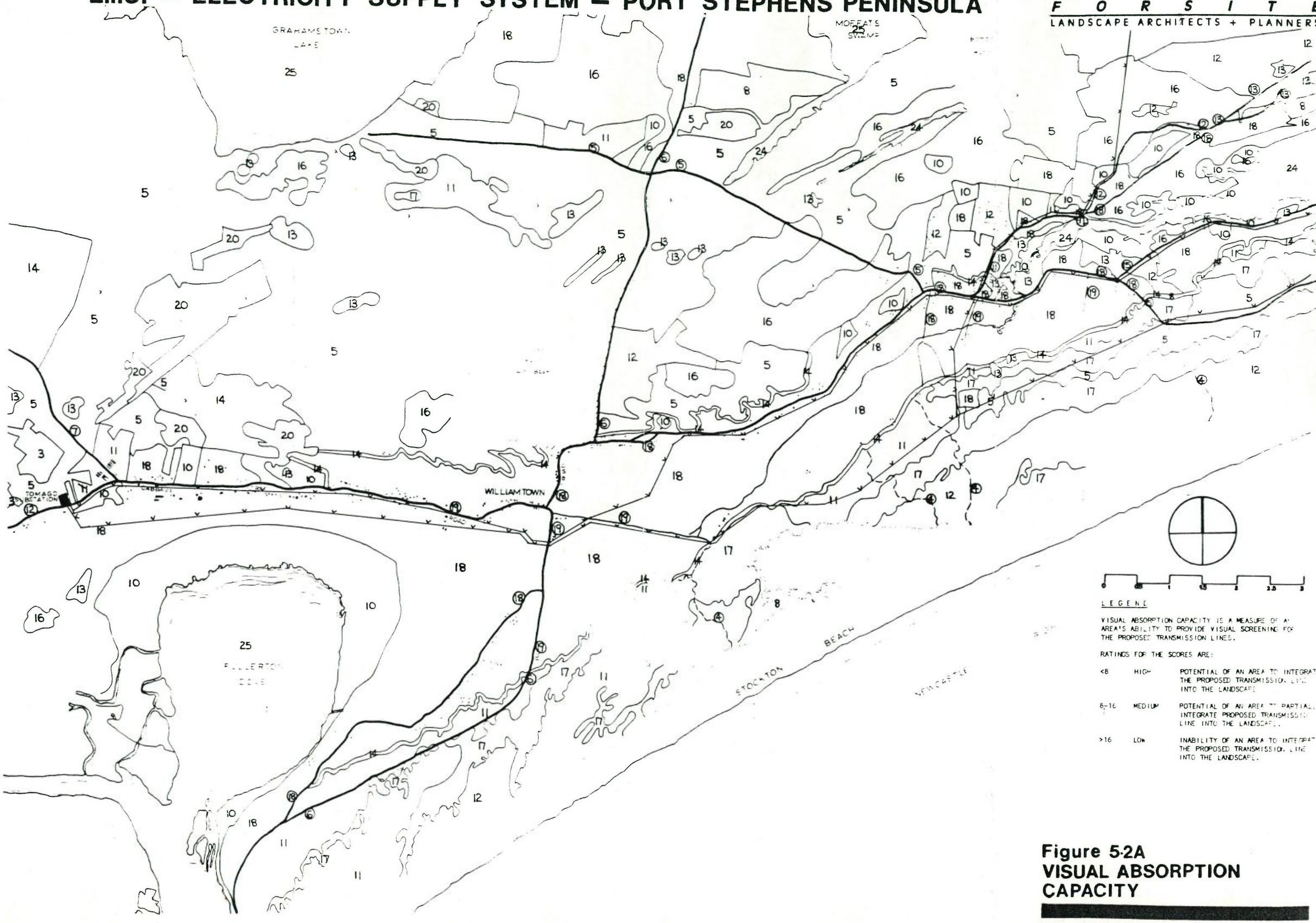
FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



Figure 5.1B
THE DEFINED CORRIDOR

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS



LEGEND

VISUAL ABSORPTION CAPACITY IS A MEASURE OF AN AREA'S ABILITY TO PROVIDE VISUAL SCREENING FOR THE PROPOSED TRANSMISSION LINES.

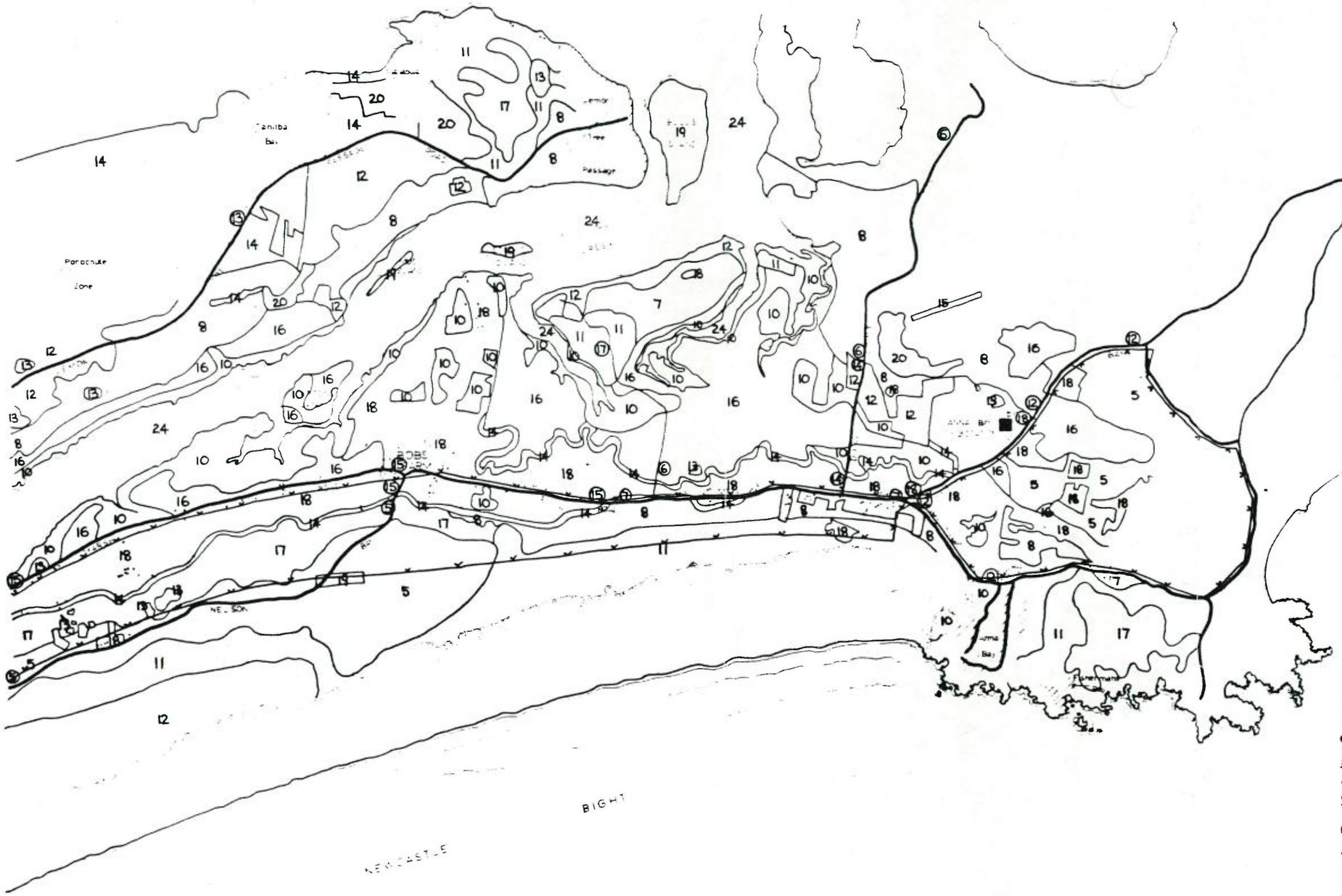
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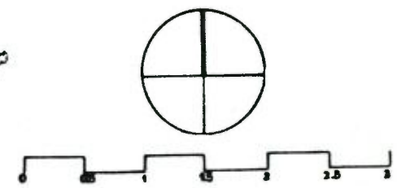
<8	HIGH	POTENTIAL OF AN AREA TO INTEGRATE THE PROPOSED TRANSMISSION LINE INTO THE LANDSCAPE
8-16	MEDIUM	POTENTIAL OF AN AREA TO PARTIALLY INTEGRATE PROPOSED TRANSMISSION LINE INTO THE LANDSCAPE.
>16	LOW	INABILITY OF AN AREA TO INTEGRATE THE PROPOSED TRANSMISSION LINE INTO THE LANDSCAPE.

Figure 5-2A
VISUAL ABSORPTION CAPACITY

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS





LEGEND

VISUAL ABSORPTION CAPACITY IS A MEASURE OF AN AREA'S ABILITY TO PROVIDE VISUAL SCREENING FOR THE PROPOSED TRANSMISSION LINES.

RATINGS FOR THE SCORES ARE:

<8	HIGH	POTENTIAL OF AN AREA TO INTEGRATE THE PROPOSED TRANSMISSION LINE INTO THE LANDSCAPE
8–16	MEDIUM	POTENTIAL OF AN AREA TO PARTIALLY INTEGRATE PROPOSED TRANSMISSION LINE INTO THE LANDSCAPE.
>16	LOW	INABILITY OF AN AREA TO INTEGRATE THE PROPOSED TRANSMISSION LINE INTO THE LANDSCAPE.

Figure 5.2B
VISUAL ABSORPTION CAPACITY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMS TOWN LAKE

MOFFATS SWAMP

TOMAGO SUBSTATION

WILLIAM TOWN

FULLERTON COVE

STOCKTON BEACH

NEWCASTLE

LEGEND

FUNCTIONAL ABSORPTION CAPACITY IS A MEASURE OF AN AREA'S ABILITY TO ACCEPT THE TRANSMISSION LINE WITHOUT LOSS TO THE PRODUCTIVITY OF THAT AREA'S FUNCTION.

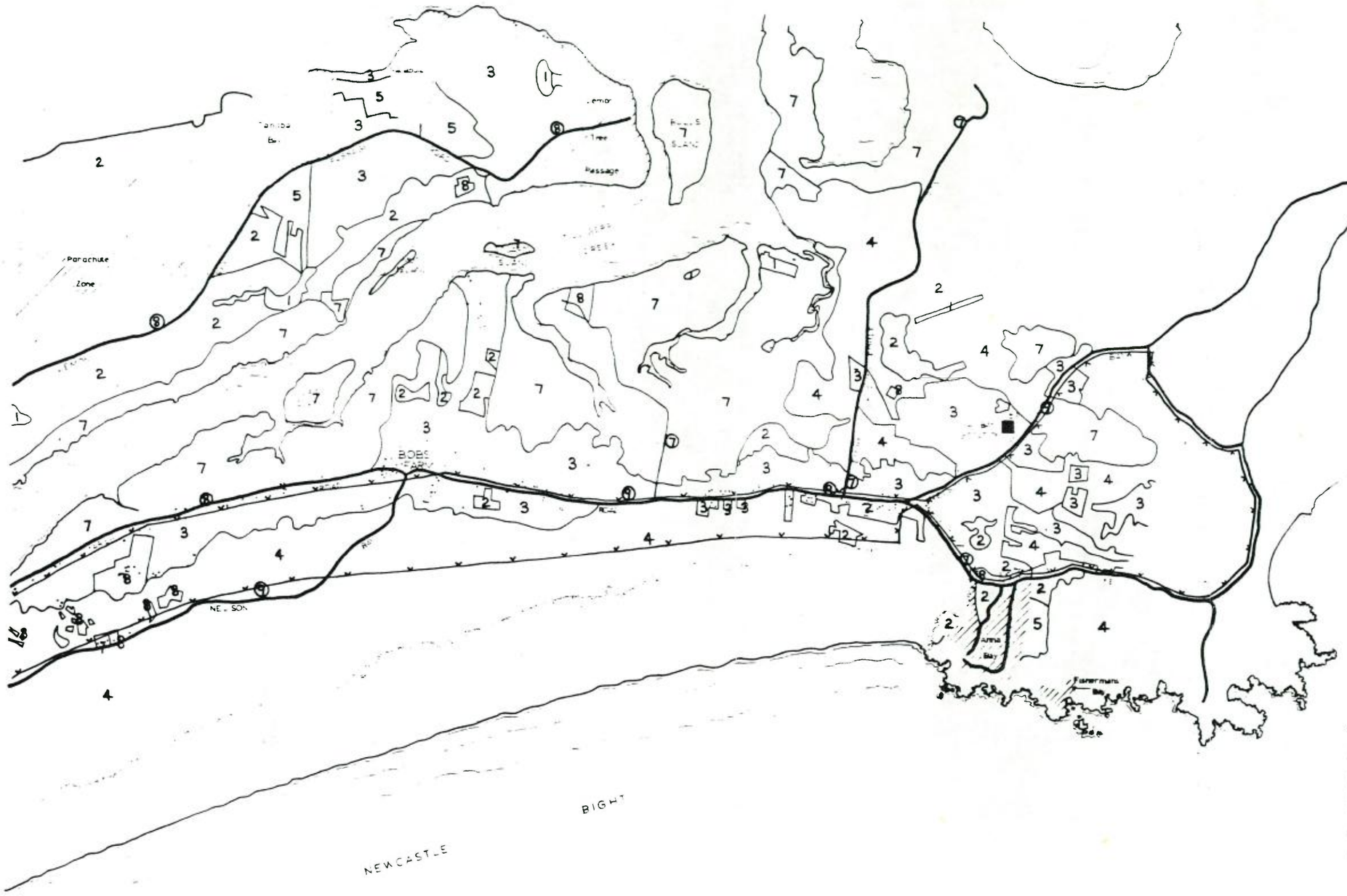
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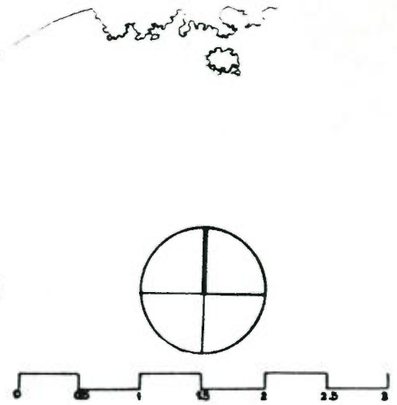
1-3	HIGH	ABILITY TO ACCEPT THE DEVELOPMENT WITHOUT LOSS IN ITS CAPACITY TO SERVE ITS NOMINATED USE.
4-6	MEDIUM	ABILITY TO ACCEPT THE DEVELOPMENT WITH PARTIAL LOSS IN ITS CAPACITY TO SERVE ITS NOMINATED USE.
7-10	LOW	INABILITY TO ACCEPT THE DEVELOPMENT WITHOUT LOSS IN ITS CAPACITY TO SERVE ITS NOMINATED USE.

Figure 5.3A
FUNCTIONAL ABSORPTION CAPACITY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS





LEGEND

FUNCTIONAL ABSORPTION CAPACITY IS A MEASURE OF AN AREA'S ABILITY TO ACCEPT THE TRANSMISSION LINE WITHOUT LOSS TO THE PRODUCTIVITY OF THAT AREA'S FUNCTION.

RATINGS FOR THE SCORES ARE:

1-3	HIGH	ABILITY TO ACCEPT THE DEVELOPMENT WITHOUT LOSS IN ITS CAPACITY TO SERVE ITS NOMINATED USE.
4-6	MEDIUM	ABILITY TO ACCEPT THE DEVELOPMENT WITH PARTIAL LOSS IN ITS CAPACITY TO SERVE ITS NOMINATED USE.
7-10	LOW	INABILITY TO ACCEPT THE DEVELOPMENT WITHOUT LOSS IN ITS CAPACITY TO SERVE ITS NOMINATED USE.

Figure 5.3B
FUNCTIONAL ABSORPTION CAPACITY

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

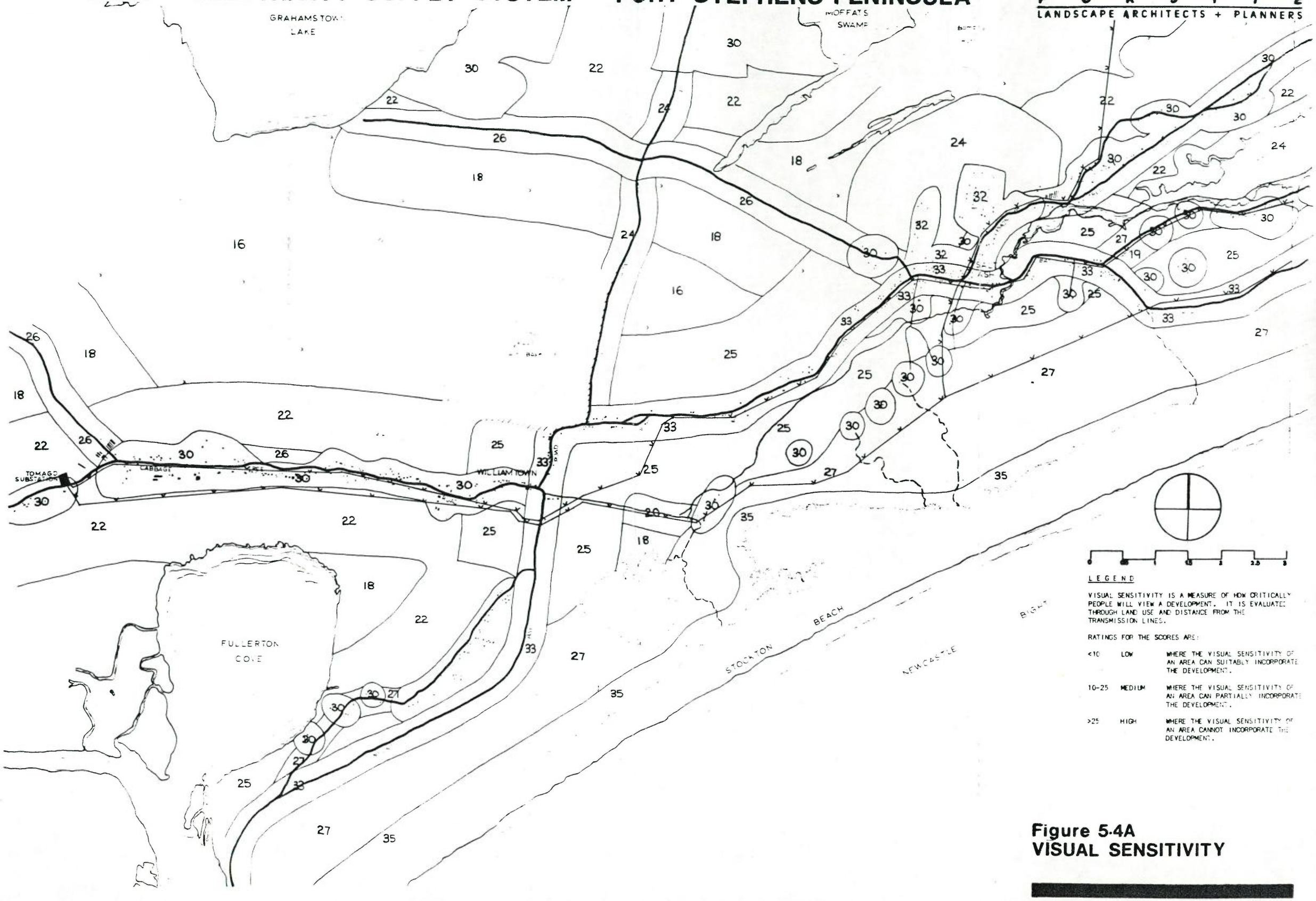
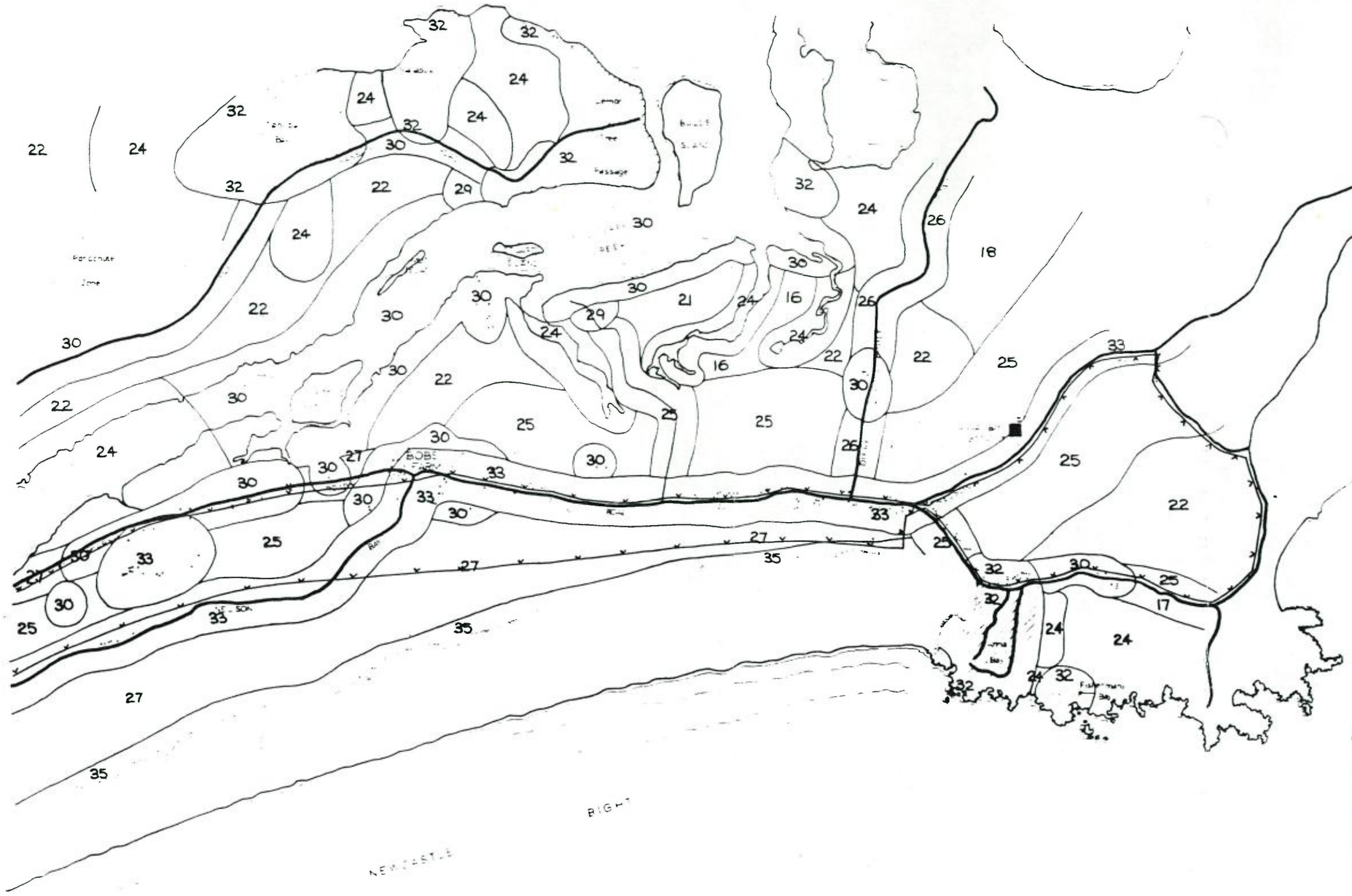


Figure 5.4A
VISUAL SENSITIVITY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS





LEGEND

VISUAL SENSITIVITY IS A MEASURE OF HOW CRITICALLY PEOPLE WILL VIEW A DEVELOPMENT. IT IS EVALUATED THROUGH LAND USE AND DISTANCE FROM THE TRANSMISSION LINES.

