MAIN ROADS WESTERN AUSTRALIA

MOUNT BARKER DEVIATION - STAGE 2

Southern Brown Bandicoot
Isoodon obesulus

SOUTHERN BROWN BANDICOOT MANAGEMENT PLAN

APRIL 1994

ecologia
ENVIRONMENTAL CONSULTANTS

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Prepared by

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1.0 PROJECT DESCRIPTION

1.1 Background

The Albany Highway Deviation Stage 2 proposed by Main Roads Western Australia at Mount Barker in the Shire of Plantagenet occurs between SLK 357.7 and 361.3. The proposal consists of the construction of a new alignment of the Albany Highway to 3.60 km south of Mount Barker (Figure 1). The realignment extends from the Mount Barker townsite adjacent to Oatlands Road south to the Golf Course Road following closely the well defined drainage line east of the existing Albany Highway and railway line easement. The goal of the project is to provide a safer route for traffic by eliminating rail crossings for through traffic, and by improving rail crossing geometry for those entering the town. The project is perceived to provide benefits in terms of;

- A safer route for local and through traffic
- Improved townscape design
- Revegetation of existing disturbed areas
- Improved visual quality to new works
- Community involvement

However, during the project feasibility assessment phase members of the public expressed concern for the welfare of the Southern Brown Bandicoot *Isoodon obesulus fusciventer* population which was thought to occur in the project area. In addition, the conservation status of the Southern Brown Bandicoot was revised subsequent to the fauna survey undertaken in 1989[1] for the environmental assessment of the proposal. The species was listed in Schedule 1 of the Wildlife Conservation Act 1950 by the Minister for Conservation and Land Management[2] as "fauna that is likely to become extinct, or is rare".

Project approval assessment required the documentation of the Southern Brown Bandicoot population existing in the project area, an evaluation of conservation values and the impact of the proposed road development. To fulfil these objectives *ecologia* Environmental Consultants conducted a survey of the Bandicoot population in the project area during September 1991. The survey provided baseline information on the Bandicoot population and habitats of the project area[3].

The resulting report of the survey outlined a series of recommendations for environmental management of the population. The foremost recommendation required the development and implementation of a Management Plan which contained appropriate management strategies. The management guidelines detailed in this management plan are designed to achieve those aims.

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[1] Hart Simpsons & Associates 1989 Mt Barker Deviation: Stage 2 Albany Highway. Fauna.

[2] Government Gazette WA, 1990.

[3] *ecologia* Environmental Comsultants 1992 Mt Barker Albany Hwy Deviation Stage 2: Southern Brown Bandicoot *Isoodon obesulus* Population Survey.

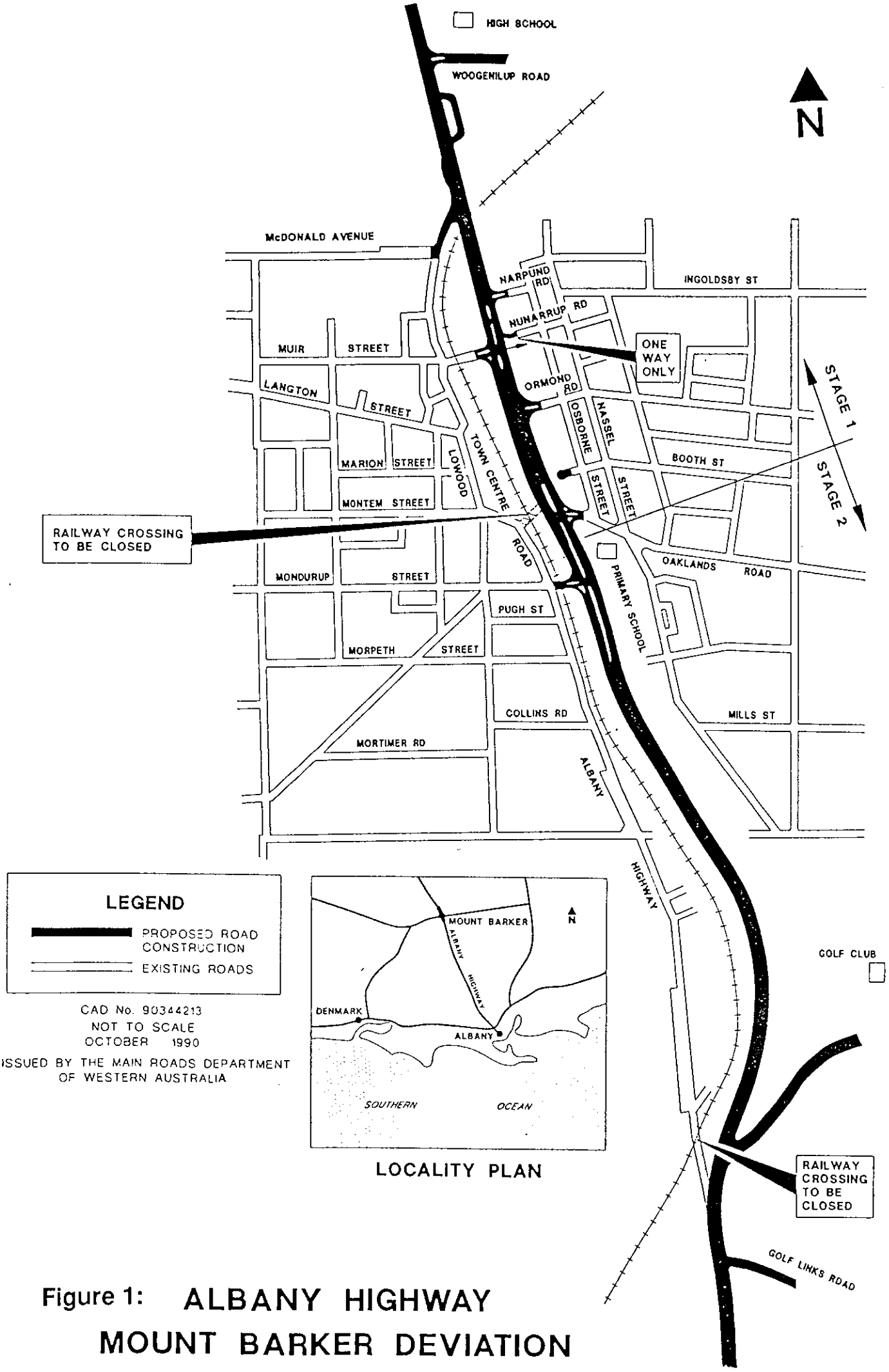

Figure 1: ALBANY HIGHWAY
MOUNT BARKER DEVIATION

1.2 Management Plan Objectives

The presence of gazetted Schedule 1 fauna within the proposed project area results in a conflict between conservation and land use values. The aims of the management plan for the Southern Brown Bandicoot population at Mount Barker are to ensure that these conflicts are effectively managed. The primary aims of the Management Plan are to;

(i) Minimise impact on the Southern Brown Bandicoot population resident in Mount Barker Albany Highway Deviation Stage 2 area.

(ii) Ensure that the species persists within the project locality.

1.2.2 Strategies

The primary strategies that will be employed to ensure that the aims of the program are fulfilled include strategies which will be implemented throughout the life of the project. Specific strategies are required for each of three project phases, Pre-construction, Construction and Post-construction. The primary strategies to be employed will be;

Preconstruction Phase

(i) Induction Programme:
Develop an induction plan for employees, contractors and sub-contractors which enhances awareness of the conservation value of the project area. Specifically, the induction programme must ensure that employees, contractors and sub-contractors are made aware of the legislated conservation status of the rare fauna Southern Brown Bandicoot and any environmental restrictions placed on the Mount Barker Deviation Stage 2 Road project.

(ii) Translocation:
The implementation of a removal trapping program to translocate individuals predicted to be at direct risk during the construction phase.

Construction Phase

(i) Habitat Clearing:
Keep clearing for all operations in the project area to an absolute minimum thereby reducing impact to surrounding ecosystems which may be utilised by Bandicoots.