RATINGS FOR THE SCORES ARE:

<10	LOW	WHERE THE VISUAL SENSITIVITY OF AN AREA CAN SUITABLY INCORPORATE THE DEVELOPMENT.
10–25	MEDIUM	WHERE THE VISUAL SENSITIVITY OF AN AREA CAN PARTIALLY INCORPORATE THE DEVELOPMENT.
>25	HIGH	WHERE THE VISUAL SENSITIVITY OF AN AREA CANNOT INCORPORATE THE DEVELOPMENT.

Figure 5.4B
VISUAL SENSITIVITY

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMSTOWN LAKE

MOFFATS SWAMP

WILLIAMTOWN

FULLERTON COVE

STOCKTON BEACH

LEGEND

THE SUITABILITY RATING IS THE SUM OF THE VISUAL ABSORPTION CAPACITY, FUNCTIONAL ABSORPTION CAPACITY AND VISUAL SENSITIVITY TO GIVE A TOTAL SCORE AND A FINAL SUITABILITY RATING.

RATINGS FOR THE SCORES ARE:

<40	HIGH	THE ABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE.
40–50	MEDIUM	THE ABILITY OF AN AREA TO PARTIALLY ACCEPT A TRANSMISSION LINE.
>50	LOW	THE INABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE.

Figure 5.5A
SUITABILITY RATING

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS





LEGEND

THE SUITABILITY RATING IS THE SUM OF THE VISUAL ABSORPTION CAPACITY, FUNCTIONAL ABSORPTION CAPACITY AND VISUAL SENSITIVITY TO GIVE A TOTAL SCORE AND A FINAL SUITABILITY RATING.

RATINGS FOR THE SCORES ARE:

<40	HIGH	THE ABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE.
40–50	MEDIUM	THE ABILITY OF AN AREA TO PARTIALLY ACCEPT A TRANSMISSION LINE.
>50	LOW	THE INABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE.

Figure 5.5B
SUITABILITY RATING

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

F O R S I T E
LANDSCAPE ARCHITECTS + PLANNERS

GRAHAMS TOWN LAKE
MOFFATS SWAMP
Bombing Range
SALT ASH
WILLIAM TOWN ROAD
TOMAGO SUBSTATION
CABBAGE
FULLERTON COVE
STOCKTON BEACH
NEWCASTLE BIGHT

0 .25 1 1.5 2 2.5 3

LEGEND

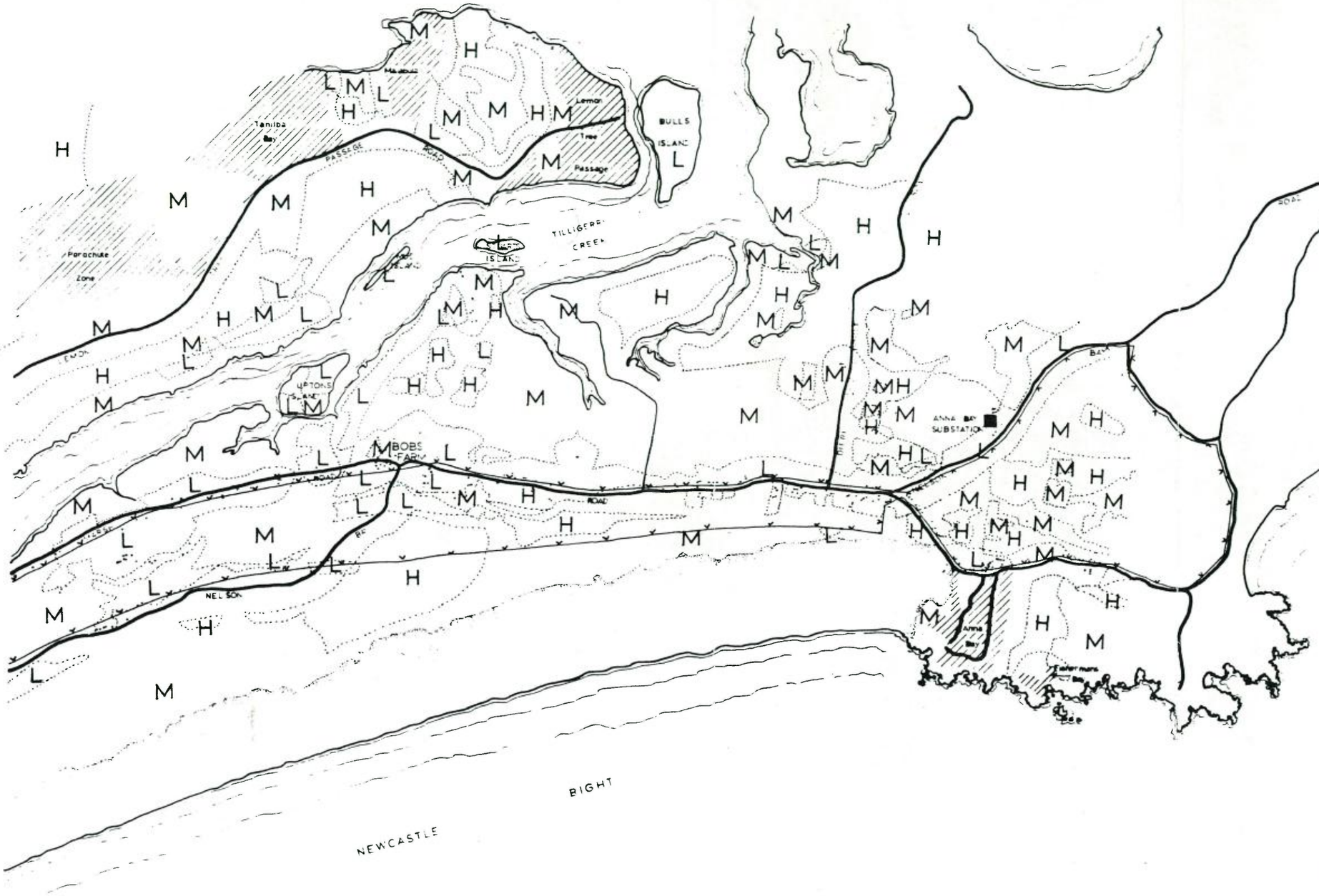
THE SUITABILITY RATING SCORES ARE CATERGORISED INTO AREAS OF HIGH, MEDIUM AND LOW SUITABILITY

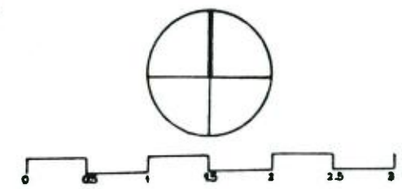
H	HIGH	THE ABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE
M	MEDIUM	THE ABILITY OF AN AREA TO PARTIALLY ACCEPT A LINE
L	LOW	THE INABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE

Figure 5.6A
SUITABILITY RATING SUMMARY

E.I.S. — ELECTRICITY SUPPLY SYSTEM — PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS





LEGEND

THE SUITABILITY RATING SCORES ARE CATERGORISED INTO AREAS OF HIGH, MEDIUM AND LOW SUITABILITY

H	HIGH	THE ABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE
M	MEDIUM	THE ABILITY OF AN AREA TO PARTIALLY ACCEPT A LINE
L	LOW	THE INABILITY OF AN AREA TO ACCEPT A TRANSMISSION LINE

Figure 5.6B
SUITABILITY RATING SUMMARY

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

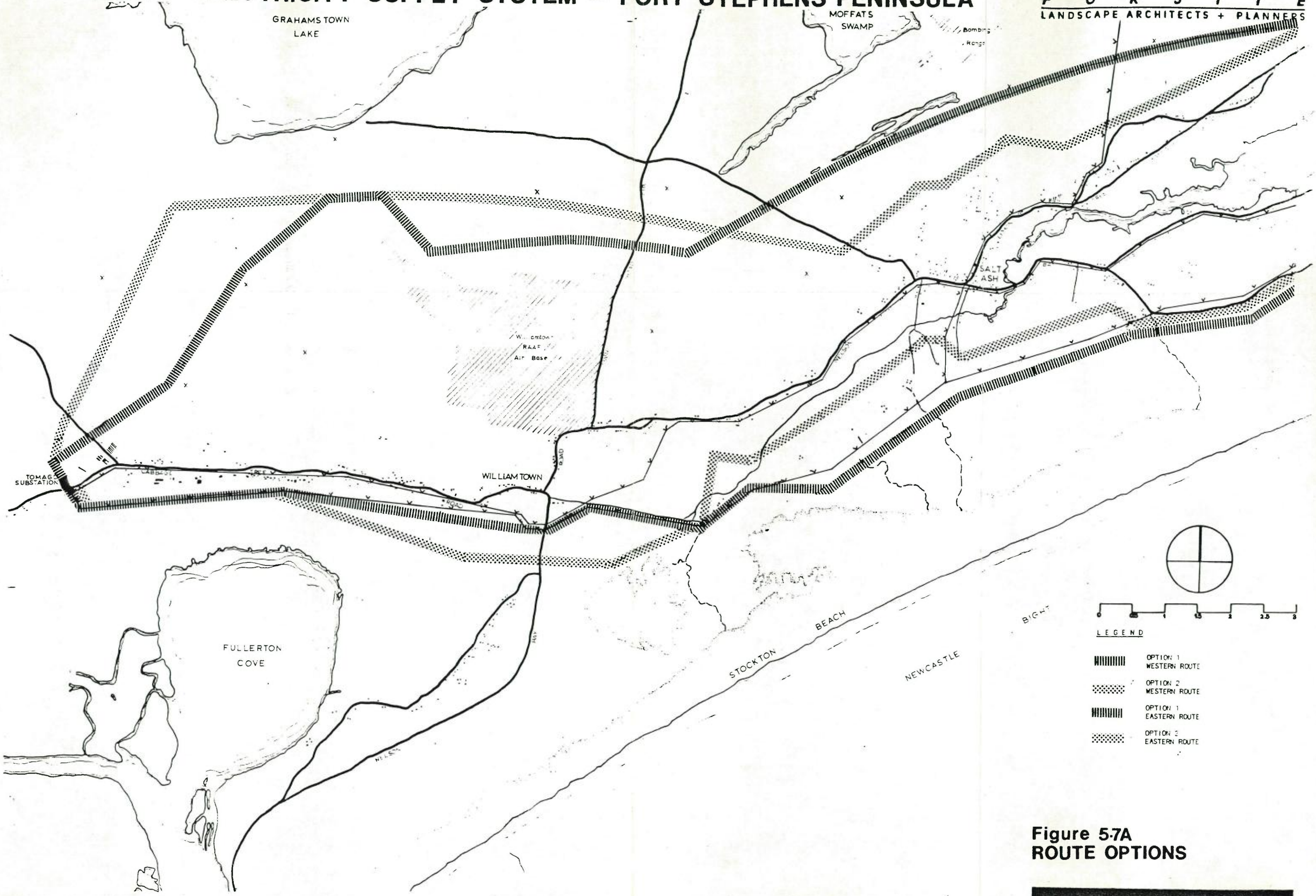


Figure 5.7A
ROUTE OPTIONS

E.I.S. – ELECTRICITY SUPPLY SYSTEM – PORT STEPHENS PENINSULA

FORSITE
LANDSCAPE ARCHITECTS + PLANNERS

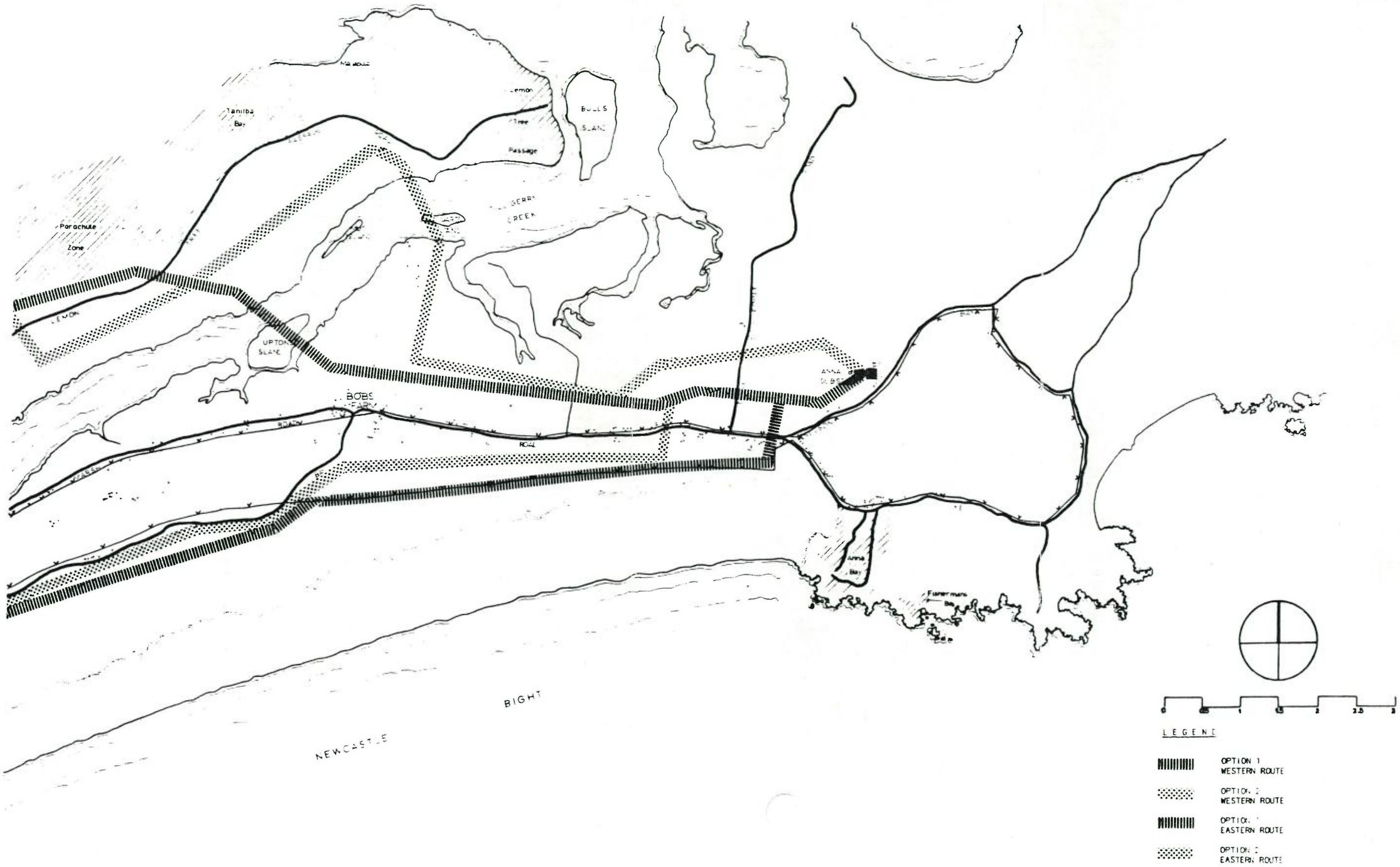


Figure 5.7B
ROUTE OPTIONS



FIGURE 5.8A THE EXISTING SANDHILLS FEEDER TRAVERSES RURAL RESIDENTIAL LAND. THE PREFERRED OPTION FOR THE DUNAL SYSTEMS LINE WILL AVOID THESE PROPERTIES.



FIGURE 5.8B THE PREFERRED OPTION FOR THE DUNAL SYSTEMS LINE WILL UTILISE EXISTING TRACKS WITHIN THE EUCALYPTUS DRY SCLEROPHYLL FOREST TO REDUCE CLEARING.

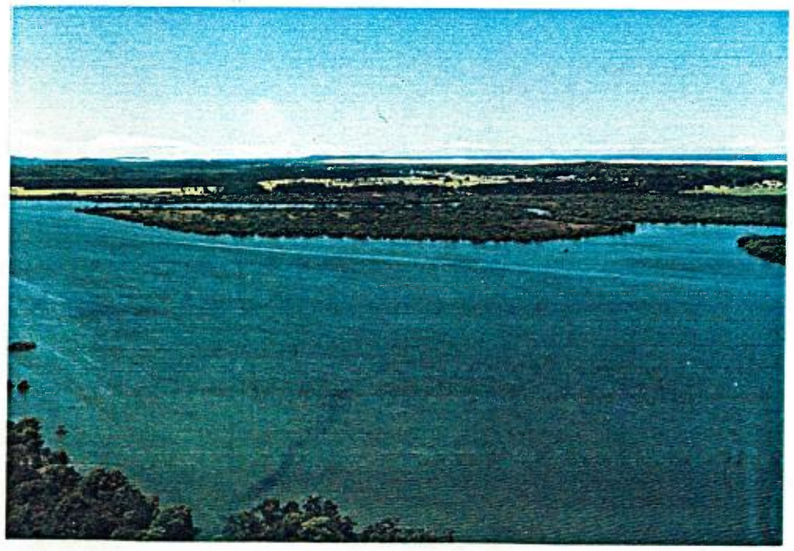


FIGURE 5.8C THE PREFERRED OPTION FOR THE TILLIGERRY PENINSULA LINE WILL TRAVERSE TILLIGERRY CREEK VIA UPTONS ISLAND – DIAGONALLY FROM LEFT TO RIGHT ACROSS THE CENTRE OF THE FIGURE.



FIGURE 5.8D THE EXISTING SANDHILLS FEEDER FORMS A DISTINCT CORRIDOR THROUGH THE EUCALYPTUS DRY SCLEROPHYLL FOREST. THIS CORRIDOR WILL BE UTILISED IN THE DUNAL SYSTEMS LINE.

Figure 5-8
ASPECTS OF THE PREFERRED ROUTES

6.00.0 CHARACTERISTICS OF THE PREFERRED ROUTES

6.01.0 THE TILLIGERRY PENINSULA LINE

6.01.1 Survey

The route lies within the Shire of Port Stephens and the precincts of Tomago and Tilligerry Peninsula (refer to Figure 2.2). It is almost totally within the Coastal Water Reserves, the final portion spanning agricultural land and covers approximately 35 kilometres.

6.01.2 Climatology

The location of this line is not influenced by climatogical factors that render conditions unfavourable to line placement.

6.01.3 Topography

The entire route traverses flat terrain of the interbarrier dune system, less than ten metres above sea level. Tilligerry Creek is crossed approximately 28km along the route. The elevation remains under 10 metres above sea level and the slope under 5 degrees within this interbarrier flat.

6.01.4 Geology & Soils

One geology, and hence one derived soil-type, underlies the entire route. Quaternary sand with gravel, silt, clay, "Waterloo" rock and marine and freshwater deposits forms the geology with an aeolian (wind-blown) soil cover. Although sand soils are considered to have well-drained peds, areas classified as wetlands, particularly those coincident with mangrove communities, tend to be poorly drained and considerably boggy initiating problems associated with stability of poles.

6.01.5 Hydrology

This route is initially kept within the Tomago Sandbeds, avoiding the numerous primary pumping stations of the H.D.W.B. The major hydrological feature of this route is Tilligerry Creek, which will be crossed at Upton Island traversing wetlands gazetted as Coastal Wetlands. The route follows the wetland periphery to the delivery point.

6.01.6 Vegetation

Eucalyptus Tall Mixed Woodland screens the transmission line for approximately 16km, within the H.D.W.B. leases. Isolated patches of Fen Wetland are traversed. Approaching the Tilligerry Creek cross-over, an alternating pattern between the two Eucalyptus Tall Mixed Woodlands adequately screens the line. At the cross-over, the line spans Fen Vegetation and Mangrove Communities. Isolated patches of Woodland and then Fen Vegetation (predominately Casuarina glauca) occur for the remainder of the route, softening the visual effects of the line.

6.01.7 Wildlife

The Eucalyptus Tall Mixed Woodland has the capacity to support various forms of wildlife, however no systematic survey exists which records the actual species. It is probable that this vegetation will sustain small mammals, birds and some herpetofauna (refer to Appendix 4.2).

Tilligerry Creek and the associated wetland ecosystem attracts large numbers of birds especially migratory waders. The areas of Fen Wetland that consist of Casuarina glauca and similar taller vegetation would support a more diverse range of wildlife.

The pockets of remnant forest within the agricultural lands are likely to contain species that are only temporarily utilising the biological island.

6.01.8 Archaeological Issues

No archaeological sites have been recorded along the Tilligerry Peninsula Line and easement (N.P.W.S. Site Register). With the possibility of sites within close proximity of Tilligerry Creek, the area in which traversing occurs was surveyed by D. Byrne in February, 1987 (refer to Appendix 6.1). No sites were recorded. This interbarrier flat is unlikely to contain any archaeological features due to the dynamic nature of the creek system and its sediment.

This route does not traverse land granted to the local aboriginal tribes by the Department of Lands.

6.01.9 Existing Land Use

The route coincides with unsealed roads and current transmission line easements of the H.D.W.B., within the Tomago Sandbeds. Present easements are followed for approximately 12km.