(ii) Facilitation Structures:
The instalment of appropriate structural designs to facilitate the persistence of local Bandicoot populations, through the development of access corridors to habitat fragments created by the presence of the road and exclusion fencing.

Post construction Phase

(i) Habitat Management:
Habitat management through rehabilitation and enhancement.

(ii) Reintroduction:
Reintroduce translocated Bandicoots and subsequent offspring back to project area.

(iii) Predator Control:
The implementation of an appropriate feral predator control program.

(iv) Population Linkage:
Protection of the northeastern access corridor to ensure linkages to adjacent Bandicoot populations remain viable.

(v) Monitoring:
Ongoing monitoring program to assess the long-term welfare and persistence of the Bandicoot population.

(vii) Public Access:
Restriction of public access to high priority conservation areas of significance to the Bandicoots.

(viii) Research:
Keeping abreast of developments in Southern Brown Bandicoot research and impact management techniques in the South West.

The formal Mount Barker Albany Highway Deviation Stage 2 environmental assessment[4] and Bandicoot population survey[5] have defined the boundaries for the road project area and Bandicoot habitats. These boundaries are the basis for the Management Plan.

1.3 Fauna Management Strategy

1.3.1 General

Habitat fragmentation by barriers such as roads and railway lines create a number of threats to the long term survival of local populations of small mammals. Primarily these threats are a) increased potential of mortality from traffic, b) increased predation as a result of the lack of cover and shelter, c) a reduction in genetic viability due to the fragmentation of populations, d) increased risk of localised extinction events, and e) reduction in the likelihood of recruitment from adjacent habitats[6]. Previous studies examining the fragmentation of habitats by linear barriers suggest that the incorporation of artificial links, such as underpasses, is a necessary part of the design component [6,7,8].

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[4] Landscape Architectural Services 1989 Mt Barker Deviation - Stage 2 Albany Highway Environmental Assessment.

[5] *ecologia* Environmental Consultants 1992 Mt Barker Albany Hwy Deviation Stage 2: Southern Brown Bandicoot *Isoodon obesulus* Population Survey.

[6] Hunt, A, Dickens, H and Whelan R.J. 1987 Movement of Mammals through tunnels under railway lines. *Aust. Zool. 24 (2)*: 89-93.

1.3.2 Southern Brown Bandicoot Management in Western Australia

Within Western Australia four environmental management operations involving management strategies direct towards Southern Brown Bandicoots are currently underway.

During 1991 a translocation program involving the removal of 40 Bandicoots from an urban highway development area in Forrestfield was undertaken[9]. The animals were relocated to Tutanning Nature Reserve in the Wheatbelt. The species became extinct within the reserve between 1972 and 1980. The translocated animals were subsequently monitored by radio-tracking and trapping. Only three mortalities were recorded and more than 50% of females were subsequently carrying pouch young. By October 1992 seven of 16 Bandicoots captured had been born at Tutanning. During November 1992 a further 38 animals from the same source were translocated to Tutanning. An additional translocation programme is also underway involving populations from Ranford Road in the Canning Vale area[10].

The results to date indicate that the species is highly amenable to a translocation programme providing the recipient habitat is suitable.

Following the translocation of Bandicoots from the area of the Roe and Tonkin Highway interchange prior to the commencement of roadworks, a series of 300 mm and 450 mm diameter tubes have been incorporated to act as fauna underpasses. The pipes vary in length from 50 m to 100 m[11]. The underpasses link habitat fragments within the interchange as well as joining the major habitat bisected by the two highways. To date the project is still under construction thus no data exists on the utilisation of the underpasses by Bandicoots. Fauna underpasses of a similar nature are planned for the Thomas Street and Hope Valley Road project in the Kwinana area [11].

As part of the Bussell Highway Ludlow Bypass four box culverts 1.2 x 1.2 m have been installed at selected locations. These larger underpasses while aimed primarily at Bandicoot usage are designed to also accommodate other terrestrial fauna of the area[12]. Again no data has been collected to date to measure the success of the strategy.

The potential benefits of fauna underpasses linking habitat fragments utilised by Bandicoots would appear to be significant. The underpasses should maintain the continuity of populations bisected by roads and reduce traffic induced mortality. However the lack of existing data on Bandicoot utilisation of such underpasses compromises the value of this strategy at this time within Western Australia. Specifically data are needed regarding the optimum dimensions, materials, placement and frequency of underpass which maximises Bandicoot utilisation and facilitates the long term viability of the target population.

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[7] Mansergh, A. & Scott, D.J. (1989) Habitat continuity and social organization of the Mountain Pygmy-possum restored by tunnel. *J. Wildl. Manage. 53 (3)*: 701-707.

[8] Reed,D.P.; Woodard, T.N. & Pojar, T.M. 1975 Behavioral response of Mule Deer to a Highway Underpass. *J. Widl. Manage. 39 (2)* :361-367.

[9] Friend,J.A.; Collis, G. & Thomas N.D. 1993 Reintroduction of the Quenda (*Isoodon obesulus fusciventer*) to the Whealtbelt of Western Australia.

[10] J.A. Friend CALM Woodvale.

2.0 SOUTHERN BROWN BANDICOOTS

2.1 Taxonomy and relationships

The Southern Brown Bandicoot is a solitary living, rabbit-sized peramelid marsupial which occurs widely throughout southern Australia (Figure 2) occupying a variety of habitats in dry sclerophyll forests, grassland and heathlands[13]. Currently four sub species are recognised:

Isoodon obesulus fusciventer - The Western Southern Brown Bandicoot or Quenda. This sub species occurs throughout the wetter portions of the south west of Western Australia from Moore River to Walpole and in the Fitzgerald River area. The Bandicoots occurring in the project area belong to this sub species.

Isoodon obesulus obesulus - southern NSW, VIC and SA.

Isoodon obesulus affinis- Tasmania.

Isoodon obesulus peninsulae - Cape York

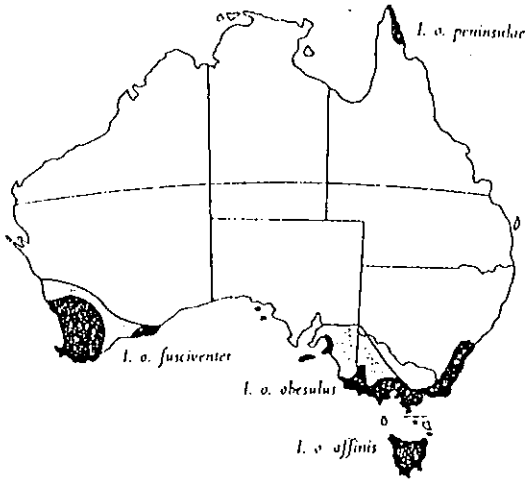

Figure 2: Distribution of the Southern Brown Bandicoot *Isoodon obesulus*

[11] P. Lilburne MRWA East Perth.

[12] M. McCarthy MRWA Bunbury.

[13] Stoddard, D.M. and R.W. Braithwaite 1979. A strategy for utilization of regenerating heathland habitat by the Brown Bandicoot (*Isoodon obesulus* ; Marsupalia, Peramelidae). *J. Anim. Ecol. 48* :165-179.

2.2 History and Conservation Status

Since European settlement, land clearing, habitat modification, and introduced predators have been severely detrimental to the species which now has a very patchy distribution over a much reduced range. The species is now restricted to areas of dense vegetation fringing wetland areas which have remained relatively undisturbed. The large reduction in numbers and range of the species within Western Australia has lead to the current status of the species as "rare and endangered".

The conservation significance of the Mount Barker Southern Brown Bandicoot *Isoodon obesulus* population has been assessed in three contexts; State, regional and local[14].

The species is considered to be of State conservation significance, by virtue of the current Schedule 1 Wildlife Conservation Act status. The Mount Barker population however is not significant at a State level in terms of the species distribution and overall abundance. The population size is small and does not significantly contribute to the species as a whole.