The periphery of the sand mining activities south of Mallabula and within close proximity to the site of the Anna Bay Substation occupies the proposed route.

The remainder of the line spans the boundary of agricultural land (grazing) and Coastal Wetlands (S.E.P.P. 14).

6.02.0 THE DUNAL SYSTEM LINE

6.02.1 Survey

The route traverses four precincts within the Port Stephens Shire: Tomago, Williamtown, Salt Ash and Anna Bay respectively (refer to Figure 2.2). The majority is within the Coastal Water Reserves, the initial and final portions spanning agricultural land and is approximately 32 kilometres in length. C.R. Hutchinson and Company have surveyed the route on several occasions, the most recent being March, 1986.

6.02.2 Climatology

The most prominent climatological aspect of Newcastle Bight is the strong onshore winds that play a major role in dune construction and destruction. This route will be protected from the prevailing south easterly winds by its location within a swale. Access corridors aligned north west to south east must be eliminated to reduce exposure.

6.02.3 Topography

The topography of the site ranges from flat terrain of the interbarrier ancient dune system (<10m a.s.l.) to stable dunes north east from Lavis Lane, that form ridge systems parallel to the coast. The route is positioned within the first swale seaward of Nelson Bay Road which has a general topographic height of less than ten metres above sea level. Line design and construction places restrictions on areas with slope in excess of 18 degrees.

6.02.4 Geology & Soils

Along the one predominant geology, Quaternary sand, two soil types are crossed. Alluvium soils (deposited through the action of water) occur between Fullerton Cove and the end of Lavis Lane. The remainder of the line lies on wind blown soils that have been constantly reworked by the strong south easterlies blowing onshore. These Duck Hole soils are well-drained and tend to be unstable when void of vegetation.

6.02.5 Hydrology

The sole hydrological feature of this route is the Tomago Sandbeds, an important source of good quality groundwater. A proposed extension by the H.D.W.B. to these sandbeds will encompass the full length of the route within the sand dunes.

6.02.6 Vegetation

The initial stages occur within Eucalyptus Savanna Woodland (agricultural land utilised for grazing). From the end of Lavis Lane to the end stages of the line, Eucalyptus Dry Sclerophyll Forest conceals the line. Within the terminating 2 kilometres, Eucalyptus Savanna Woodland and Eucalyptus Tall Mixed Woodland are spanned.

6.02.7 Wildlife

The extensive areas of pristine vegetation within the dunal system provide habitats for numerable wildlife species, being particularly suited to aboreal and ground-dwelling mammals. A colony of flying foxs are known to occupy the dunes (George, H.; pers.comm.). The degenerate nature of this forest, resultant from the high frequency of fire, has however reduced its potential wildlife capacity. Birds and herpetofauna also occupy the area (refer to Appendix 4.2).

The agricultural areas are virtually void of wildlife whereas the isolated patches of remnant vegetation would provide corridors, but are unlikely to provide any significant permanent habitats.

6.02.8 Archaeological Issues

The Dunal System Line and easement has only one recorded archaeological site: an aboriginal midden of pipi shells located approximately 300m south along Boyces Track from Nelson Bay Road. The route was surveyed by D. Bryne in February, 1987, and the report is in Appendix 6.1.

The preferred option does not traverse land granted to the local aborigines by the Department of Lands.

6.02.9 Existing Land Use

Presently, three major land uses occupy the route: non-urban

(40 ha minimal), non-urban land with mining leases and Crown land.

The non-urban land is privately owned and utilised predominately for cattle grazing. Both commercial and subsistence market gardens are present. These properties have a 40 ha minimum on size. This land use occupies the initial and final portions of the route.

At the eastern end of Lavis Lane, non-urban land is designated for sand mining purposes. The sand is currently being extracted from the footslopes of the dunes.

The third land use, which is the most extensive, is Crown land. The entire forested dunal system of Newcastle Bight is Crown land that is set aside as Coastal Water Reserves vested in the H.D.W.B.

7.00.0 EVALUATION OF THE IMPACTS OF THE PROPOSAL

7.01.0 OVERVIEW

The Route Selection Procedure identifies areas that have the lowest potential for impacts that may result from the development. Such areas of high suitability, when utilised, will automatically minimise the likely adverse impacts. In conjunction with line design, a further reduction in onsite impacts can be obtained.

Transmission lines and easements produce numerous impacts upon the land. The study area will experience a range of impacts that can be identified through consideration of the following factors.

1.	Visual	-	sensitivity
		-	absorption
2.	Physical	-	topography
		-	soils
		-	vegetation
		-	wildlife
3.	Ecological	-	the dunal ecosystem
		-	the wetland ecosystem
4.	Cultural	-	archaeology
		-	natural heritage
5.	Social	-	land use (function)
		-	the property owners
6.	Economical	-	land value
		-	construction costs
7.	General	-	electromagnetic radiation
		-	safety aspects
		-	radio interference
		-	weeds

A summation of all the above factors will disclose the cumulative effect on the environment.

The primary impact of any transmission line and easement is the visual impact, most particularly if it is skylined or if the easement forms a strong artifical line in the landscape. Vista relates primarily to people, both residents and visitors, and their expectations of an area: a highly conspicuous development contrasts with the community's views. The effect of this impact is reduced through placement within areas of low visibility and/or low visitation (that is, low sensitivity) or within areas capable of screening the line (high visual absorption).

Approximately 60 percent of Option 1 for the Tilligerry Peninsula Line traverses land rated highly suitable to transmission line development (refer to Figure 5.7). Hence, the potential impacts are minimised through the selection of country capable of accepting the development. The remainder of this line occupies land with a medium and low suitability (35 and 5 percent respectively. It is the crossing of Tilligerry Creek that scored a low suitability, however this is not avoidable as all water bodies are associated with low suitability and the creek must be traversed in order to service the Port Stephens Peninsula. The potency of the impact can be reduced through suitable management techniques.

The alternative route for the Tilligerry Peninsula Line is considered to generate more impacts whilst crossing Tilligerry Creek. This route utilises a break in the S.E.P.P. 14 wetlands, however, the proximity to its mouth at Port Stephens, the township of Lemon Tree Passage and tourist facilities such as Fenninghams Island Caravan Park initiate considerable impacts. The distance of water to cross at Stuarts Island introduces extensive additional costs.

The majority, 55 percent of the Dunal Systems Line, lies within land of a medium suitability, utilising the highly suitable areas (30 percent) along its length (refer to Figure 5.7). Thus, the impacts of this preferred option are considered to be higher than the Tilligerry Peninsula Line. However, the most suitable land identified by the Route

Selection Procedure was utilised. Areas of low suitability occur at both Nelson Bay Road crossings (north of Lavis Lane and at Anna Bay).

Social impacts could be generated with use of the alternative route for the Dunal Systems Line. Whilst both the agricultural land and the coastal forest obtained a medium suitability, a transmission line has the potential to alter certain functions of the properties, however general agricultural activites would remain unaltered (refer to Appendix 5.3). The close proximity of a homestead could introduce safety hazards. Also within this open landscape, visual exposure is eminent.

7.02.0 THE TILLIGERRY PENINSULA LINE

Within the H.D.W.B. land, the impacts are acknowledged as negligible: determined by the flat terrain, tall vegetation cover, land use characteristics and low visitation to the area. The line will utilise existing H.D.W.B. corridors minimising disturbance to the vegetation, wildlife and incorporated ecosystems. The economic impacts of construction along this preferred route are negligible, due to the suitable terrain and the existing corridors.

Directly south of the Parachute Zone, an area of medium suitability occurs: the close proximity to Lemon Tree Passage Road and the open structure of the vegetation community exposes the line more readily to viewers. The transmission line will be 0.25 km from the road, however the actual viewing distance along the road will be 2 km, producing a total viewing time of 2 minutes (assuming the viewer to be travelling at 60km/hr). This impact is considered low, in comparison to the total length of the line.

From the crossing of Lemon Tree Passage Road to the crossing of Tilligerry Creek, a new corridor will be created in the Eucalyptus Tall Mixed Woodland. The impact is classified as low because the physical and land use features of the area

are compatible with the transmission line development. This section obtained a high suitability rating (refer to Figure 5.6B). Creating a new corridor within this natural vegetation may potentially disturb the ecosystem within the forest, however only minimal clearing is required due to the more open structure of the community. Any clearing will be specific, restricted to the easement. It can be concluded that the overall impact will be minor.

Crossing Tilligerry Creek is the most adverse hazard of this line. Disturbance to the wetland ecosystem is inevitable although clearing or trimming of mangroves is not required for electrical ground clearances. Wetlands are particularly vunerable to change in the water flow regime, as each evolved in response to regular patterns of water movement and salinity distribution (Browne et al., 1986). It is of prime importance to maintain the existing water flow regime of Tilligerry Creek.

The S.E.P.P. 14 wetlands, which line both sides of Tilligerry Creek, are considered to be of ecological importance and hence development must meet the minimal disturbance requirements outlined in the Policy. The alternative option of this line utilises a break in the S.E.P.P. 14 wetlands, however to cross the creek at this point, high additional expenses are necessary to cover the increased distances.

Two options exist for the method of traverse: overhead or submarine cables. Each method generates different impacts through this land of low suitability, so each method is discussed individually.

Overhead Transmission Line

The crossing occurs approximately 7.5 km from its mouth entering Port Stephens and hence the visual impact is reduced. The visual absorption capacity of the creek is low in view of the height of the structures compared with the height of the mangroves (7.5 m above the highest recorded

flood level). A high visual sensitivity evolves from the extensive viewing lines both upstream and downstream and in all directions across the floodplains. The users of Tilligerry Creek, especially the tourists and recreation seekers, have expectations of the natural environment. A transmission line alters the aesthetic values of the creek.

Wetland ecosystems survive on a delicate balance between the natural elements comprising them. Changes to the ecosystem to accommodate power line construction and maintenance within the easements, may alter this balance.

The topographical impacts are generally negligible on low-lying terrain: it is however this low-lying nature that generates other difficulties. Being constantly inundated and water-logged, construction techniques are more complex in order to adequately insert and stabilise the poles. Access for construction and maintenance may also be difficult. Extra work during construction and maintenance activities produces more physical disturbance to the soil. The impact within a wetland area has the potential to be severe through excessive construction activity.

Water quality is of significant importance. Wetlands act as efficient water treatment areas and pollution traps that maintain water clarity and quality in the associated water body. An easement to the water line has the potential to open the buffer zone to expose the waters and alter their conditions. The bank vegetation of Tilligerry Creek however, will be maintained as the height of the mangroves provide adequate clearance. This will enable the bank vegetation to continue to function as a buffer, filtering all inputs (including additional material resultant from the easement) and reducing the impact.

A further potential impact is the flush of raw pollutants (for example oils, fertilisers, pesticides, septic effluents and sediment) into Tilligerry Creek - a result of possible leakage from residental areas near the easement and other areas where vegetation has been removed. Placement of this

option avoids high usage or residential areas reducing the likely sources of raw pollutants. Maintenance of the vegetation fringing the creek assists to further minimise the potency of this impact to negligible.

Mangroves play a major role in bank stability. Along the easement instability will prevail and erosion will eventuate, if the mangroves are removed. Siltation is a common problem. Particularly vulnerable are the seagrasses which form a fringing strip along the mangrove community. Seagrass beds are the main source of organic detritus and serve as a nursery for juvenile fish as well as a shelter and sanctuary for marine animals. They are a direct food source for some species of fish and water birds. Disturbance by smothering with sediment and pollutants results in the disappearance of almost all animals and organisms sustained by the seagrasses. Siltation is also detrimental to oyster farming. This impact is of no significance as mangroves will not be removed, preserving the bank and thereby preventing erosion and subsequent siltation.

Mangrove Community and Fen Vegetation are affected by the development. In particular, the vegetation on Upton Island is disturbed through the vegetation removal necessary to insert the structure required for the wires to span the creek. The vegetation removal, however, is considered low, in terms of the total surface area of these vegetation communities.

Mangrove swamps harbour a large variety of marine flora and fauna and produce vast amounts of organic matter which fertilise the adjacent waters. The slow but continuous rate of decomposition of the leaves form a constant supply of food for the marine organisms, including crabs, prawns, some fish including the micro-organisms essential as food for oysters (Dunstan, 1978). The impact upon the wildlife is indirect through the removal of wetland vegetation during construction procedures. Considering the percentage lost from the total, the impact on the wildlife is reduced to low.

In summary, the impacts generated from this option would be reduced, primarily through maintenance of the buffer zone along the bank and hence the repression of silt entering the water. It is this impact which is most detrimental to the wetland ecosystem, as opposed to the physical disturbance to the vegetation. The visual prominence is diminished by locating the line beyond the general viewing distances of popular tourist areas.

Submarine Transmission Line

Use of a submarine cable nullifies the visual impact directly over the creek as the cable will be on the creek floor. Two transition structures on either bank will be the only visible features. These structures however, require termination structures either side to support additional loads. These will introduce a further visual impact on the banks and vegetation would need to be cleared to accommodate the extra structures. Appendix 7.1 details options for transition structures over Tilligerry Creek.

The physical impacts on the banks of Tilligerry Creek are synonymous with those outlined for the overhead cables. The degree of damage will be greater as the cable with a mechanical protector needs to be buried in the bank, to a depth of approximately 2m. Thus, construction works will require more physical disturbance rendering the potential of impacts on the hydrology and vegetation higher.

The cable will be lowered into a shallow trench dug in the river bottom along the route. It could be incorporated into the marine environment. Upton Island will be free of the development, leaving this 'Coastal Wetland' unaltered.

The estimated cost of a submarine cable 1km in length to cross Tilligerry Creek is $600,000. Two types of cables have been selected as being possibly suitable. The B.I.C.C. oil filled cable, including accessories and installation could be

used at this cost. The X.L.P.E. could also be used however this design has not been tested at 132kV and is only manufactured in 500m lengths in Australia. A 1km length cable would have to be manufactured overseas and transported to the site bringing the cost to approximately $600,000.

There is also an increased environmental cost if the submarine cable is damaged. The cable trench would have to be reopened through the mangroves and along the creek bed, destroying any regrowth that has taken place.

With the increase in the physical disturbance to the bank, there is an increase in potential impacts on the creek ecosystem. Each bank would be more prominent visually due to the presence of termination structures. In conjunction with cost, the overall impact with the submarine transmission line is greater.

In summary the advantage of the submarine cable over an overhead system is the reduced visual impact of the aerial conductors over the transmission structure on Upton Island. Against this advantage of the submarine cable are the high installation and maintenance costs, maintenance difficulties, and the increased environmental impact on wetlands and creek during construction and maintenance operations.

The Remainder of Route

From the southern bank of Tilligerry Creek to Diere Point Road the impacts generated are moderate due to the proximity to residents and Nelson Bay Road. The most significant interaction is with the visual environment but by locating the line approximately along the natural boundary between the agricultural grassland and the Casuarina glauca of the Fen Vegetation the visibility of the line is reduced. This natural boundary is just beyond the S.E.P.P. 14 boundary, thus development will not require the consent of the D.E.P. Conserving the Casuarina glauca will protect the wetland beyond as these form the buffer zone to the wetland. Within

the initial portions of this section, clumps of tall remnant forest provide additional screening.

Impacts upon the environment neighbouring the man-made drain are low: the land is forested providing suitable visual screening, the topography is flat however it is unlikely to be flooded, and disturbance to wildlife habitats is considered minor. The land is categorised highly suitable. The only potential impact is on the water quality within the drain due to local construction activities. However this is considered temporary and, with proper prevention methods minor.

To the Anna Bay Substation, the major impact is on the visual environment as it is currently void of vegetation due to the past sand mining activities. The close proximity to Nelson Bay Road increases the visual sensitivity. The development is compatible with all other aspects of the environment. Measures of vegetation restoration will be taken to reduce the visual exposure of the development.

In summary, the Tilligerry Peninsula Line generally traverses land of a high suitability and therefore the impacts generated are negligible or low. However, crossing Tilligerry Creek has the potential to cause major localised changes within the wetland ecosystem through careless construction activities. Appropriate management measures will however, mitigate the impacts.

7.03.0 THE DUNAL SYSTEMS LINE

The initial stages of the route traverse land of a medium suitability generating visual impacts due to the proximity of Cabbage Tree Road. No further interactions will evolve as the proposed line will primarily utilise an existing easement and the present land use can freely continue. Locating the line further south, closer to Fullerton Cove is not feasible due to remnant settling ponds from past rutile and zircon mining. Construction in this area would be unstable and

unsafe. Impacts on the land's physical components, such as soil, would be high.

Crossing Nelson Bay Road would produce numerous impacts as the road has a high sensitivity and low visual absorption capacity. Safety to the users is of prime importance. Implementation of suitable measures such as placing the supporting structures outside the road reserve and planting of vegetation to screen the structures will reduce these impacts.

The majority of the feeder occurs within a swale on gentle slopes - the topographic nature of this feature allows almost total visual screening of the transmission line. Hence, the visual impact of the development does not destroy the natural character and beauty of the area. The tall forest adequately screens the line to nullify the visual impact. The relatively low visitation to the dunes combined with distance from both the Nelson Bay Road and the coast reduce the visual sensitivity to low.

The entire dunal system is very susceptible to erosion, especially wind erosion along east-west aligned openings. The soils are most sensitive when denuded of ground covering vegetation. A large physical impact on the dunal soils would result if the ground cover was cleared within the easement.

Within the Eucalyptus Dry Sclerophyll Forest, the major impacts on the vegetation will result from clearing of specific trees and shrubs and physical damage to neighbouring species. Excessive and accidental felling will increase this impact. Clearing will open the canopy and create an artifical space. This space, however, can expand vegetation diversity through increased opportunities for immediate generation of suppressed species. This opportunity, however, is also available to weed species.

While the 30 metre easement is considered a significant impact locally, it is also considered small in view of the

large quantities of the same vegetation community either side of the impact. The integrity of the bush can be maintained through the capacity of its seed store. The easement will create a firebreak, sustaining regeneration of the understorey, which is currently poor in quality due to the prevalence of fire.

A high potential impact on the wildlife exists in this character zone. Clearing for the 30 metre easement creates three situations :

1. a biological division;
2. a loss in habitat;
3. an increase in potential habitat diversity.

Biological divisions are created through change to an area, particularly clearing, that result in the formation of two separate "biological islands". Such divisions restrict or cease the transfer of wildlife from one "island" to the other. Small ground-dwelling mammals are inhibited by the smallest changes to habitat or frequently travelled zones: most cease to visit areas through intimidation. A 30 metre easement is considered a significant distance in creating a biological division.

Clearing trees of a height greater than 4.0 metres will cause the direct loss of tree habitat within the easement. Felling of dead trees is detrimental to possoms and similar mammals that live in these hollows.

Opening the vegetation and altering the diversity can indirectly increase habitats along the easement periphery. Hence, more opportunity exists for wildlife species to the area.

Maintenance activities and activities of recreation seekers are restricted to daylight hours whereas the wildlife is primarily nocturnal. These activities will therefore not significantly interact, minimising the impact.

Changes to specific components of the dunal ecosystem can initiate a chain of events with the potential to cause detrimental effects to the ecosystem as a whole. However, giving regard to the scale and complexity of the dunal system, the extent and character of the impact from the transmission line is not considered to be significant. In conjunction with proper planning and management, the proposal may assist the overall growth of the ecosystem.

One aboriginal site was revealed in the detailed archaeological survey (Appendix 6.1): a small exposure of pipi midden located adjacent to Boyces Track (on a westward deviation track), 300 metres from Nelson Bay Road. This site lies 100 metres outside the designated easement. The site, however is protected under the National Parks and Wildlife Act, 1974, and any disturbance is in breach of this Act.

The extensive Newcastle Bight dunal system plays a role in the natural heritage of the study area, which satisifies the human needs for aesthetic, recreational, educational and scientific values (Browne, et al., 1986). The Bight's scenery, clean waters and beaches provide the fundamental basis for the area's tourist industry. The prominence of a transmission line in the environment would affect the natural and cultural heritage of the area and the expectations of the tourists. The impact would be severe. Through placement of this portion of the line within the swale between the two most landward forested dunes, the impact is resolved as low.

The impact on the function of the dunes is also relatively low. The development will affect neither the water supply source available within the Coastal Water Reserves nor the extractive activities, primarily west of this portion of the line.

Recreational activities such as bushwalking and nature study will be restricted within the easement, however, this will be a local impact only. The vast quantities of natural bushland either side of the line will nullify this impact. Use of the

easement as a vehicular path (by four-wheel drives and motor cycles) is an eminent potential ecosystem degrader. The attraction of a semi-cleared corridor for beach access, or simply joy-riding, is high without implementation of control measures.

The land use also includes back portions of private properties within the vicinity of Boyces Track. This option, however, traverses only two properties, rectifying the social impact of other options.

Impacts upon the use of the dunes as Coastal Water Reserves are low: the water supply will continue to be protected. The only potential impact is from contamination of the aquifer from saltwater intrusion (H.D.W.B., 1983) however the poles gain insufficient depth for such contamination.

Implementing the Route Selection Procedure and appropriate management guidelines minimises conflict between the presence of the transmission line and the conservation issues within a National Park. Extensions to Tomaree National Park are proposed for the future and will include this dunal system (Browne, et al., 1986) - the transmission line will only be a slight intrusion.

At the junction with the present 33kV line, the impacts from the new 132kV line will be much reduced from the previous section within the dunal forest as a transmission line is already incorporated into the environment. The line will remain within the natural depression to minimise visual impacts on the forest. The tall trees will adequately screening the development. The visual impact will be comparable to that of the existing 33kV corridor, possibly reduced with line design (refer to Section 8.03).

Further impacts such as erosion, clearing of vegetation, physical damage to vegetation, production of a biological division, introduction of weeds and a general imbalance to the ecological system can be considered negligible provided

all activities are confined within the current easement. These impacts would have been felt within the dunal ecosystem with the construction of the present 33kV, 32 years ago, and adjustments to this development would already have occurred. The far eastern end of the line is particularly vunerable due to its proximity to the mobile dunes and hence erosion is a high potential impact. Collectively the impacts along this section are considered low.

Crossing Nelson Bay Road along a property boundary diminishes the social impacts associated with transmission lines. The land use impacts are similarily decreased. The most prominant impact is visual due to the span of the road at this junction, the frequency of travellers and the lack of tall vegetation for screening purposes. The line traverses flat agricultural land to a man-made drain.