The conservation significance of the population becomes evident at a regional assessment level. Regionally, the project area is of significance to the species as an area of partially undisturbed remnant native woodland - wetland vegetation. Despite the high degree of degradation of some vegetation associations, the project area provides a mosaic of *Eucalyptus occidentalis* - *Melaleuca* - *Watsonia* creekline association and adjoining Jarrah - Marri woodlands. The juxtaposition of these two major associations allows seasonal utilisation of the area by Bandicoots. Few such areas remain which contain an appropriate mosaic of Bandicoot habitats in the Mount Barker region. All remaining areas of this type in reasonably good condition are of value ecologically to the species and therefore are of conservation significance.

The semi-contiguous nature of the project area with other populations within the locality of Mount Barker enhances the value of the area to the species. The drainage line to the east links the project area with another Bandicoot population 800 metres to the north east. The population is situated in a dense *Melaleuca* woodland - sedgeland of approximately 12 ha which is seasonally inundated. Activity levels indicate the population to be of similar density to that of the project area. Evidence of low level activity along the partially vegetated drainage line linking the two areas indicates that it would be used as a movement corridor between the two populations. The presence of the corridor significantly increases the viability and conservation value of both populations.

Regionally, the species appears to be still present in several small isolated populations in wetland areas with surrounding woodland. However wetland remnants are rare and often heavily modified. The 1992 survey [7] located two other populations at Quechinup Swamp and South Kokokup and one population in the immediate hinterland of Mount Barker. In addition public submissions revealed the presence of Bandicoots on the northern perimeter of the township behind the caravan park, near Mt. Barker hill and Narrikup. With continued urban and rural development of the lower south coast and hinterland, Bandicoot populations in the region will become extremely fragmented and dislocated. As more populations

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[14] *ecologia* Environmental Comsultants 1992 Mt Barker Albany Hwy Deviation Stage 2: Southern Brown Bandicoot *Isoodon obesulus* Population Survey.

come under threat of disturbance localised extinctions are expected to increase. These factors increase the conservation value of the few remaining populations upon which the survival of the species in the region is dependent.

Local conservation significance of the project area to the population was assessed by classifying the associations on the basis of utilisation by Bandicoots[15]. Three nominal categories were outlined; High (high usage, central core habitat) Intermediate and Low (low usage, significant disturbance). The high value areas to the population during winter are the *Watsonia*, Swamp Yate - *Melaleuca* forest and *Hakea* shrubland. Vegetation of moderate conservation value include the *Kunzea* - *Acacia* sedgeland and Jarrah - Marri woodland. During periods of maximum inundation of the wetlands the Jarrah - Marri woodlands would be utilised to a higher degree. Similarly during summer the *Kunzea* - *Acacia* sedgeland have high value and comprise the core Bandicoot habitat along with the *Watsonia*. The areas of low conservation value to the population typically have little or no understorey remaining, such as farmland or some upper sections of the creekline. Few native species remain and exotics almost totally dominate. Adjacent farmland is only utilised for foraging if within 20 m of cover.

2.3 Biology and Ecology

The Southern Brown Bandicoot prefers scrubby habitats with low ground cover that are irregularly burnt. During the early stages of regeneration the diversity of growing vegetation supports abundant insect food and constitutes a very favourable habitat. Later as the vegetation approaches maturity food supply is reduced. For a given area to support a stable population a mosaic of suitable habitats is required[16].

The species is nocturnal and prefers to stay close to cover when searching for food on the surface of the ground and digs characteristic shallow conical holes with its powerful foreclaws. It feeds opportunistically on a wide range of invertebrate and plant material including beetles, earthworms, spiders and grass root tubers[17]. During the day it sleeps in a nest which is constructed on the ground from grass and other plant material mixed with earth. Some nests are extremely well concealed among litter and debris under dense vegetation.