The path from the drain to the substation coincides with that of the Tilligerry Peninsula Line and hence the environmental interactions are the same. The impacts, which are low, are described in Section 7.02.

In conclusion, the cumulative impact along the Dunal System Line is low in light of the impacts discussed above. Within the sand dunes, a new corridor is created and the possibility for high impacts on the wildlife, vegetation and the physical structure of the dunes (through erosion) exists without stringent construction and maintenance management. With adequate controls, however, only minimal changes will result.

7.04.0 OTHER GENERAL IMPACTS

In addition to the specific impacts along the routes that result within each character zone, some non site specific issues require attention.

7.04.1 Electromagnetic Radiation

When transmission lines are energised, electric and magnetic

fields are created in the airspace surrounding the line conductors. The electric field intensity at any point depends on the operating voltage while the magnetic field varies with the line current. The strengths of these fields decrease rapidly with increasing distance from the line conductors.

Electric fields may induce a charge on objects insulated from ground of a similar nature to static charges, which often build up when nylon carpets or clothing are rubbed. In accordance with established practice, metallic objects in the vicinity of the line, such as wire fences will be earthed at the time of line construction to prevent the build-up of electric charges.

At ground level the magnetic field due to the transmission line will be smaller than the local intensity of the earth's magnetic field, although it will alternate in polarity with the frequency of the alternating current in the line.

The search for conclusions on the effect of human health from living or working near transmission lines has been extensive over the last ten years. Many possibilities have been examined but as yet, none have proven conclusive. It is not unreasonable to expect that further work exploring less promising avenues will equally show nothing.

This area of study has had more than its share of announcements of startling discoveries which, due to unacceptable experimental procedures, later prove to be wrong. Links between electromagnetic radiation and health problems including cancer, brain tumours, leukemia and immunity disorders create fear within the community. These links are however, vague based upon assumptions or through experiments involving extremely high voltage power systems and satellites.

The most authoritative document on this subject is World Health Organisation (1984). The Australian National Health

and Medical Research Council considers that the conclusions and recommendations offer an acceptable basis for the design and operation of high voltage transmission lines. This document concludes that electric and magnetic fields caused by transmission systems up to system voltages of 420kV do not constitute a danger to human health.

Transmission lines and stations pose obvious potential hazards due to electrocution if contact is made with energized conductions. Proper safety clearances and restricted access to stations minimise these hazards, and existing guidelines outlined by Graves (1986) render these hazards generally acceptable throughout the world.

Based on more than 20 years of research and the bulk of scientific evidence, typical exposure to fields associated with high voltage transmission lines designed in accordance with acceptable international practices:

* will not adversely affect plant life
* will not adversely affect domestic or wild animals
* pose no public health problem (Rust, P, 1986; pers.comm.)

It is commonly recognised that the magnitude of magnetic fields next to many common household appliances and electrical tools are often in excess, often far in excess, of those generated by transmission line and station environments.

The design standards and easement policies of S.C.C. comply with these conclusions and recommendations and are in accordance with internationally accepted practices.

7.04.2 Television and Radio Interference

Television and radio reception in the primary service area of transmitting stations is normally unaffected by transmission lines.

Tests have been undertaken on the electrical energy generated by transmission lines, to ascertain the level of interference to radio and television reception. Sydney County Council (1984) and Donges and Associates (1984) indicate that interference to television reception can occur when the ratio of the TV signal (microvolts) to the transmission line (microvolts) approaches 2:1. The ratios measured (for 132kV lines) ranged from 20:1 to over 150:1 and were thus well above the 2:1 required to generate interference. This shows that there should be no significant interference with the local television reception attributable to the installation of the new 132kV feeders.

Potential for interference can be increased when lines are coated with dust or other forms of particulate or chemical matter. Some momentary fading of radio reception may also be experienced in a car passing underneath the line, particularly if the radio signal strength is low. In fringe areas experience has shown that a properly erected aerial generally overcomes any potential reduction in quality of television or radio reception arising from proximity of the transmission line.

7.04.3 Safety

Safety is a major consideration in the design of high voltage transmission lines. It is necessary to have regard for safety of the general public, the staff working on the line during construction and maintenance and for the safety or security of the line itself.

It is unlikely that a modern transmission line would cause a bushfire. Regular patrols are mounted with particular emphasis during spring and summer to ensure that trees growing under or near transmission lines do not attain such height that would allow electricity to arc from the line conductors under any operating conditions of the transmission line. The sensitive monitoring apparatus and high speed circuit breakers installed on major transmission lines ensure that any fault which may occur on the line from for example,

a lightning strike, is immediately detected and the line quickly de-energised.

Travelling bushfires however, can present a hazard to the security of a transmission line. Where easements are only partially cleared of vegetation, passing bushfires can burn at almost full intensity underneath the conductors. Bushfires generate rising plumes of ionised gases which destroy the insulating properties of air and can easily permit a "flashover" resulting in the line being automatically switched out of service. The passage of bushfires across transmission easements is now the most frequent cause of major transmission lines being forced out of service.

Major transmission lines are not considered to present a significant safety hazard to aircraft. On the contrary, pilots of light aircraft tend to use major lines, which are normally marked on aeronautical charts, as navigational aids. Aerial agriculture operators, whose work requires low flying, are involved in very few incidents with major lines. These operators normally have extensive local knowledge and through contact with property owners their requirements are taken into account wherever practicable by S.C.C. in the detailed siting of new transmission lines.

It is a very rare occurrence for a transmission line to fail mechanically. Standard factors of safety, loading conditions and other requirements for incorporation in the design of all transmission lines in New South Wales are stipulated in the Overhead Line Construction and Maintenance Regulations (made under the Electricity Development Act, 1945). Line fittings and materials are specified in various Australian Standards. These requirements which are considered to provide an adequate margin of safety are followed, and in many instances bettered, by S.C.C.

Major transmission lines are normally not sited along roads and hence the line structures are rarely in a location that would present a hazard to motor vehicles. When roads are

crossed it is normal practice to site structures well back from the road shoulder or kerb.

7.04.4 Weeds

Within the natural seed store of native bushland lies dormant a supply of exotic seeds. These species have the ability to take advantage of any disturbance and quickly colonise bushland. Even minor disturbances create conditions liable to favour the establishment, growth and spread of weeds. If establishment of a species has occurred prior to the disturbance, the potential for further proliferation is high (Savet, 1986).

This potential is further increased if seeds of exotic species are introduced to an easement in dumps of earth attached to plant equipment and vehicles or by natural means of seed dispersal including birds and animals.

The initial flush of nitrogen (through increased air to the soil), additional light plus the slower rate of germination by native species creates a favourable environment for weed species germination.

However, past experience shows that regrowth on transmission line easements is almost entirely within the range of vegetation already existing in the immediate environs when accompanied by appropriate clearing techniques, except where species are introduced specifically as part of restoration work. The weeds which did become established were usually found to reach a peak in the first year following line construction and then decline significantly as native vegetation became more established and the conditions favourable to weeds were reduced.

8.00.0 RECOMMENDATIONS TO MITIGATE THE IMPACTS

The preferred routes, evolved through route selection and line design, minimise the impacts along their course as they primarily traverses land of a high or medium suitability. Small sections cross unsuitable land, so safeguards are required to mitigate the impacts. Some areas, such as the sand dunes, evolved from the Route Selection Procedure as highly suitable for transmission line development. However, as a new corridor will be created in the forest, management is necessary to minimise ecological change through construction and operation techniques.

The following are recommendations aimed at reducing inevitable and possible impacts. Safeguards are discussed on two levels: general and specific. Sound construction and operational practices should be universally incorporated along both lines. Each line is then specifically evaluated to reduce high impacts within specific areas.

8.01.0 GENERAL

8.01.1 Preconstruction Phase

Prior to construction, considerable liaison with the landowners is necessary. During surveying and detailed line design it is important to negotiate the particular requirements of each landowner and clear any problems that may arise - for example with land use.

The acquisition of easements should proceed in conjunction with detailed discussion with the landowners.

8.01.2 Construction Phase

Having minimised environmental impacts through locations and design of elements, good construction practices will ensure these benefits are not lost. The following recommendations

should be applied along both routes.

Public Relations

* Inform property owners adjacent to the easement when construction is planned to take place. Ascertain that this causes no hardship in terms of various land use activities.

* A construction person should be in constant liaison with the property owners during construction.

* Minimise the work time in any one property as much as possible.

* Ensure the operation is tidy through control of waste products, litter, machinery and materials.

Visual Impact Reductions

* Consider if visual aspects can be improved, through detailed site inspections associated with construction work. Involve construction staff and determine whether a minor location or design change will help.

Clearing Design

* Taper clearing widths and adjust tree heights between poles in accordance with safe operational distances.

* Minimise working area clearing at each pole and utilise existing openings where possible.

* When a pole must be close to the road, retain undergrowth to assist in screening.

* Minimise clearing for pilot wire runout path.

* Use hurdles to further reduce need for clearing.

* On river banks, only clear or preferable lop tall trees.

* Ensure all trees or loppings do not fall into rivers or creeks.

* Do not allow access tracks on steep river creek or gully banks.

* Tree felling should be into the cleared areas to minimise damage to retained vegetation.

* If felled material is not removed, cut tops and branches so that felled material is no higher than 750-1000mm above the ground.

* When clearing parallel to view lines, consider "featuring" cleared edge, however this should only be utilised in highly critical view areas.

Track Construction

A major visual impact and potential soil erosion hazard may result from track construction. Access tracks should be constructed as per Soil Conservation specifications (Environmental Assessment Manual; 1985) to reduce chance of soil erosion. In addition, the following visual design criteria should be considered.

* Retain or reinstate brush or grass over trail, to reduce visual contrast with surrounding vegetation.

* Horizontal alignment of the trail should consider the visual lines in the landscape e.g. road lines, fence lines, etc.

* In high sensitivity areas avoid cut and fill activities; if necessary reseed to regain colour/texture values of surrounding vegetation.

* Avoid placing track at right angles to major sight lines.

* Avoid long straights parallel to prevailing wind directions.

* Consider tree felling by chain saw to minimise damage to undergrowth.

* Felling should be directional into the area that has been cleared.

* Consider track establishment and maintenance by tritter allowing natural mulch to provide the track surface.

Timing of Works

* Consider any time limitations on construction activities that might result from activities associated with existing land use adjacent to the easement for example.

* Certain stock are people shy, breeding activities could be affected.

* Consider busy usage periods within the visual catchment of line works e.g. tourist areas, recreation areas, roads, etc.

* Consider the breeding season of wildlife if line is crossing a significant natural area.

* Consider increased fire hazards if work carried out in fire prone environments during periods of high fire danger.

* In intensive cropping areas, minimise interference with agricultural cycles.

8.01.3 Operation Phase

During the life of the transmission lines monitoring, remedial works, landscape improvements and maintenance is required to retain the development in safe working order. These works are related to the environment: maintaining its condition or improving certain characteristics of the environment (such as visual aspects), with minimal enviromental impact.

Monitoring

Monitoring is the inspection that is carried out at various intervals to ensure environmental standards are achieved and maintained. This is a regular but non-time consuming operation. Monitoring should occur post construction, during consolidation activities and accompanying maintenance.

Post construction monitoring should ensure that environmental works have been completed according to the design specifications and ensure the viability of the works. Particular attention is required with the tidiness of the finished site, the status of disturbed earth (ground levelling to the natural surface), clearings, the visual performance of the line and landscape works.

The timing and type of consolidation inspection would depend on whether construction has been completed by contractors or Council staff. If a contractor is used, the inspection should be completed at the end of the consolidation period. For landscape works, consolidation periods vary from 8 to 12 weeks. If the work is completed by Council staff, a consolidation inspection should be completed after a suitable period. This period would be influenced by growth patterns of consolidation plant materials, especially grasses. Another determinant could be based on climatic factors. For example, inspection could be made -

* After the first severe rainfall period to determine whether wash outs have occurred in soil stabilisation works.

* After prolonged dry periods to check the viability of new planting works.

* After high wind periods to check the heavily timbered sections of the lines for clearances.

Ongoing environmental maintenance inspections can be carried out simultaneously with route line inspections. Specific attention should be given to track and earth work stability (ideally covered with vegetation), clearing distances (for fire safety) and landscape works.

Ensure the environmental guidelines are suitable: review and update if required.

Remedial Works

Remedial works are those that are carried out to ensure the environment is left in a viable stable condition. Specific considerations should be given to such works in relation to track construction, vegetation disturbance in sensitive areas and where the functional efficiency of existing land use activities is compromised.

Following completion of line construction works, the long term requirements for the track should be considered. If the track is no longer required, the trail should be allowed to revert to its initial condition. Where tracks are required for long term maintenance access, adequate surface stablisation and drainage should be achieved. Tracks should be adequately drained. Where possible allow grasses and ground covers to stabilise the track surface. Maintenance of this surface should be by tritters or slashers and not the traditional grader.

The likelihood of vegetation disturbance requiring restoration work is minimal. Instances where it could occur include:

* River banks.
* Visually sensitive areas i.e. road crossings.

Although difficult, care should be taken to identify all the functional aspects of the land use in conjunction with discussions with adjoining land holders. Elements such as fences, gates, etc., should retain functional efficiency. Similarly restoration planting, e.g. the use of acacias, should not create a weed problem in intensive management areas.

Landscape Improvements

Landscape improvements cover aspects of environmental upgrading to improve the functional, visual or environmental capacity of the landscape to cater for the development. Landscape treatments within or adjacent to the transmission line and easement will generally not achieve total screening. However they will increase the VAC of the landscape to accept the line by creating natural lines and providing some vertical scale in areas that are dominated by horizontal line.

Each land use should be individually evaluated and assessed in terms of improvements with landscape works.

Planting of trees should be carried out according to established horticultural practices. Special care should be taken with,

* ground preparation (cultivation, topsoiling, weed removal)
* planting techniques (manual, hydromulching machine, fertilisers, mulch)
* plant protection (staking, tying, fencing)
* maintenance (watering, mulch, weed removal).

The implementation of the above operations vary according to the techniques used to achieve plant cover. Planting techniques include;

* seeding
* mass planting
* individual planting
* mass planting urban areas.

Local Forestry Commission officers or local nurserymen with experience in propagation and cultivation of endemic plant species should be consulted for advice regarding species selection, most appropriate planting techniques and most appropriate planting times.

The Environmental Assessment Manual (1985) provides comprehensive guidelines for landscape works.

Maintenance

Maintenance works incorporate the manipulation of environmental factors on a continuing basis to ensure the constant viability of the environment and to allow the safe operation of the powerlines and auxillary facilities. Maintenance work is most likely to be associated with track maintenance and line clearing.

Tracks should be sustained at a standard that enables maintenance vehicle access and ensures the track is in an erosion free state. Maintenance vehicles can tolerate ground cover growth up to 300mm or greater in height. The track surface should be kept in a stable condition. The best way to achieve this is to allow ground cover regrowth and mulch to accumulate on the surface. This surface should be maintained by tritter or slasher. Cross drains should retain the hydrological characteristics of the locality. Any breaks in the banks or siltation of the spoon drain itself should be corrected by grader or by handwork.

S.C.C. has an established code of practice for tree maintenance in the vicinity of Council assets. They adopted a policy on "The care and control of trees in the vicinity of its Assets" in August, 1983 which adequately recommends on all aspects of tree maintenance.

8.02.0 THE TILLIGERRY PENINSULA LINE

Overall, the measures necessary to mitigate the impacts generated from the Tilligerry Peninsula Line are minimal. Only one area, the crossing of Tilligerry Creek, demands the use of careful construction techniques to avoid disruption of the sensitive wetland ecosystem.

The two most adverse impacts on Tilligerry Creek are siltation and the visual intrusion. Siltation alters the hydrological regime and the ecological balance. The visual prominance detracts from the natural setting.

To overcome any potential siltation from the easement onto the wetland ecosystem, silt traps or sediment ponds should be constructed between the transition structure and the mangrove community before construction activities commence. These will be designed to trap increased loads of silt in the runoff flowing along the easement, slow the water input and allow the mangroves to remain functioning as buffer vegetation to the wetland. Different types are available: the most feasible alternative is a terrafirma fence partially embedded into the soil or hay bails spiked to the ground with star pickets. These function to trap the silt but allow the water to continue to flow. Bank stability will also be maintained. The overhead cable offers increased opportunities to reduce the siltation input as a trench will not be required. The structures will be placed back from the bank reducing disturbance and bank instability. Any disturbed areas should be restored to assist wetland regeneration.

Measures to reduce the flush of raw pollutants other than

sediment can also be reduced through silt traps. The traps will thus be designed to be effective in diminishing all types of raw pollutants. The Soil Conservation Service or the State Pollution Control Commission can offer advice on the design and suitability of traps (S.P.C.C., 1987).

Installation of the traps is the most appropriate method to reduce impacts on many aspects of the wetland ecosystem as siltation initiates disruption to the hydrology, flora, fauna and the productivity of the system (refer to Section 7.03).

Placement of the structures back from each bank and design of signage to harmonise with the environment will assist in reducing the visibility of the line. Measures to blend the overhead structure with the island environment are minimal due to the physical prominance of them in the mangrove and wetland vegetation.

Vegetation clearing should be restricted to an absolute minimum: mangroves only directly interferring with the development should be selectively cleared; saltmarsh should be retained as completely as possible. Cleared vegetation should be chipped and utilised in planting and restoration works at Anna Bay. Vehicle movements should be restricted to the prepared trails in order to produce only minimal disturbance.

The seagrass beds, being the main source of organic detritus and supporting extensive varieties of fauna, should be fully protected.

Crossing Lemon Tree Passage Road at an acute angle, across the bend (see Figure 5.7B), is recommended to utilise the pocket of tall woodland within the surrounding open woodland. The visual prominence of the transmission line spaning the road will be reduced. Tomago Road should be traversed at right angles, to reduce the viewing time from this high visual sensitivity zone. The surrounding tall forest provides adequate screening. Line structures will be sited

back from the road for the safety of motorists.

Within the vicinity of the man-made drainage system, in the final portions of the line, precautions must be applied to avoid contamination of the water. Buffer vegetation, comprising tall woodland should remain on the drain banks and the transmission line sited 30m back from it.

The area immediately surrounding the proposed Anna Bay Substation is of high suitability however planting and restoration works will further improve this suitability by increasing visual absorption potential of the area. Their is a need for detailed consideration of inward and outward going lines and landscape treatment to complement these corridors. Consultation with a landscape architect is recommended. The single most important factor in this process involves the utilisation of the correct vegetation species -those from the existing natural communities. Any weed species should be removed. Seed can be collected from the existing communities or advanced seedlings can be planted. A weed free sandy loam should be imported and spread to a minimum depth of 150mm over the existing base. The planting area will then be mulched to a minimum depth of 75mm, with material obtained from vegetation cleared at the Tilligerry Creek crossing. Plants will be watered in (approximately 15L of water each) and should be watered fortnightly to improve and quicken establishment. Water is particularly important if planting is carried out in the summer. Temporary staking and tying of trees can be applied to assist in establishment.

The Environmental Assessment Manual (1985) further details restoration, landscape and maintenance works.

8.03.0 THE DUNAL SYSTEMS LINE

The character zone requiring the most detailed safeguards is the forested sand dunes. Although they are high to moderate in suitability, this area is pristine and a new corridor will be carved into the forest. To avoid detrimental changes

careful management is necessary.

The soils are prone to erosion: to avoid erosion and dune instability the following soil conservation measures should be implemented.

* Maintain the ground cover of bracken and grasses at all times.

* Stage the construction activities to minimise the amount of vegetation removed at any one time, consistent with necessary staging of construction operations.

* Use sand stabilisers (such as rapidly growing vegetation) continually through construction.

* Install sediment basins to prevent sediment from leaving easement where required.

* Apply special attention to areas with a slope greater than 10 degrees.

* Implement the methods of access pathway construction outlined in the Environmental Assessment Manual (1985).

Further advice and consultation can be sought from the Soil Conservation Service.

The northern section of the dunal system (at Anna Bay) is an extreme erosion hazard when void of vegetation (Hunt, J.;pers.comm.). Local erosion problems are currently experienced, including sediment movement and drainage line erosion. A rehabilitation program is, at present, being undertaken by the Soil Conservation Service to stabilise the sand drift. Particular care is necessary with the soil conservation procedures in this area.

Safeguards are implemented to prevent a simplification and reduction in the diversity and quality of plant species.

Measures must also be applied to reduce the viability of the environment for weed species. Minimal disturbance is the key.

Within the dunal systems, selective, manual clearing is necessary to avoid both excessive clearing and accidential damage to surrounding vegetation. The following clearing restrictions will be implemented:

* trees under 4.0m in height will not be removed;
* trees smaller than 0.3m in girth will not be removed;
* dead trees of any height will only be removed if potentially hazardous to the development;
* shrubs under 3.0m in height will not be removed;
* groundcover will remain at all times.

All activities, including vehicle movements and path of felled trees, should be confined to within the easement to completely preserve areas beyond this. Cleared vegetation should be chipped and stored as mulch for later regenerative works.

The distance between the three transmission wires on the intermediate structures should be spaced greater than 450mm to prevent flying foxs from becoming electrocuted. This distance prevents these mammals from holding both wires simultaneously as it is too great a span for them to reach.

To prevent the introduction of exotic species to the easement and peripheral areas, the sources must be eliminated (Savet, 1986). All equipment and vehicles involved in clearing, structure erection and stringing should be washed down prior to usage to remove weed seeds. All imported sand, ballast and soil must be weed-free and from a reliable source. Restoration techniques must involve plant species native to the Eucalyptus Dry Sclerophyll forest present and mulched with onsite material. Waste dumping and continual physical disturbance along the easement can be deterred through adequate signage at access points.

In the event of the establishment of weeds, control techniques acceptable to primarily pristine vegetation are those that minimise disturbance, non-target effects and chemical residues (Savet, 1986). Preferred techniques include hand-grubbing, The Bradley Method, biological control and selective spraying. Each technique serves a different purpose enabling control of varying weed infestations. Small spot infestations are best removed manually. Spraying can be applied initially to assist in removal. For larger infestations, The Bradley Method (Bradley, 1971) is the most appropriate. Biological control requires experimentation before use and is only necessary for infestations too large for mechanical or chemical control. Onsite advice can be sought from the Department of Agriculture or a suitable consultant with reference to the most suitable method for the particular weed species and the size of the infestation.

The one small archaeological site will be delineated clearly to avoid destruction of the site. If during line design, the route is relocated closer to the midden, it should remain delineated during both construction and maintenance works. The position of the poles, supportive structures and easement will be such to avoid potential disturbance.

Private properties within the sand dunes should have gates installed across the easement along properties boundaries, which will be locked when not in use. Privately supplied locks from the property owners may be inserted in series with S.C.C. locks.

Three crossings of Nelson Bay Road - at Tomago Substation near Lavis Lane and at Anna Bay respectively - span areas of low suitability due to the high frequency of travellers on the road and the lack of visual absorption. It is recommended for crossing to occur at right angles, to reduce the viewing time and hence the visual impact. Line structures will be sited back from the road formations and kerb so as not to create a safety hazard to motorists. Planting should be carried out where the easement crosses

Nelson Bay Road. The most important factor involves utilisation of the correct vegetation species -those from the original natural communities. Tree and shrub species lining both sides of the road can be utilised to screen the transmission line from view.

The portion of the transmission line in close proximity to Por. 13, 75, 76, 101 (J. H. & O. H. Towers) (leading NE from Lavis Lane) should be aligned with the change in the slope of the dunes. All poles should be placed as far away as is practical from existing homesteads at the eastern end of Lavis Lane. Planting along the eastern property boundary is recommended to screen the line along this viewing front.

The following controls are recommended for the development in areas of agricultural grasslands.

* Utilise property or paddock boundaries where possible.

* Screen the line with the isolated patches of remnant forest, without clearing.

* Distant all structures associated with the development as far as practical from residences.

* Utilise existing tracks or property roads where possible.

* Property owners will be consulted prior to all construction and maintenance operations.

* Gates will be constructed at the junction of property fences and the easement to ensure continued privacy.

9.00.0 C O N C L U S I O N

This Environmental Impact Statement details the selection of two suitable routes and the effects of the construction of two 132kV transmission lines on the Port Stephens Peninsula. This peninsula covers approximately 75 square kilometres in area containing the townships of Williamtown, Salt Ash, Bobs Farm and Anna Bay. The predominant land uses include Coastal Water Reserves, vacant Crown land and agricultural land utilised for grazing and market gardens. Tilligerry Creek, which is lined with S.E.P.P.14 wetlands, dissects the study area.

The Route Selection Procedure was implemented to determine the optimum route zone for each transmission line. Within this zone fewer impacts will be produced on the environment, due to the high suitability of the land. The small areas of low suitability that are traversed in order to link areas of high suitability will however be subject to impacts.

Crossing Tilligerry Creek is the most sensitive section of the Tilligerry Peninsula Line. The S.E.P.P.14 wetlands lining the creek are considered to be of ecological importance and hence development must meet the minimal disturbance requirements outlined in the Policy. The two most adverse impacts are siltation and visual intrusion.

Siltation can be effectively reduced with the installation of silt traps or sediment ponds between the transition structures and the wetland communities. This must occur before construction commences and be maintained throughout the process. Vegetation along the banks should be restored to its original condition to enable it to function as a buffer zone. The creek will be crossed approximately 7.5km from its mouth, in an area not frequently visited, thereby reducing the visual impact. Setback of the transition structures from each bank will also assist in reducing the prominence of the line.

The forested sand dunes require the most detailed safeguards of areas along the Dunal Systems Line. Although they are moderate in suitability, a new corridor will be created opening the ecosystem to disturbance.

To avoid soil erosion and dune instability, the ground cover must be maintained at all times, with the assistance of sand stabilisers where required. Selective manual clearing will avoid excessive clearing and accidental damage to surrounding vegetation. Restrictions on the size of the trees and shrubs to be cleared must be implemented. All activities should be confined to within the easement to preserve outside areas. Minimal disturbance is the key.

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APPENDIX 2.1 E N E R G Y S T A T E M E N T

In October 1979, the N.S.W. Government released its Energy Policy which required Environmental Impact Statements for major developments to include an Energy Statement. The purpose of the statement is to provide a balanced assessment of the impact of the proposed development on energy resources, to allow efficient and rational use of these resources.

Energy will be consumed during the construction phase of the proposed transmission line in the form of liquid fuel used to power plant and equipment and through the energy used to manufacture the materials used in construction such as reinforced concrete, fittings, conductors, insulator discs and bushings.

The proposed transmission line will provide a more efficient means of delivering electricity between Tomago and Nelson Bay. It will eliminate voltage problems and present power rationing which may occur with the present electricity supply system.

When the transmission line is in service, there will be little consumption of raw materials of any nature. Some energy will be consumed in supplying system losses when power is transmitted along the new transmission line but this will be significantly less than under the present arrangement. Additional energy will be consumed during periodic maintenance inspections, but the quantities involved, mainly through consumption of liquid fuels, will be minor.

APPENDIX 2.2 C O R R E S P O N D E N C E

Consultation and correspondence with the following bodies was held.

Commonwealth Scientific & Industrial Research Organisation;
National Information Network.
Department of Agriculture.
Department of Agriculture (Division of Fisheries).
Department of Environment & Planning.
Department of Housing & Construction.
Department of Lands.
Department of Main Roads.
Department of Water Resources.
Electricity Commission of New South Wales.
Forestry Commission of New South Wales.
G. M. Consultants, Specialists in Occupational Health.
Hunter District Water Board.
Maritime Services of New South Wales.
Mine Subsidence Board.
National Parks & Wildlife Service.
Occupational Health & Safety, Sydney Hospital.
Port Stephens Shire Council.
Public Works Department.
Royal Australian Air Force.
Soil Conservation Service.
State Pollution Control Commission.
Tourism Commission of New South Wales.
Williamtown, Salt Ash, Bob's Farm Association.

APPENDIX 2.3 THE PROJECT TEAM

The following individuals and organisations have contributed to this statement:

Forsite Landscape Architects & Planners Pty. Ltd.
Mr. John van Pelt - Director
Miss. Julie Savet - Environmental Planner
Project Co-ordination
Route Selection
Impact Evaluation
Environmental Safeguards

Shortland County Council
Technical Components of Development
Design of Line Elements
Electricity Supply Regime

Denis Byrne
Archaeological Issues

APPENDIX 4.1 VEGETATION COMMUNITIES OF THE STUDY AREA

VEGETATION COMMUNITY	RECORDED SPECIES	
	Latin Name	Common Name
Eucalyptus Tall Mixed Woodland	**Dominant Trees :**	
	Angophora costata	Sydney Red Gum
	Eucalyptus crebra	Narrow-leaved Ironbark
	" eugenoides	Thin-leaved Stringybark
	" maculata	Spotted Gum
	" oblonga	Narrow-leaved Stringybark
	" punctata	Grey Gum
	" resinifera	Red Mahogany
	" saligna	Sydney Blue Gum
	" siderophloia	Northern Grey Ironbark
	" umbra	Bastard Mahogany
	Dominant Shrubs :	
	Acacia falcata	
	Banksia collina	
	Banksia integrifolia	
	Breynia oblongifolia	
	Casuarina torulosa	Forest Oak
	Glochidion ferdinandi	Cheese Tree
	Hakea sericea	
	Leptospermum spp.	tea tree
	Melaleuca styphelioides	Prickly-leaved Tea-tree
	Persoonia pinifolia	Pine-leaf Geebung
	Dominant Groundcover :	
	Briza maxima	Quaking Grass
	Imperata cylindrica	Blady Grass
	Lomandra longifolia	
	Themeda australis	Kangaroo Grass
Eucalyptus Dry Sclerophyll Forest	**Dominant Trees :**	
	Angophora costata	Sydney Red Gum
	" floribunda	Rough Barked Apple
	Eucalyptus acmenoides	White Mahogany
	" agglomerata	Blue-leaved Stringybark
	" capitellata	Brown Stringybark
	" grandis	Flooded Gum
	" gummifera	Red Bloodwood
	" haemastoma	Scribbly Gum
	" maculata	Spotted Gum
	" pilularis	Blackbutt
	" punctata	Grey Gum
	" resinifera	Red Mahogany
	" robusta	Swamp Mahogany
	Melaleuca quinquenervia	paperbark

VEGETATION COMMUNITY	RECORDED SPECIES	
	Latin Name	Common Name
Eucalyptus Dry Sclerophyll Forest (cont)		
	Dominant Shrubs :	
	Acacia floribunda	
	Acacia longifolia	Sydney golden Wattle
	Acacia suaveolens	Sweet scented Wattle
	Actinotus helianthi	Flannel Flower
	Banksia serrata	Saw-toothed Banksia
	Banksia serratifolia	honeysuckle
	Eriostemon australasius	Wax Plant
	Haemodorum spp.	bloodroot
	Lambertia formosa	Mountain Devil
	Macrozamia communis	burrawang
	Melichrus urceolatus	
	Persoonia levis	Broad-leaved Geebung
	Pimelea linifolia	Granny's Bonnet
	Ricinocarpus pinifolius	Wedding Bush
	Dominant Groundcover :	
	Cheilanthes tenuifolia	Rock Fern
	Imperata cylindrica	Blady Grass
	Lomandra longifolia	
	Pteridium esculentum	Bracken
	Themeda australis	Kangaroo Grass
Eucalyptus Savanna Woodland	**Dominant Trees :**	
	Eucalyptus crebra	Narrow-leaved Ironbark
	" oblonga	Narrow-leaved Stringybark
	" maculata	Spotted Gum
	" melliodora	Yellow Box
	Lesser Trees :	
	Eucalyptus albens	White Box
	" blakelyi	Blakley's Red Gum
	" molluccana	Coastal Grey Box
	" tereticornis	Forest Red Gum
	" dawsonii	Slaty Gum
	Livistona australis	Cabbage Tree Palm
Heath	**Dominant Shrubs :**	
	Oxylobium spp.	
	Hovea spp.	
	Boronia spp.	boronia
	Persoonia spp.	geebung
	Leucopogon spp.	
	Kunzea spp.	

VEGETATION COMMUNITY	RECORDED SPECIES	
	Latin Name	Common Name
Fen (Swamp) Vegetation	**Dominant Trees :**	
	Casuarina glauca	Swamp Oak
	Eucalyptus robusta	Swampy Mahogany
	Leptosperum spp.	tea tree
	Melaleuca quinquenervia	Broad-leaved Paperbark
	" styphelioides	Prickly-leaved Paperbark
	" nodosa	
	Dominant Groundcover :	
	Paspalum paspalodes	Salt Couch
	Sarcocornia quinqueflora	Saltwort
	Sporobolus virginicus	Sand Couch
	Suaeda australia	Seablite
	Triglochin striata	
	Isolepis nodosa	
	Samolus repens	
Mangrove Community	**Dominant Trees :**	
	Avicennia marina	Grey Mangrove
	Aegiceras corniculatum	River Mangrove

APPENDIX 4.2 MAMMALS OF THE STUDY AREA

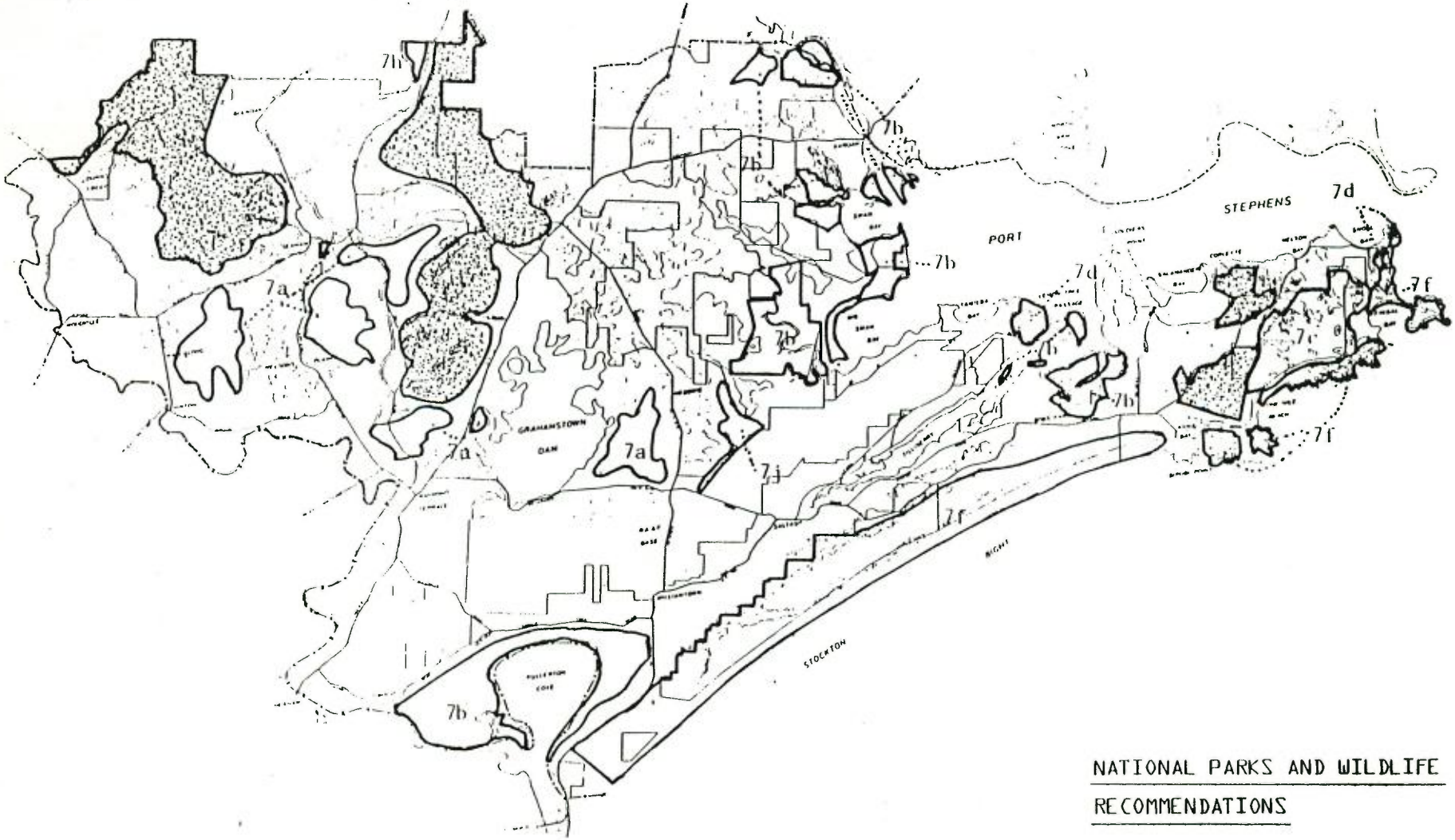
Latin Name	Common Name
Macropus giganteus	Eastern Grey Kangaroo
Macropus robustus	Wallaroo
Macropus rufogriseus	Red-necked Wallaby
Wallabia bicolour	Swamp Wallaby
Petrogale penicillata	Brush-tailed Rock-wallaby
Thylogale thetis	Red-necked Pademelon
Aepyprymnus rufescens	Rufous Rat-Kangaroo (Rufous Bettong)
Potorous tridactylus	Long-nosed Potoroo
Cercatatus nanus	Pygmy Possum
Trichosurus vulpecula	Common Brushtail Possum
Trichosurus caninus	Mountain Brushtail Possum
Pseudocheirus peregrinus	Common Ringtail Possum
Petauroides volans	Greater Glider
Petaurus breviceps	Sugar Glider
Phascolarctos cinereus	Koala
Tachyglossus aculeatus	Echidna
Vombatus ursinus	Common Wombat
Phascogale tapoatafa	Brush-tailed Phascogale
Isoodon macrourus	Brindled Bandicoot (Northern Brown Bandicoot)
Perameles nasuta	Long-nosed Bandicoot
Isoodon obesulus	Short-nosed Bandicoot (Southern Brown Bandicoot)
Dasyurus viverrinus	Eastern Native Cat (Eastern Quoll)
Dasyurus maculatus	Tiger Cat (Spotted-tail Quoll)
Canis familiaris	Dingo
Antechinus stuartii	Brown Antechinus
Antechinus swainsonii	Dusky Marsupial Mouse
Rattus fuscipes	Bush Rat
Rattus lutreolus	Swamp Rat
Rattus norvegicus	
Rattus rattus	
Mus musculus	House Mouse
Sminthopsis murina	Common Dunnart
Pseudomys gracilicaudatus	
Pseudomys novaehollandiae	New Holland Mouse
Melomys cervinipes	Fawn Footed Melomys
Miniopterus schreibersii	Bent-winged Bat
Pteropus poliocephalus	Grey-headed Flying-fox
Hydromys chrysogaster	
Felis catus	
Vulpes vulpes	
Lepus capensis	European Hare

APPENDIX 4.3 A B O R I G I N A L L A N D C L A I M S

The following land claims have all been made by local aboriginal tribes to the Department of Lands. Six have been granted (G), but the remainder are still under investigation (S.U.I).

CLAIM NO.	PROPERTY IDENTIFIER	STATUS
2428	Por 108 (ML17)	S.U.I.
2429	Por 103	G
2432	Por 359	G
2433	Por 29 (ML19)	S.U.I.
2434	Por 30	S.U.I.
2435	ML30	S.U.I.
2436	Por 360 (ML32)	G
2437	ML18	S.U.I.
2442	Por 254 (ML16)	G
2443	Por 255	G
2444	Por 363	S.U.I.
2445	ML29	G
2446	Por 207	S.U.I.
2913	South of Por 186	S.U.I.
2914	ML27 Crown Land west of Por 146	S.U.I.
2915	ML24 Crown Land east of Por 57	S.U.I.
2916	Por 17 (R35874)	S.U.I.
2917	South portion of Por 207	S.U.I.
2918	Part of Por 207	S.U.I.
2919	Part of Por 24 (ML28,ML6)	S.U.I.
2920	Part Por 6	S.U.I.
2921	Part Por 128	S.U.I.
2922	Part Por 179	S.U.I.
2923	East of Por 147 (ML14)	S.U.I.
2924	South of Por 11	S.U.I.
2925	Part of Por 206	S.U.I.
2926	Crown Land east of Por 146	S.U.I.
2927	Crown Land west of Por 127 (ML17,ML25)	S.U.I.
2928	Por 158	S.U.I.
2929	Por 146 (ML11,ML22)	S.U.I.
2930	Por 186	S.U.I.
2931	Por 125 (ML16)	S.U.I.
2932	Por 127	S.U.I.
2933	Por 130	S.U.I.
2934	Por 226	S.U.I.
2935	Part of Por 206 (remainder)	S.U.I.
2937	Por 169	S.U.I.
2969	Por 30 (west of ML30)	S.U.I.
2970	Por 246	S.U.I.
2971	Stuarts Island	S.U.I.
2972	Bulls Island	S.U.I.

CLAIM NO.	PROPERTY IDENTIFIER	STATUS
2973	Boondaba Island	S.U.I.
2974	Mud Island	S.U.I.
2975	Por 412	S.U.I.
2976	Por 456 (DP720651)	S.U.I.
2977	Por 384 (part of Pig Island)	S.U.I.
2978	Por 324	S.U.I.
2979	Crown Land south of Uptons Island	S.U.I.
2980	Por 338	S.U.I.
2981	Por 73 (part of Pig Island)	S.U.I.
2982	Por 343	S.U.I.
2983	Por 319	S.U.I.
2984	Por 108	S.U.I.
2985	West of Por 209	S.U.I.
2986	Por 330	S.U.I.
2987	Uptons Island	S.U.I.
2988	Pelican Island	S.U.I.



NATIONAL PARKS AND WILDLIFE

RECOMMENDATIONS

7h - Environmental Protection Historic Site

7j - Environmental Protection Scientific Site

Visually Significant Area

7a - Environmental Protection Wetlands

7b - Environmental Protection Estuarine Wetlands

7c - Environmental Protection Water Catchment

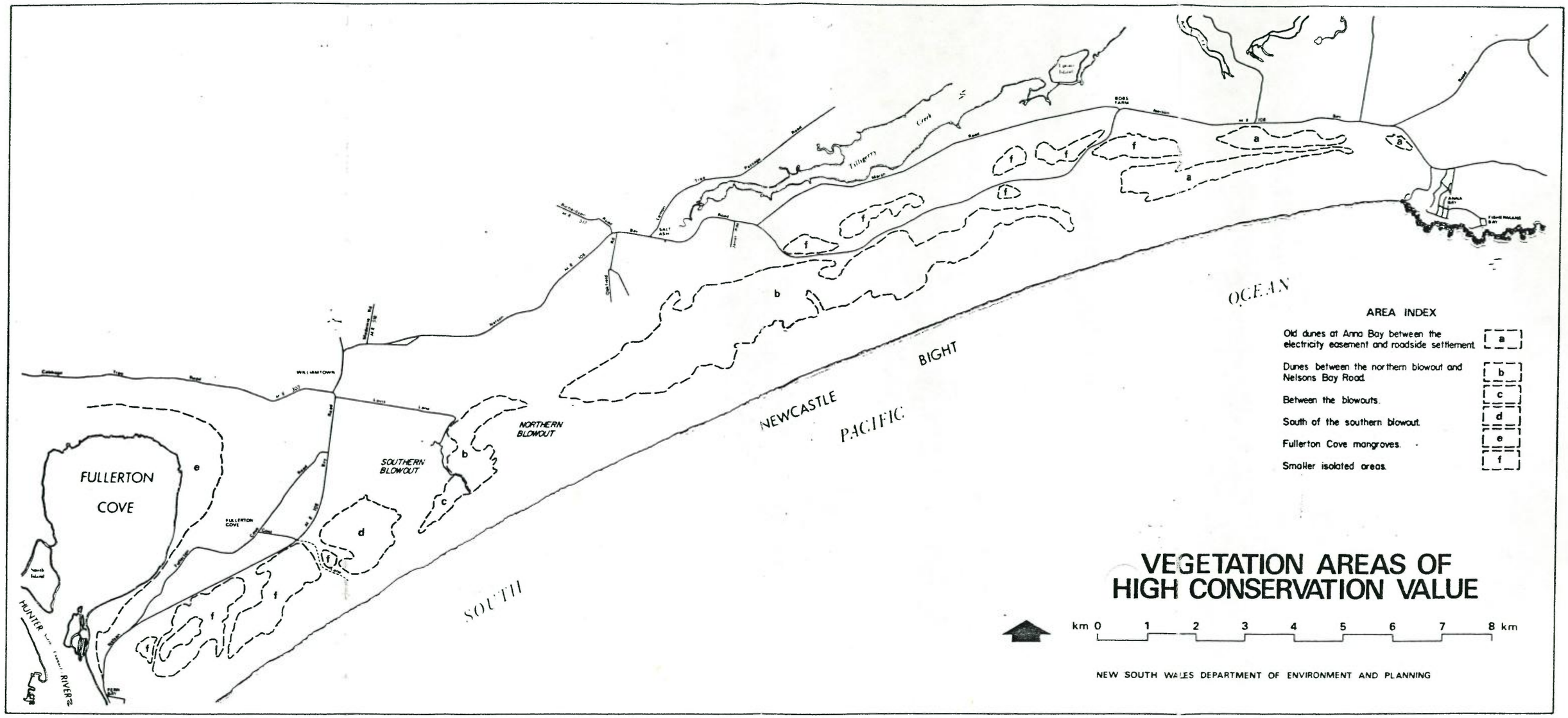
7d - Environmental Protection Scenic Protection

7f - Environmental Protection Foreshore Protection

SHIRE OF PORT STEPHENS

LOCAL ENVIRONMENTAL PLAN

APPENDIX 5.1A



VEGETATION AREAS OF HIGH CONSERVATION VALUE

NEW SOUTH WALES DEPARTMENT OF ENVIRONMENT AND PLANNING

APPENDIX 5.1B

APPENDIX 5.2

GENERAL RESTRICTIONS WITHIN TRANSMISSION LINE EASEMENT AREAS

Transmission line easements are acquired to provide adequate working space along the route of the line for construction and maintenance work and also to ensure that no work or other activity is undertaken under or near the transmission line or the structures which could either by accident or otherwise create an unsafe situation either for persons or for the security of the transmission line.

It would be noted that this list is not exhaustive and where there is any doubt concerning a particular activity within the easement area, advice should be sought from the Council.

1. Houses, buildings or other substantial structures or parts thereof shall not be erected within the easement area.

2. Minor structures, plant or equipment shall not be erected or installed within the easement area without the prior written approval of the Council.

3. It is preferable that unroofed verandahs and pergolas attached to residences and outbuildings, including detached garages, sheds and carports, be located clear of the easement area. Where this is found not to be practicable, consideration may be given in certain circumstanes to these types of structures encroaching up to but not exceeding 3 metres onto the easement area.

4. It is preferable that swimming pools be constructed clear of the easement area. Where this is found not to be practicable, consideration might be given in certain circumstances to a swimming pool being located up to but not exceeding 4.5 metres, including the coping, onto the easement area, provided that, at this location, the pool is not closer than 30 metres to the nearest transmission line structure.

5. Minor structures such as clothes hoists, non-metallic fences, barbeques and the like may be erected within the easement area, subject to a height limitation of 2.5 metres and the earthing of metallic parts.

6. Excavation work or other alterations to existing ground levels shall not be carried out within the easement area without the prior written approval of the Council. Approval will not normally be granted for such work within 16 metres of any transmission line structure.

7. Access to the transmission line structures shall be available at all times for Council plant and personnel.

8. Obstructions of any type shall not be placed within 15 metres of any part of a transmission line structure.

9. Vehicles, plant or equipment having a height exceeding 4.3. metres when fully extended shall not be brought onto or used within the easement area without the prior approval of the Council.

10. The parking of vehicles other than caravans, trailers and flammable liquid carriers within the easement area shall be limited to types whose height when fully extended does not exceed 4.3 metres. Adequate precautions shall be taken to protect the structures from accidential damage.

11. Garbage, refuse or fallen timber shall not be placed within the easement area.

12. Flammable material or explosives shall not be stored within the easement area.

13. Explosives shall not be used within the easement area without the prior written approval of the Council.

14. Tennis Courts may be located on the easement area subject to the following conditions:

    (a) A continuous and unobstructed access way 4.5 metres wide, traversing the property in the same general direction as the transmission line and in a location approved by the Council shall be retained within the easement area.

    (b) The height of the enclosure shall not exceed 4 metres and, if of metallic construction, that part of the enclosure within the easement area shall be earthed.

    (c) Lighting or electric power supply shall not be located within the easement area without the prior written approval of the Council.

    (d) Any approval given to locate a tennis court on the easement area shall be on the clear understanding that, should the Council find it necessary at some time to alter or reconstruct the transmission line and require the removal of the tennis court, any costs associated with such removal would not be met by the Council.

15. Trees and shrubs may be planted within the easement area provided that they are limited to types that will not grow

to a height exceeding 4 metres and do not interfere with access to any transmission line structure.

It should be noted that the Council requires plans forwarded for approval to be drawn to scale and fully dimensioned, showing property boundaries and other relevant information.

APPENDIX : 5.3 INTERVIEWS WITH LANDS OWNERS EFFECTED BY THE PROPOSED DEVELOPMENT

NAME	PROPERTY	YEAR PURCHASED	FIRST KNOWLEDGE OF EASEMENT	LAND USE UNDER LINE	MAJOR CONCERNS EASEMENT/TRANSMISSION LINE [E] [L]	ALTERNATIVES	SUMMARY
BORG	Por. 259		No Contact				
LEE	Lot 436 D.P. 42566		Easement Acquired				
LEE & MISON	Por. 332	1984	1986	Cleared;idle; plans for development	[E] (1) value (2) divides land (3) security (4) privacy (5) future	(1) property boundary with C.L.	Opposed
BLANCH	Por. 124	F		Natural forest; road	[E] (1) sand drifting (2) services corridor (3) future upgrading and widening (4) value	(1) off property to natural grassed sandhills (C.L.) (2) underground	Strongly opposed
THOMSEN	Lot D.P. 363976	1950		Natural forest; road.	[E] (1) value (2) services corridor (3) disturbance (4) aethetics	(1) into C.L.	Opposed
FOX	Pt. A D.P. 361953	F		Natural forest; road.	[E] (1) sand drifting (2) value (3) future	(1) remain - keep vegetated; no easement (2) underground	Opposed
UPTON	Por. 254		Section of land previously leased from Council, no longer leased.				

NOTE: Surveys completed on the basis of original preferred routes not routes determined by this study.

APPENDIX : 5.3 INTERVIEWS WITH LANDS OWNERS EFFECTED BY THE PROPOSED DEVELOPMENT

NAME	PROPERTY	YEAR PURCHASED	FIRST KNOWLEDGE OF EASEMENT	LAND USE UNDER LINE	MAJOR CONCERNS EASEMENT/TRANSMISSION LINE [E] [L]	ALTERNATIVES	SUMMARY
WALLACE	Lot 31 D.P. 595597	1984		Natural forest; cleared for access.	[E] (1) value (2) future (3) radiation	(1) in C.L. (2) property boundary on road.	Strongly opposed.
STEVENS	Lot 2 D.P. 500146	1983		Commercial market gardens; plans for development.	[E & L] (1) loss of crops (2) value (3) radiation (4) services corridor (5) future	(1) in C.L.	Strongly opposed.
PICKSTONE	Lot 52, D.P. 719899	1986		Natural forest; cleared for access; plans for vegetable garden (subsistence)	[L] (1) radiation (2) disturbances (3) services corridor	(1) in C.L.	Opposed.
HOLLIDAY	Pt. Por. 101 and Pt. 3	F		Natural forest; cleared for access; plans for development.	[E] (1) value (2) aesthetics (3) future	(1) in C.L.	Strongly opposed.
MAYNELL	Lot 168 D.P. 239144	1978	1978	Commercial market gardens; recreation/ living area.	[E & L] (1) radiation (2) loss of crops (3) residential development restrictions (4) future (5) services corridor	(1) in C.L. (2) front property boundary	Opposed.
SMITH	Lot 167 D.P. 239144	1984	1984 - Solicitor said easement of no concern.	Recreation/ living area.	[E & L] (1) radiation (2) residential development restrictions (3) value (4) privacy (5) services corridor	(1) in C.L. (2) front/road boundary (3) further north, away from home.	Opposed.

NOTE: Surveys completed on the basis of original preferred routes not routes determined by this study.

APPENDIX : 5.3 INTERVIEWS WITH LANDS OWNERS EFFECTED BY THE PROPOSED DEVELOPMENT

NAME	PROPERTY	YEAR PURCHASED	FIRST KNOWLEDGE OF EASEMENT	LAND USE UNDER LINE	MAJOR CONCERNS EASEMENT/TRANSMISSION LINE [E] [L]	ALTERNATIVES	SUMMARY
DE LA FONTAINE	Lot 165 & 166 D.P. 239144	1980	Survey June 1986, showed no easement.	Commercial market gardens.	[E & L] (1) loss of crops (2) residential development restrictions (3) privacy (4) future (5) road on easement (6) compensation	(1) in C.L. (2) front/road boundary.	Strongly opposed.
MURDOCH & GRONOLD	Lot 164 D.P. 239144	1985	1985 - Council said easement of no concern because no extension.	Subsistence vegetables.	[E & L] (1) value (2) privacy (3) radiation (4) divides land	(1) in C.L.	Opposed.
KAFER	Lot 32 & 33 D.P. 630231	1960	1985 - application for stall, but easement not on deeds.	Commericial market gardens	[E] (1) loss of crops (2) value (3) future (4) services corridor	(1) in C.L. (2) front/road boundary.	Strongly opposed.
SYDNEY BRICK COMPANY P/L	Lot 1 D.P. 174963		No contact				
CERTINA INVESTMENTS PTY. LTD.	Por. 195		No contact				
WILLIAMS	Por. 197	1981	Easement acquired.	Natural forest	[L] (1) increase in voltage (2) childrens safety (3) value	(1) out of property. Opposed.	

NOTE: Surveys completed on the basis of original preferred routes not routes determined by this study.

APPENDIX : 5.3 INTERVIEWS WITH LANDS OWNERS EFFECTED BY THE PROPOSED DEVELOPMENT

NAME	PROPERTY	YEAR PURCHASED	FIRST KNOWLEDGE OF EASEMENT	LAND USE UNDER LINE	MAJOR CONCERNS EASEMENT/TRANSMISSION LINE [E] [L]	ALTERNATIVES	SUMMARY
McCAW	Lot 633 D.P. 622379	1983	No evidence of easement in 1983.	Natural forest.	[E] (1) value (2) divides land (3) future	(1) in C.L. in swale between dune systems	
THOMAS	Lot 632 D.P. 609506	1980	1986	cleared; intended for cattle grazing	[E & L] (1) value (2) security (3) fire risk (4) legal obligations (5) privacy (6) future	(1) in C.L. in first swale between dune systems. (2) in C.L. in second swale between dune systems.	Strongly opposed.
CASHELL PTY. LTD.	Lot 963 D.P. 533440	1977	1986	natural forest; road	[E] (1) value (2) divides property (3) future	(1) in C.L.	Opposed.
RUSSELL	Lot 41 D.P. 247593	1976	1982/84 surveys for routes.	Winter feed for cattle; irrigation	[E] (1) value (2) future (3) services corridor	(1) in C.L.	Opposed.
WISELY & REID	Lot 42 D.P. 247593	1974	Easement acquired	recreation/ living area	[L] (1) radiation (2) future	(1) in C.L. between dune systems.	Opposed.
OUTTRIM	Lot 43 D.P. 247593	1985	1985 - told acquisition in approx. 5-6 years, not positive	potential site for home; best high land	[E & L] (1) value (2) radiation (3) aesthetics	(1) in C.L. in swale between systems. (2) southern boundary	Strongly opposed.
McKENZIE	Lot 2 D.P. 710028	1978	1985 - acquired easement on condition no 132kV line on property	ploughed for gardens of vegetables and cattle feed	[L] (1) value (2) future	(1) in C.L. in swale between dune systems.	Strongly opposed.
SAMSON	Pt. Por. 149	1964		commercial cattle grazing	[E] (1) value (2) future (3) aesthetics (4) security (5) services corridor	(1) in C.L. in swale between dune systems.	

NOTE: Surveys completed on the basis of original preferred routes not routes determined by this study.

APPENDIX : 5.3 INTERVIEWS WITH LANDS OWNERS EFFECTED BY THE PROPOSED DEVELOPMENT

NAME	PROPERTY	YEAR PURCHASED	FIRST KNOWLEDGE OF EASEMENT	LAND USE UNDER LINE	MAJOR CONCERNS EASEMENT/TRANSMISSION LINE [E] [L]	ALTERNATIVES	SUMMARY
COX	Pt. Por. 149	F	1984	commercial cattle grazing; swampy	[E & L] (1) value (2) increased voltage close proximity to home (3) aesthetics (4) services corridor (5) present instability of line in marsh	(1) in C.L. - swale between dune systems	Strongly opposed.
MORTIMER	Por. 136 D.P. 501012	1982	no indication in 1982	commercial cattle grazing	[E & L] (1) value (2) present instability of (3) increased voltage, increased danger (4) services corridor (5) future (6) security	(1) in own land in sandhills - between dunes. (2) in C.L.	Opposed.
PADMOS & CHESWORTH	Pt. Por. 57, 69 & 70 Lot 1 D.P. 308610	F	1984	commercial market gardens and cattle grazing; windmill and trough.	[E] (1) value (2) services corridor	(1) in C.L. - flat country between dunes (2) southern boundary	Opposed.
MOXEY	Pt. Por. 73, Por. 122 D.P. 916061 Por. 58 Lot 2 D.P. 308610						
TOWERS	Por. 13, 75, 76 & 101 Vol. 11339	F	September 1986	Approximately along residential road; commercial cattle grazing sand mining	[E] (1) value (2) close proximity of pole to home (3) future	(1) along property boundaries. (2) move pole near house (3) along creek and then along Larvis Lane.	Opposed.

LEGEND : F = property has been in family for years
E = easement
L = transmission line
C.L. = crown land

NOTE: Surveys completed on the basis of original preferred routes not routes determined by this study.

APPENDIX 6.1

SURVEY FOR ABORIGINAL ARCHAEOLOGICAL SITES ALONG THE ROUTE OF A PROPOSED 132kV TRANSMISSION LINE ALONG NEWCASTLE BIGHT, N.S.W.

DENIS BYRNE
CONSULTANT ARCHAEOLOGIST

February, 1987

DENIS BYRNE
MA MAACAI
CONSULTANT
ARCHAEOLOGIST
91 GLEBE POINT ROAD
GLEBE SYDNEY NSW 2037
TEL. (02) 660 8038

SURVEY FOR ABORIGINAL ARCHAEOLOGICAL SITES ALONG THE ROUTE OF A PROPOSED 132kv TRANSMISSION LINE AT NEWCASTLE BIGHT, NSW

A

Report to

FORESITE LANDSCAPE ARCHITECTS AND PLANNERS

By

DENIS BYRNE

Feb 1987

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PROPOSED DEVELOPMENT

Shortland County Council propose to construct a 132kv electricity transmission line a major section of which traverses the sand dunes of Newcastle Bight between Williamtown and Anna Bay. The archaeological survey of the proposed route for this section was carried out to a brief from Foresite Landscape Architects and Planners who are preparing an Environmental Impact Statement in relation to the project.

The proposed route is illustrated in Figure 2. The proposed line will be carried by single concrete poles with standoff insulators. The poles are to be spaced at 300 metre intervals within an easement 30 metres wide.

The principal archaeological relevance of the proposed project is the amount of ground disturbance likely to be involved along the route. This will be confined mainly to the holes dug for the concrete poles. It is anticipated that clearance of the easement will involve only selective felling of the larger existing trees. It is planned to retain the present ground cover of bracken and small shrubs. Clearing would not involve the use of bulldozers. Finally, it is not intended to construct a vehicle access track along the easement.

In addition to the survey of the above route an inspection was made, at the request of Foresite Planners, of a small area of the Tilligerry Creek foreshore at Lemon Tree Passage (see Figure 3) where it is intended to locate a concrete pole carrying a transmission line which crosses Tilligerry Creek, via Stuarts Island, at this point.

ENVIRONMENTAL BACKGROUND

Newcastle Bight is a three kilometre long embayment, weakly indented and fully exposed to a high energy marine environment. The prograded bay barrier stretches from the Hunter estuary to Port Stephens. It features a transgressive sheet of Holocene sands grading landwards into back barrier sands or muds (Figure 1).

The back barrier is Pleistocene in age, dating from the last interglacial or earlier. The accretion of the foredune sands is thought to have occurred between 6,000 - 3,000 years BP (Chapman et al. 1982: 93).

The back barrier, including numerous swamps, remains mostly uncleared. The zone of mud deposits is cleared pasture country adjoining the landward extension of the transgressive Holocene sands. These support a sclerophyll forest vegetation for about two kilometres towards the sea at which point the vegetated dunes meet the encroaching free sand in mobile dunes.

The route of the proposed transmission line is within the vegetated landward zone of the Holocene sands. At the western end the route is, in places, only a couple of hundred metres from the pasture land. Towards the east end it is situated about midway between the pasture land and the mobile dunes.

The proposed route is mostly immediately landward of a high dune formation running parallel to the coast. The top of this dune stands at about 30 metres ASL. Landward of the high dune is a more or less clearly defined swale separating the high dune from a zone of lower dunes to the north-west. The proposed route is located within this swale.

Sand mining for heavy minerals has occurred along sections of the Holocene dunes. Unfortunately, the records of the Department of Mineral Resources for sand mining on this part of the coast are inaccessible. For the most part it is unlikely that the proposed route has suffered any disturbance in the past apart from the occasional vehicle tracks which meader through the dunes and, in places, follow the line of the swale.

ARCHAEOLOGICAL BACKGROUND

The Newcastle Bight area has attracted considerable archaeological interest in the past few decades though the site recording efforts have been piecemeal and the results sketchy.

The National Parks & Wildlife Service's Site Register includes a number of sites on the sand barrier. These are reviewed from west to east. Starling (1974) recorded a long exposure of pipi midden to the foredune west of Freshwater Lagoons and another to the east. These are sites **38-4-54** and **38-4-62** (NPWS Site Register) respectively. They are up to two kilometres seaward of the western end of the proposed transmission line route. Also in the Freshwater Lagoon area, Sullivan (1980) investigated stratified midden exposures (sites **38-4-57** and **38-4-56**) adjacent to the lagoons themselves. These consisted mostly of pipi shells and included flaked-stone artefacts to a density of 15:1m^2. A preliminary report on site **38-4-57** was also filed by Dyall (1980) who noted the presence of 414 unretouched flakes, 12 cores, and 45 retouched items in an area of 75m^2. This site is c.300 metres seaward of the western end of the proposed route.

Dyall (ibid.) also reports a site at Williamtown (**38-4-53**), disturbed in the course of runway construction for the RAAF base, which consisted of a thin scatter of artefacts and shell (mostly estuarine).

To the east Dyall (NPWS Site Record) recorded a number of middens (collectively **38-4-63**) in the foredune area near Boyce's Track. These were pipi middens with a low density of flaked-stone artefacts. The sites are approximately one kilometre seaward of the proposed transmission line route. A further midden (contents unspecified) was recorded by a NPWS Ranger in a deflation area behind the foredune in the Boyce's Track area. Again, this site (**38-4-66**) is about one kilometre seaward of the proposed route.

Several sites are on record in the Morna Point area at the eastern end of the Bight (e.g., **38-5-37**, **38-5-35**, **38-5-16**). Dyall excavated the Birubi midden (**38-5-16**) and has filed a detailed report on the fauna (beach, estuarine, and rock platform shellfish along with a large number of fish species) and artefacts (including bone points and fish hooks). A basal date of 1240±80 years BP was obtained (Dyall 1979).

With the exception of **38-4-63** all the above sites were recorded piecemeal rather than by systematic survey. The **38-4-63** middens were recorded during a survey on foot carried out by Dyall in 1975 between Boyces Track and Birubi Point (information from **38-4-63** site file). Coverage seems to have been confined to the foredune.

Systematic surveys have been carried out in the general area

of Newcastle Bight. These are the investigation by Brayshaw (1982) of the Williamtown RAAF base extensions, Brayshaw's (1981) survey of the aluminium smelter site at Hexham, and Cubis's (1981) survey of a housing sub-division at Lemon Tree Passage. Neither of Brayshaw's surveys produced any sites. Cubis recorded an estuarine midden (**38-5-74**) in the course of his Lemon Tree Passage survey.

ARCHAEOLOGICAL POTENTIAL

The pattern of archaeological remains reviewed above fits neatly within the pattern of site occurrence known for the New South Wales north coast. The main features of this pattern are thin stratifications of pipi midden in foredunes, pipi midden/open sites landward of foredunes, small to substantial midden deposits adjacent to rock platforms, and substantial midden deposits at the intersection of open coast and estuarine environments (see, for instance Sullivan [1982] and Byrne [1986]).

Clearly only a fraction of existing sites have yet been recorded in the Newcastle Bight area. The specific archaeological site potential of the present survey area would seem to be restricted to pipi middens and open sites (stone artefact scatters). It will be noted that to date all middens on the Holocene sands have been recorded seaward of the survey area. Most obviously this would seem to reflect proximity of the beach with its shellfish and fish resources. The possibility of such sites as far inland as the survey area, however, can by no means be ruled out. One would note the non-marine food

resources available in the survey area (e.g., small mammals, Macrozamia nuts, bracken fern rhyzome). Overall, though, the potential density of sites here is probably less than in the area to seaward.

ARCHAEOLOGICAL SURVEY

The proposed route of the transmission line was inspected on foot at a number of points between Lavis Lane in the west and Anna Bay in the east. For the most part these points were chosen because of access considerations.

Fieldnotes on 12 of the tracts inspected are contained in Appendix 1.

It is estimated that approximately 40% of the c.20 kilometre route was covered on foot by the survey. Vegetation along most of the route consisted of a tree cover of Eucalypts, Melaleuca, Casuarina, and Banksia. Groundcover vegetation was dominated by bracken. Ground visibility ranged from zero to about 60%. The main variable was whether or not a particular area had been recently burnt. In recently burnt areas the bracken and leaf litter cover was markedly reduced and ground visibility enhanced.

At many points along the route four-wheel drive vehicle tracks were present. These may have caused superficial ground disturbance but were a positive assistance in enhancing ground visibility.

SURVEY RESULTS

The survey resulted in the recording of one archaeological site. This consisted of a small exposure of pipi midden located adjacent to Boyces Track within the easement of the proposed line. The site has been designated **Boyces Track #1**.

Boyces Track #1: 0087:7070 (Williamtown 1:25,000)

The site is located 300 metres from the Nelson Bay Road end of the track. It is situated on a deviation track running west off Boyces Track.

A 5cm thick layer of pipi shell is visible in the shallow section on the south side of the deviation track. The layer is 5cm below the ground surface and is visible for a length of 70cm. It is likely that the layer extends for some distance surrounding the point of exposure.

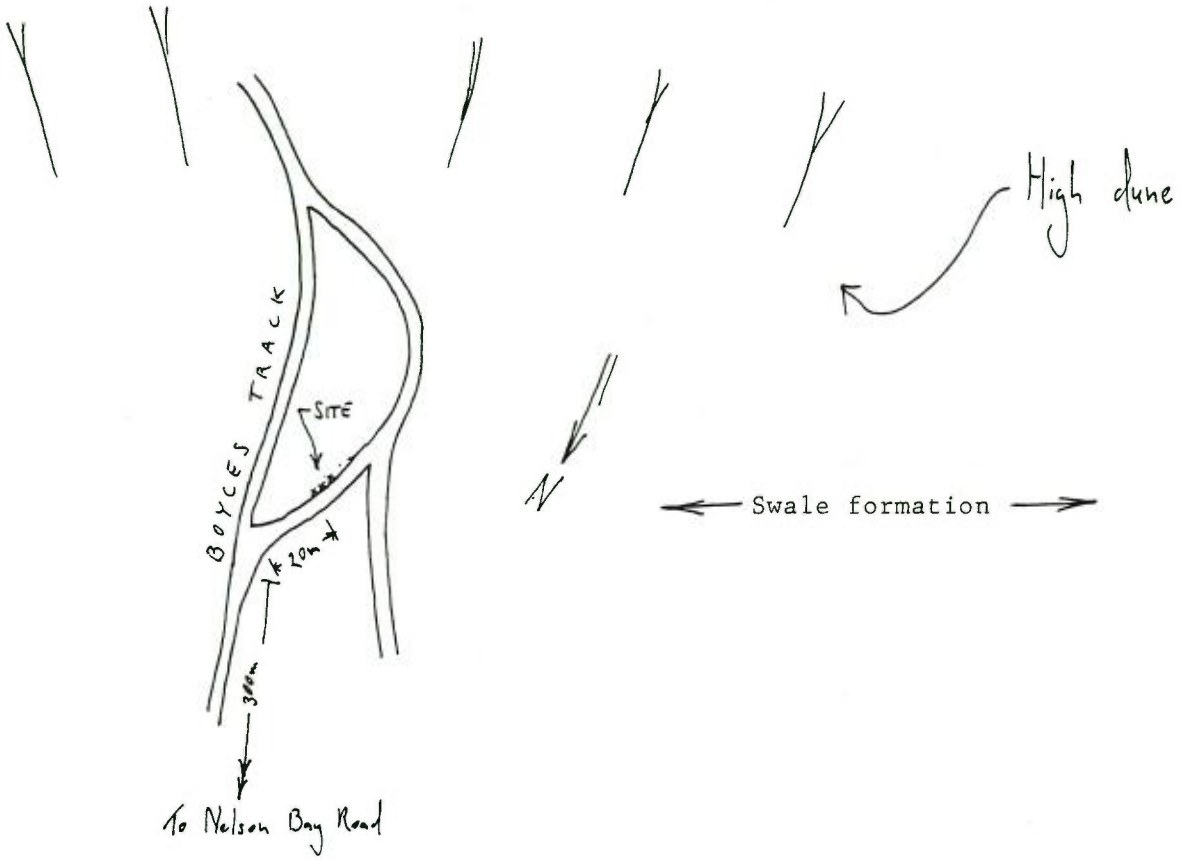
No stone artefacts, bone, or other archaeological material were noted.

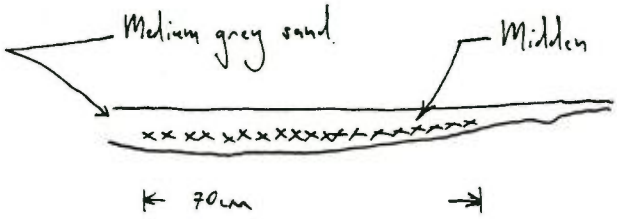
A low-density scatter of pipi shell is present on the surface of the deviation track between the midden exposure and Boyces Track.

All the shell, much of it fragmented, was in an eroded condition.

See Appendix 3 for photographs of site.

No midden material was detected elsewhere in the general vicinity of **Boyces Track #1**.





South section of track

BOYCES TRACK #1

LEMON TREE PASSAGE INSPECTION

An inspection was made of a small area of the foreshore of Tilligerry Creek west of Gibber Point at Lemon Tree Passage (see Figure 3). It is proposed to locate a concrete pole to carry a transmission line crossing Tilligerry Creek via Stuarts Island at this point.

In 1981 Cubis carried out a survey of a proposed residential sub-division east of Gibber Point. He located a shell midden consisting of estuarine species here (**38-5-74**). Cubis (ibid.) also surveyed the site of a proposed oyster farm depot which is immediately east of the proposed transmission line route. He located no sites in this second area.

My inspection revealed no midden deposits or other archaeological material. The land surface abutting the creek at this point is only a few centimetres above water level. Vegetation consists of sedges, grasses, and shrubs. Ground visibility was restricted to about 5% in addition to the exposed creek bank zone.

ABORIGINAL CONSULTATION

The survey area is within the boundaries of the Worimi Local Aboriginal Land Council. It was not possible to contact the Land Council during fieldwork for this Report. However, Jeff Bradford, representing the LALC, was contacted following the survey and informed of the terms of the proposed development and the results of the archaeological survey.

Directions as to the location of the site **Boyces Track #1** were given to Jeff Bradford and he expressed an interest in visiting the site. He was informed that it was anticipated that the site would be retained undisturbed within the easement of the proposed line.

It was agreed to supply the Worimi LALC with a copy of the present Report.

MANAGEMENT RECOMMENDATIONS

It is recommended that the midden site **Boyces Track #1** be retained undisturbed within the terms of the proposed development. This should not be problematic given the flexibility in choosing locations for the concrete poles. It is recommended that the site should be clearly marked during instalment of the line and that the site and its immediate vicinity (radius 10 metres) be avoided by machinery likely to cause ground disturbance. It should be noted that the site is protected under the terms of the National Parks and Wildlife Act 1974.

It is conceded that the instalation of the proposed line is likely to cause only minimal ground disturbance along its route. There is, however, a possibility that archaeological sites (e.g., midden deposits, Aboriginal burials) may be encountered during excavation of holes for the concrete poles. The developer should be aware of the need to report any such discovery immediately to the National Parks and Wildlife Service's Regional Archaeologist.

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Brayshaw, H. 1981 Archaeological Survey of Proposed Site of Tomago Aluminium Smelter near Hexham. Unpublished Report to Tomago Aluminium Co Pty Ltd.

Brayshaw, H. 1982 Archaeological Survey of Proposed Facility Extensions at Williamtown RAAF Base North of Newcastle. Unpublished Report to Gutteridge Haskins & Davey Pty Ltd.

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Dyall, L. 1979 Preliminary Report on Excavation at Birubi. Unpublished Report to the National Parks & Wildlife Service (NSW).

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Starling, J. 1974 A Survey of the Aboriginal Sites on the North Coast of New South Wales, 1970-1971. Unpublished Report to the National Parks & Wildlife Service (NSW).

Sullivan, M. 1980 An Investigation of an Aboriginal Site At Stockton Bight, NSW. An unpublished Report to Mineral Deposits Ltd.

Sullivan, M. 1982 Aboriginal Shell Middens in the Coastal Landscape of New South Wales. PhD Thesis, Department of Prehistory, RSPacS, Australian National University.

APPENDIX 1: FIELDNOTES

FIELDNOTES:

(See Figure 2 for numbered locations)

1) Easement close to cleared pasture. Medium bracken cover and leaf litter. Ground visibility 10-30%.

2) Vegetation as for 1). Some disturbance by fences and tracks.

3) Swale ill-defined and undulating. Vehicle track follows swale. Vegetation partly cleared. Ground visibility 20-40%.

4) Thick bracken. Vehicle track follows swale. Visibility off track 0-5%.

5) Very thick ground cover. No tracks. Bracken, shrubs, heavy leaf litter. Ground visibility 0-5%.

6) As for 5) but recently burnt. Ground visibility 50%. No track.

7) Recently burnt area. Ground visibility 40%. Track across dunes but not following swale.

8) Swale ill-defined. Recently burnt - young bracken and some leaf litter. Ground visibility 40%.

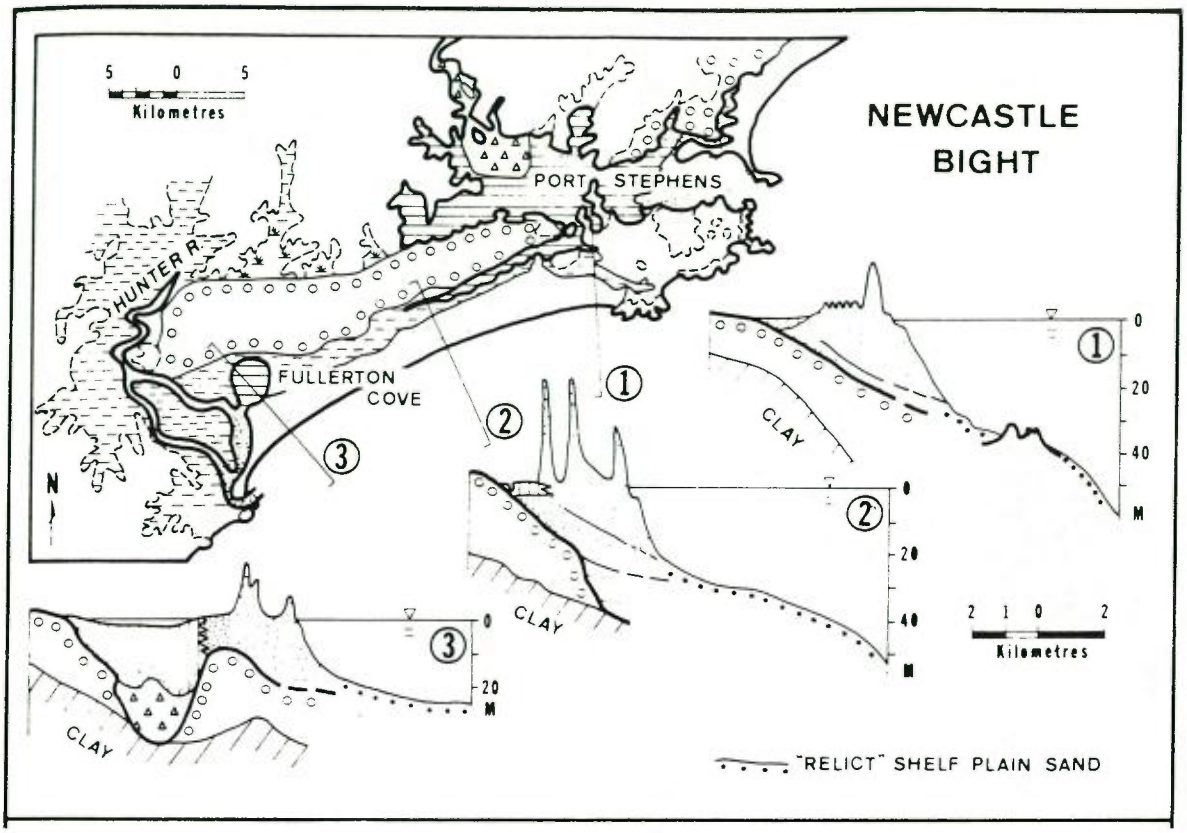
9) Thick bracken and heavy leaf litter. Low undulating dunes. Ground visibility 10%.

10) Low undulating dunes. Recently burnt. Some leaf litter. Ground visibility 20%.

11) Proposed line follows easement of existing line. Thin cover of small bracken and grass off track. Ground visibility 40%.

12) As for 11). Easement crosses high north-south dune. Ground visibility 40%.

APPENDIX 2: FIGURES





DELTAIC FLOOD PLAIN INFILLED MUD BASIN
RIVER DELTA AND CHANNEL SAND, MUDDY SAND
MUD BASIN (PRODELTA) MUD, SANDY MUD
TIDAL DELTA BACKBARRIER SAND, MUDDY SAND
BARRIER SAND (NEARSHORE, BEACH, DUNE)
PLEISTOCENE BARRIER SAND

FIGURE 1: Lithofacies distribution and stratigraphy of Newcastle Bight (from Chapman et al. [1982: 87]).

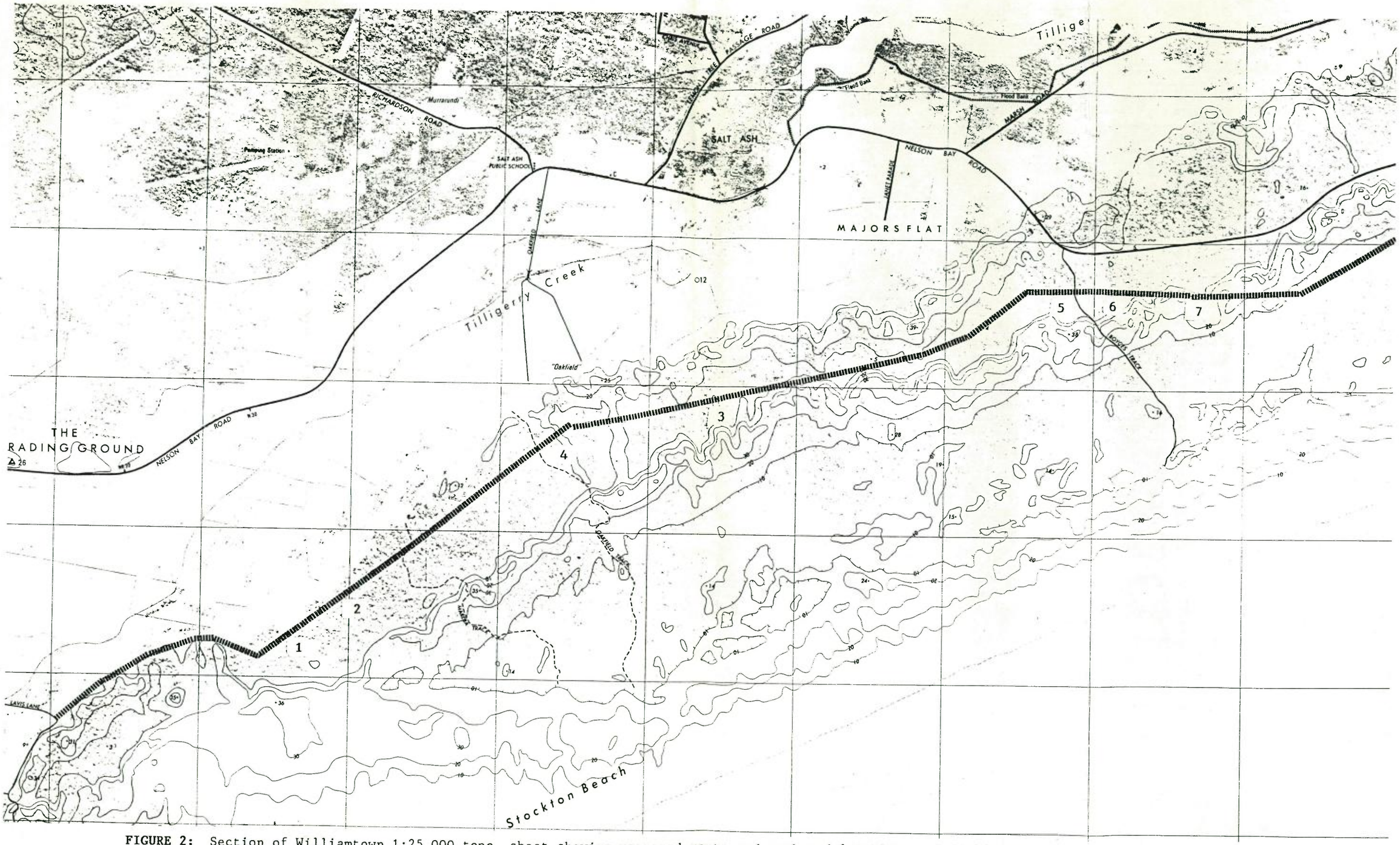


FIGURE 2: Section of Williamtown 1:25,000 topo. sheet showing proposed route and numbered locations of fieldnotes.

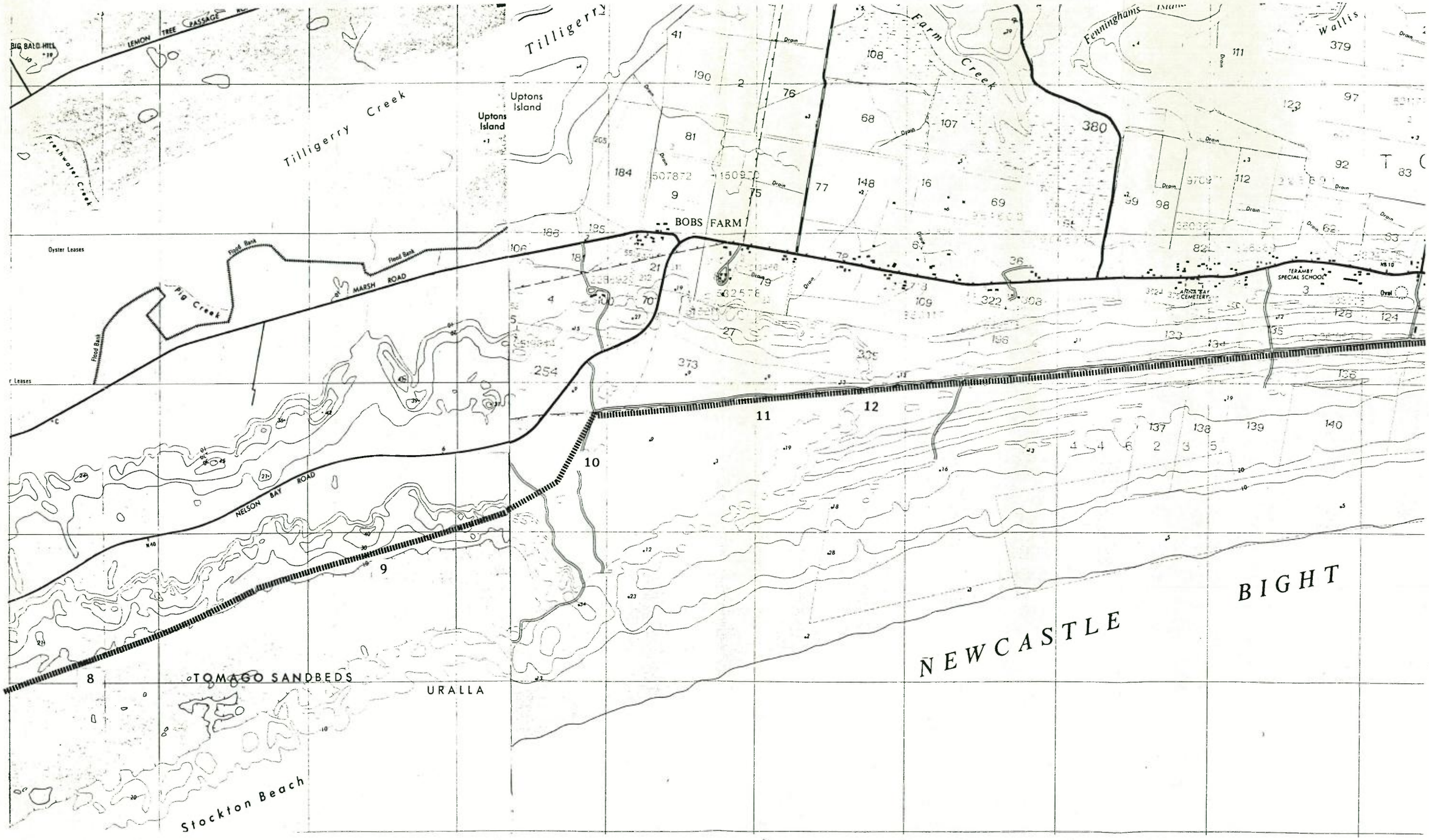
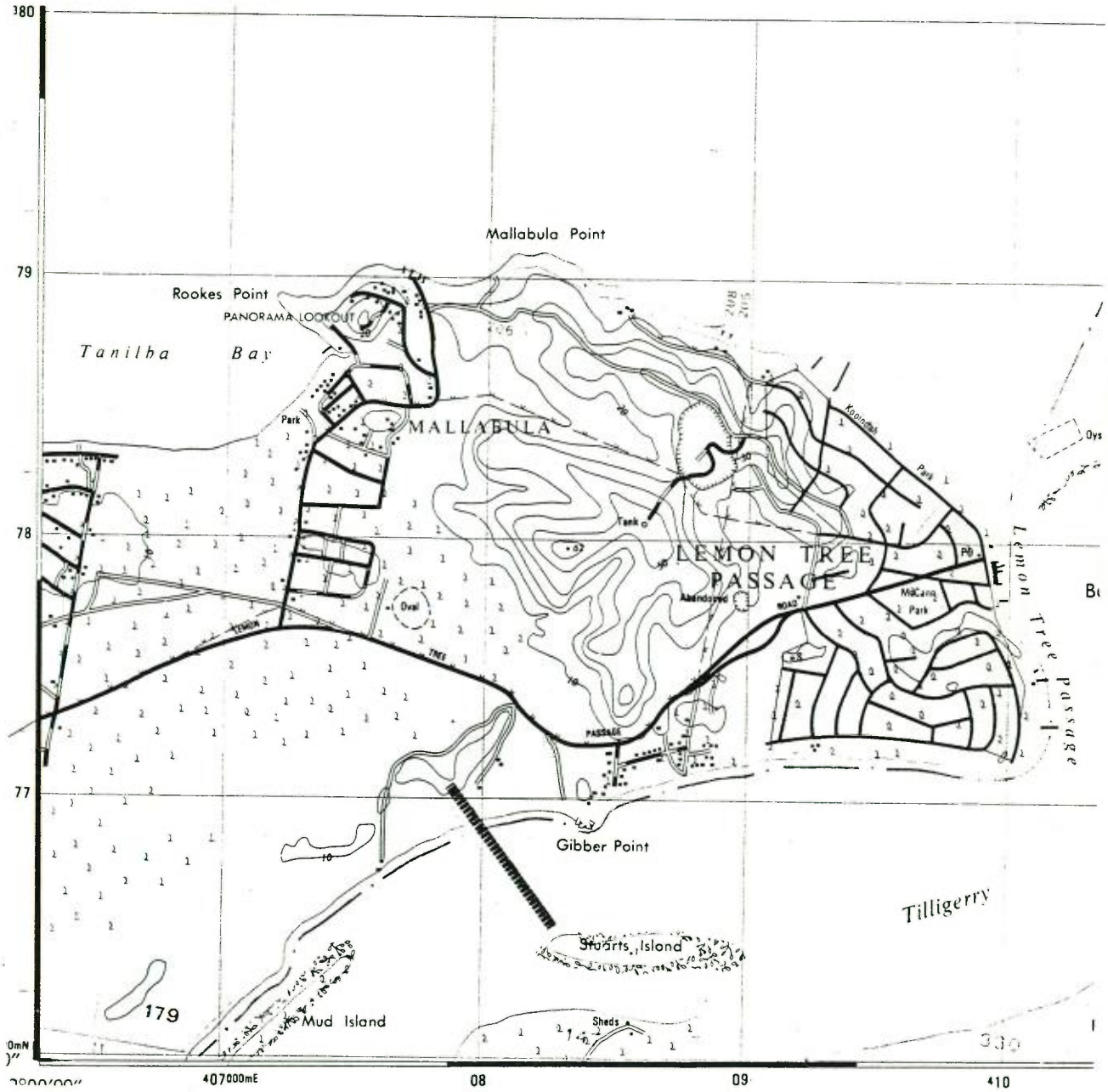


FIGURE 2: Continued (Compilation of Williamtown and Morna Point 1:25,000 topo. sheets)



FUGURE 3: Inspection area at Lemon Tree Passage (section of Port Stephens 1:25,000 topo. sheet)

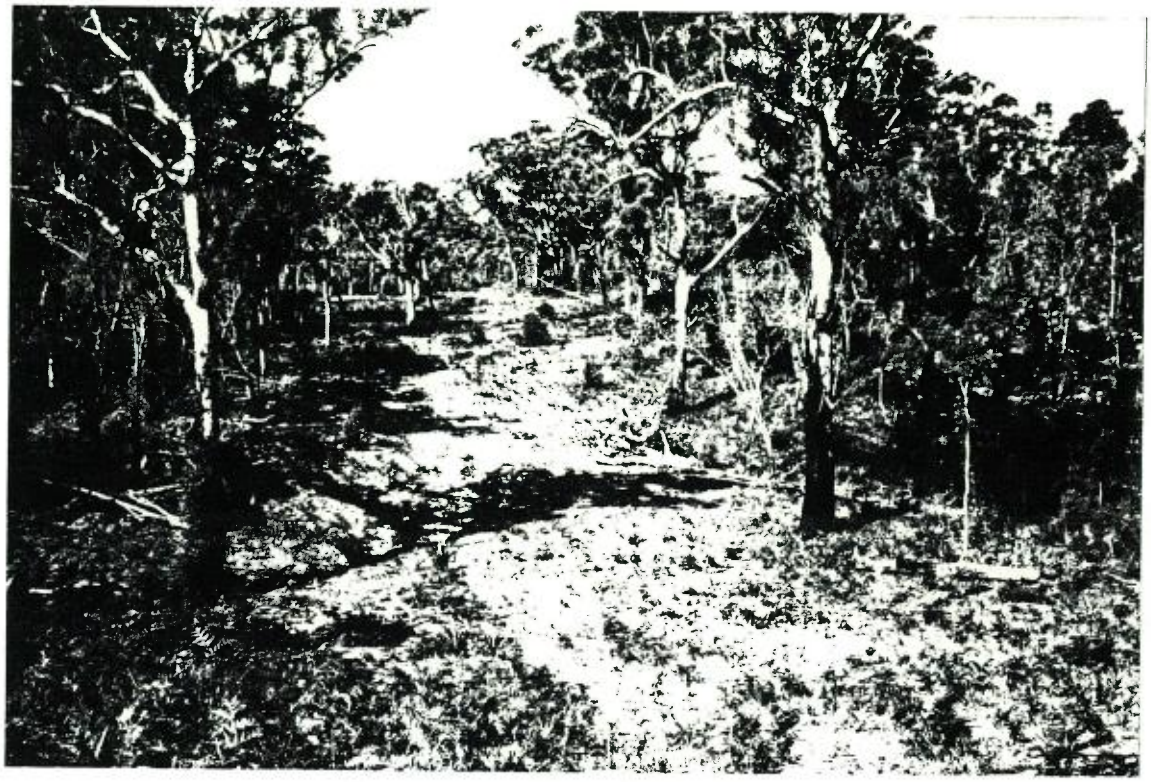
APPENDIX 2: PHOTOGRAPHS



Proposed route east of Boyces Track.



Proposed route follows existing easement east of Bobs Farm



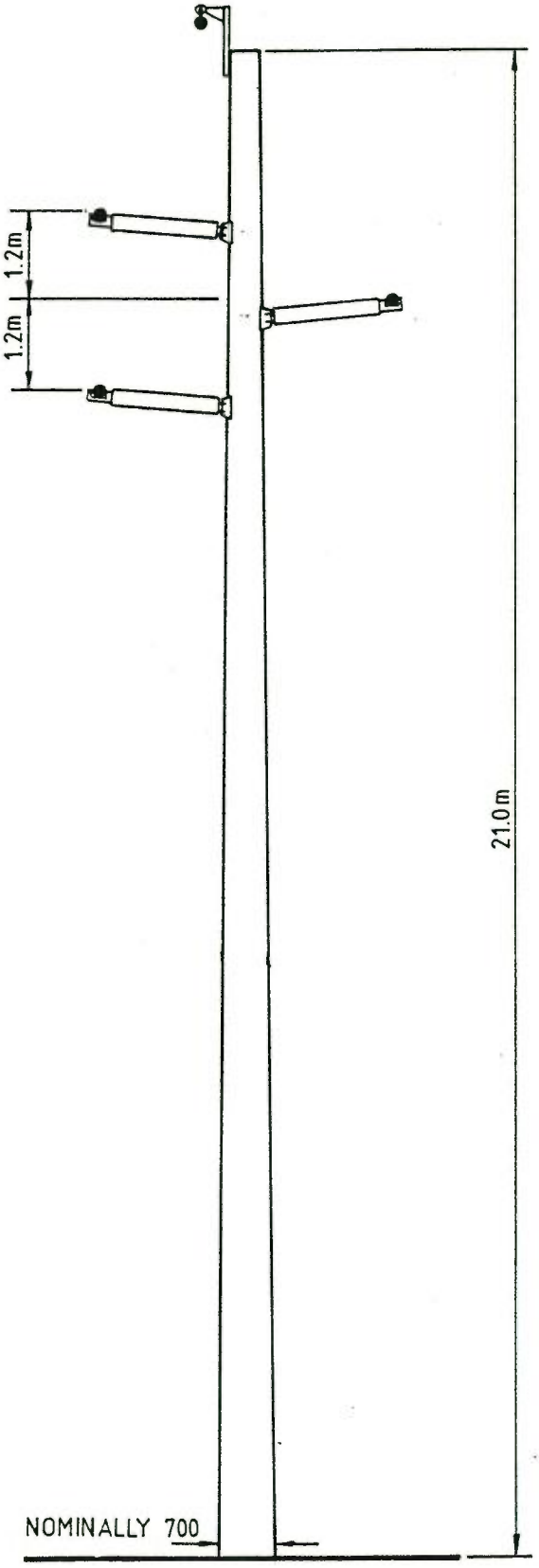
Proposed route in the vicinity of Oakfield Track

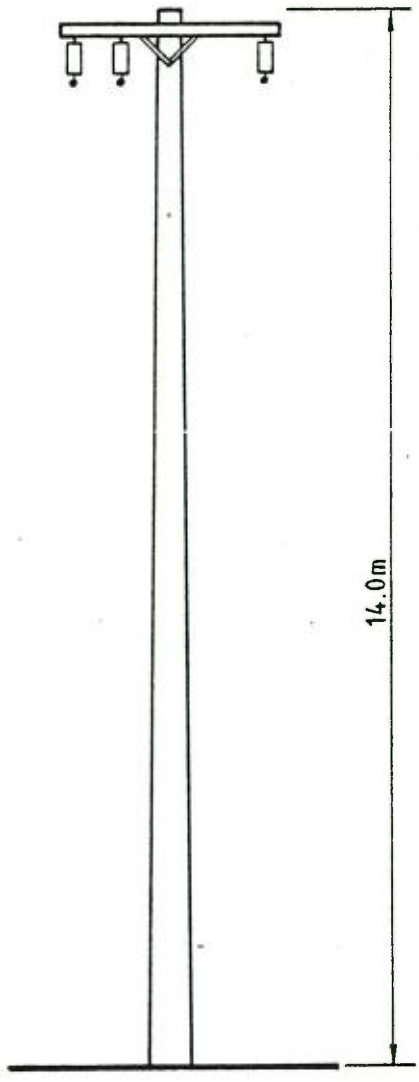


Midden exposed on track at **Boyces Track #1.** Exposure above compass in centre frame

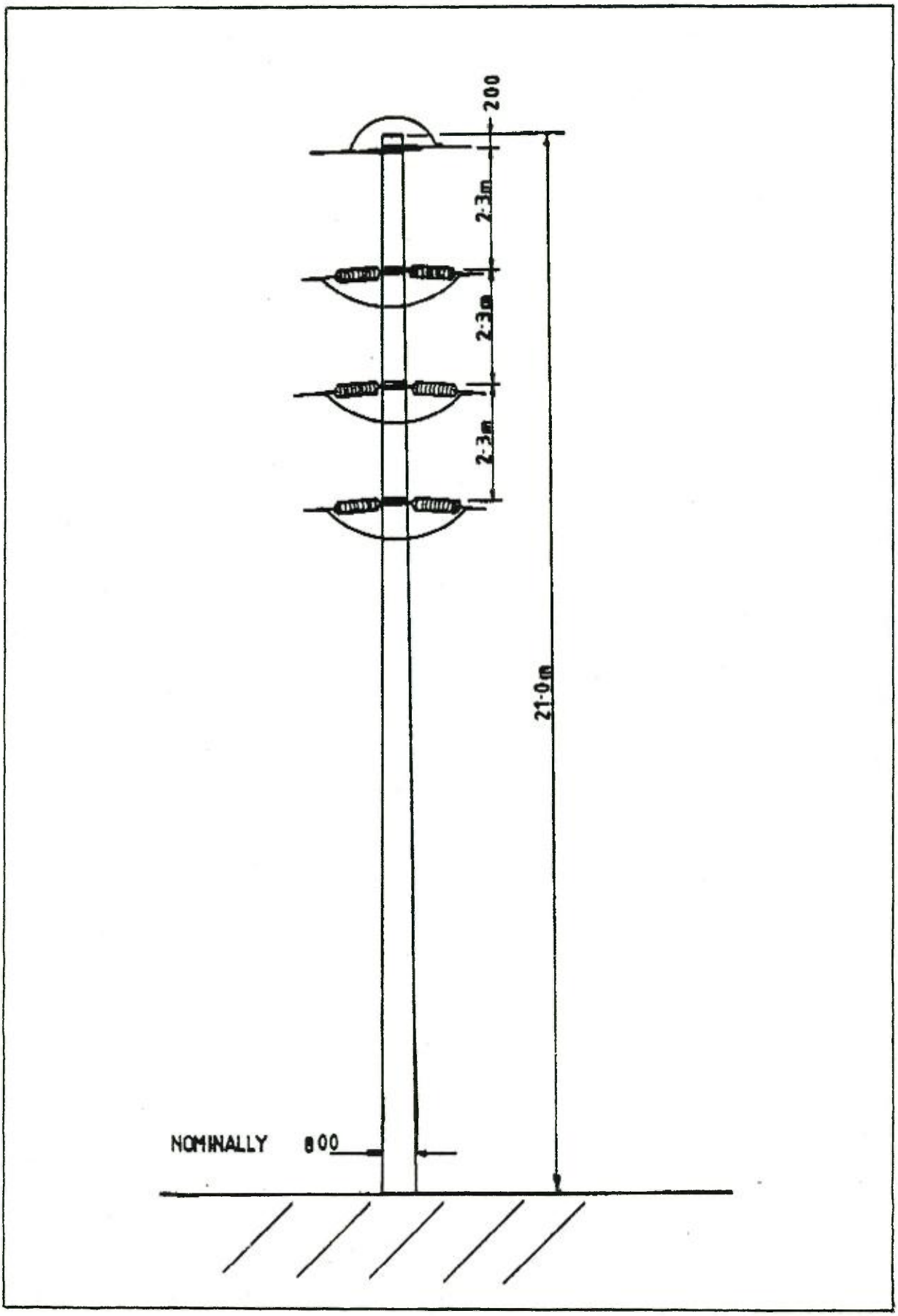
APPENDIX 7.1 TYPICAL TRANSMISSION LINE STRUCTURES

APPENDIX 7IA TYPICAL 132KV INTERMEDIATE STRUCTURE. (33KV STRUCTURE SHOWN FOR COMPARISON).

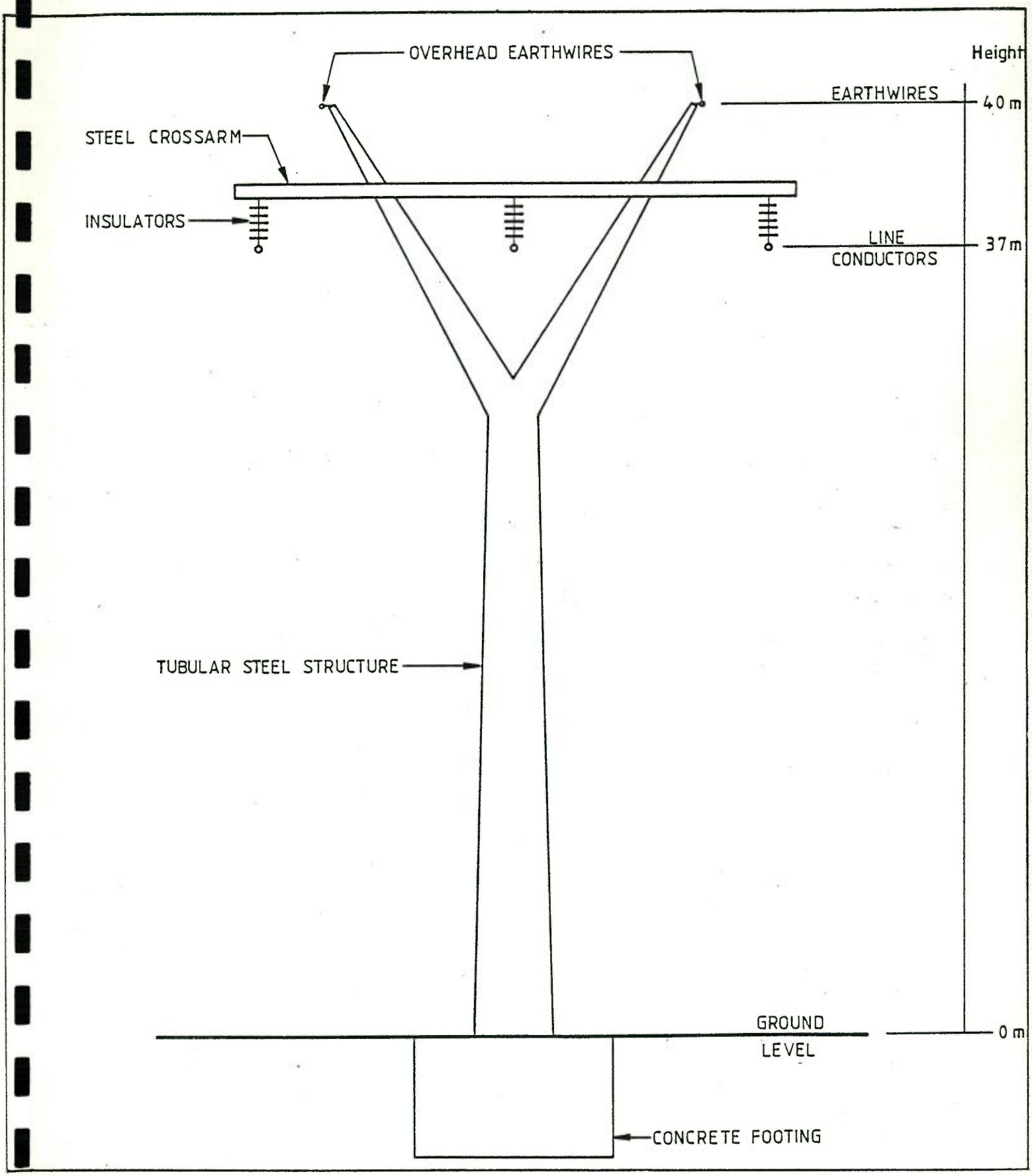




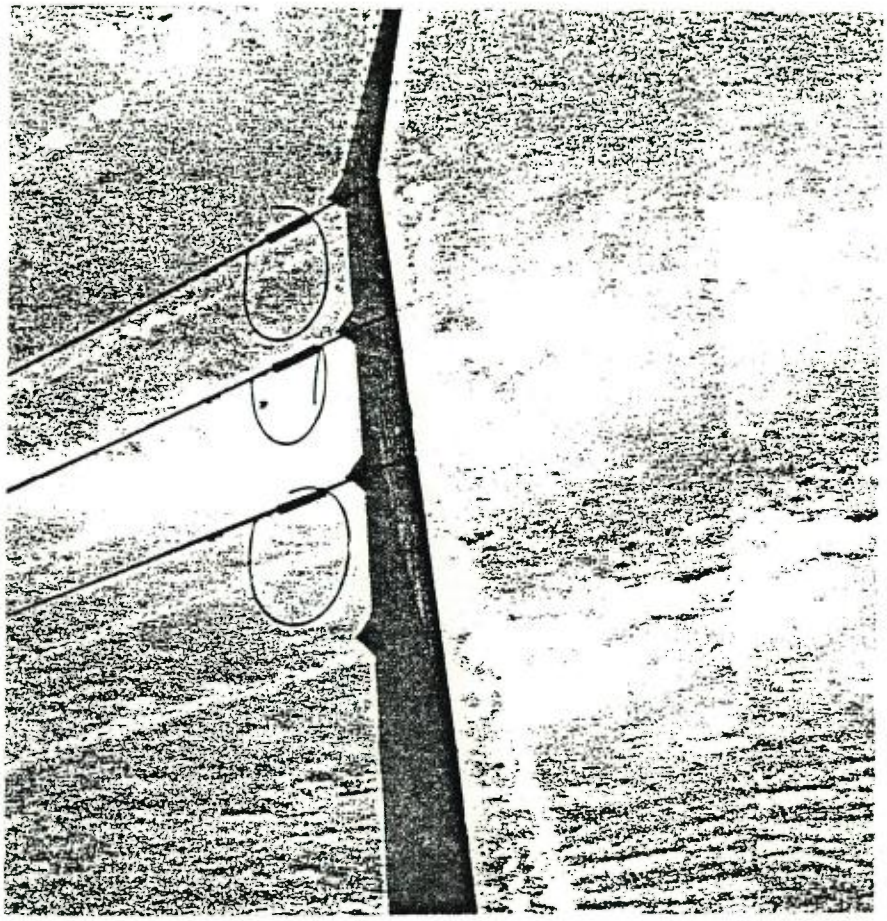
APPENDIX 7.1B TYPICAL 132KV TERMINATION STRUCTURE.



APPENDIX 7.1C POSSIBLE TRANSMISSION STRUCTURE FOR TILLIGERRY CREEK CROSSING



APPENDIX 7.1D POSSIBLE TRANSITION STRUCTURE FOR TILLIGERRY CREEK CROSSING. (ONLY IN CONJUNCTION WITH SUBMARINE CABLES).



SHORTLAND COUNTY COUNCIL

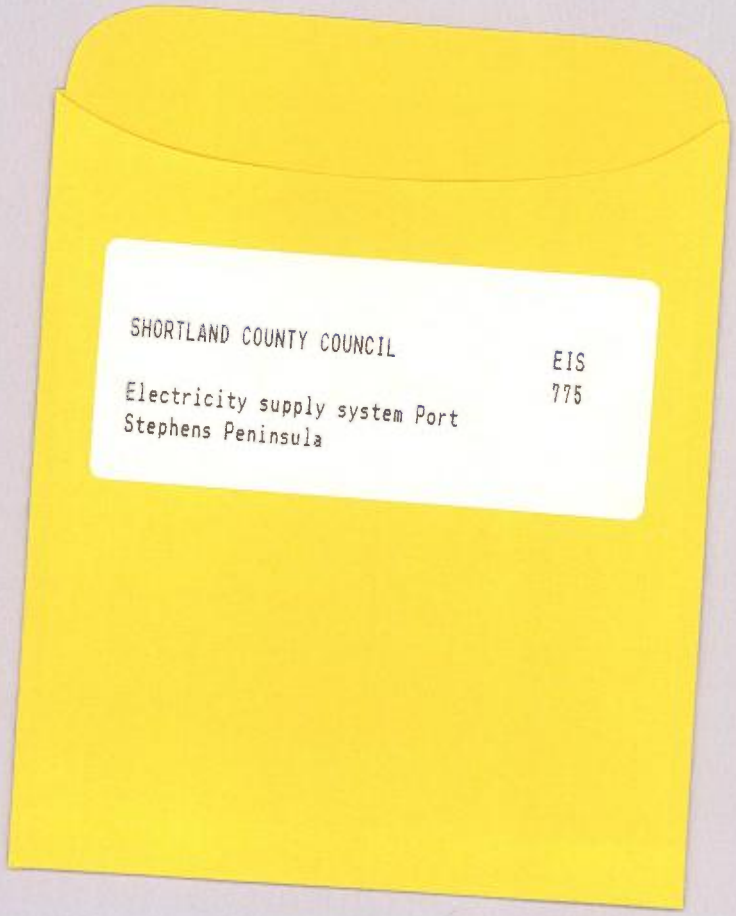
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Stephens Peninsula

Borrower's name	Date	Ex

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