The breeding season begins in winter and usually lasts for 6 to 8 months. There are 8 nipples in a rear opening pouch and the number of young per litter is 1 to 6, usually 3 or 4, with older females producing larger litters. Two or 3 litters may be produced each year, the weaning of one litter being quickly followed by the birth of another[18]. The survivorship

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[15] *ecologia* Environmental Comsultants 1992 Mt Barker Albany Hwy Deviation Stage 2: Southern Brown Bandicoot *Isoodon obesulus* Population Survey.

[16] Stoddard, D.M. and R.W. Braithwaite 1979 A strategy for utilization of regenerating heathland habitat by the Brown Bandicoot (*Isoodon obesulus* ; Marsupalia, Peramelidae). *J. Anim. Ecol. 48* :165-179.

[17] Quinn, D.G. 1988 Observations on the diet of the Southern Brown Bandicoot, *Isoodon obesulus* (Marsupalia, Peramelidae), in Southern Tasmania. *Aust. Mam. 11* : 15-25.

[18] Craven, L.N. (1981) Ecology of a population of Quendas *Isoodon obesulus* (Gray). M.Sc. Prelim Thesis, Department of Zoology, UWA.

of weaned young, about 60 -70 days old, depends upon the availability of suitable habitat in which to establish and defend a territory which may or may not overlap another Bandicoot's territory. The species is solitary and aggressively territorial with successful adults living for 3 to 4 years and holding a territory of up to 7 ha. Home range size may be a function of food supply[19].

The main predators of the species include the Chuditch *Dasyurus geoffroii*, the fox *Vulpes vulpes* and the Feral Cat *Felis catus*.

2.4 Mount Barker Albany Highway Deviation Stage 2 Habitats

The project area falls within the Menzies Botanical District of the South Western Botanical Province[20]. The vegetation of the district which contains predominately Jarrah - Marri woodland and is also influenced by the adjacent Avon, Eyre and Warren Districts. Within the Menzies District, Mt. Barker is included within the Narrikup System containing almost continuous Jarrah - Marri woodland with Swamp Yate *Eucalyptus occidentalis* along minor creeklines. Swamps in valley depressions often contain *Melaleuca* species[21]. Within the project area six major vegetation associations were identified during the biological survey conducted in late 1989[22] (Figure 3);

1. Jarrah - Marri Woodland: The dominate association in the southern portion of the project area. A 20% - 40% canopy cover of *Eucalyptus marginata* and *E. calophylla* trees to 12 m over a mixed shrub layer to 2 m with small shrubs and sedges on laterite or lateritic loam. Dominant species include *Hakea lissocarpha*, *H. undulata*, *Xanthorrhoea preissii*, *Sphenotoma capitatum*, *Hypocalymma angustifolium*, *Mesomelaena tetragona*, *Bossiaea* spp., *Acacia lateritca* and *Isopogon formosus*.

2. *Hakea* Shrubland: A dense shrubland to 2.5 m dominated by *Hakea ambigua*, *H. trifurcata*, *H. undulata* and *Agonis juniperina*. Fifty percent canopy cover over small shrubs and herbs including *Daviesia preissii*, *D. cordata*, *Pericalymma ellipticum* and *Acacia drummondii* on heavily lateritised soils.

3. *Kunzea* Heath Sedgeland: A dense low heath of *Beaufortia micrantha*, *Kunzea recurva* and sedges with greater than 70% coverage over a seasonal ephemeral swamp. The heath also contains *Mesomelaena tetragona*, *Darwinia vestita*, *Acacia pulchella*, *Hibbertia acerosa* on alluvial sandy loam over clay.

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[19] Heinsohn, G.E. 1966 Ecology and reproduction of the Tasmanian Bandicoots (*Perameles gunnii* and *Isoodon obesulus*). University of California, *Zool. 80* : 1-96.

[20] Beard, J.S. (1980) A new phytogeographic map of Western Australia. Res. Notes W.A. Herbarium 3:37-58

[21] Beard, J.S. (1981) Swan. Explanatory notes to sheet 5,1:1,000,000 series Vegetation Survey of Western Australia. Univ. of W.A. Press: Nedlands

[22] Napier & Associates, 1989 Botanical Survey of the Mt Barker Deviation (Stage 2).

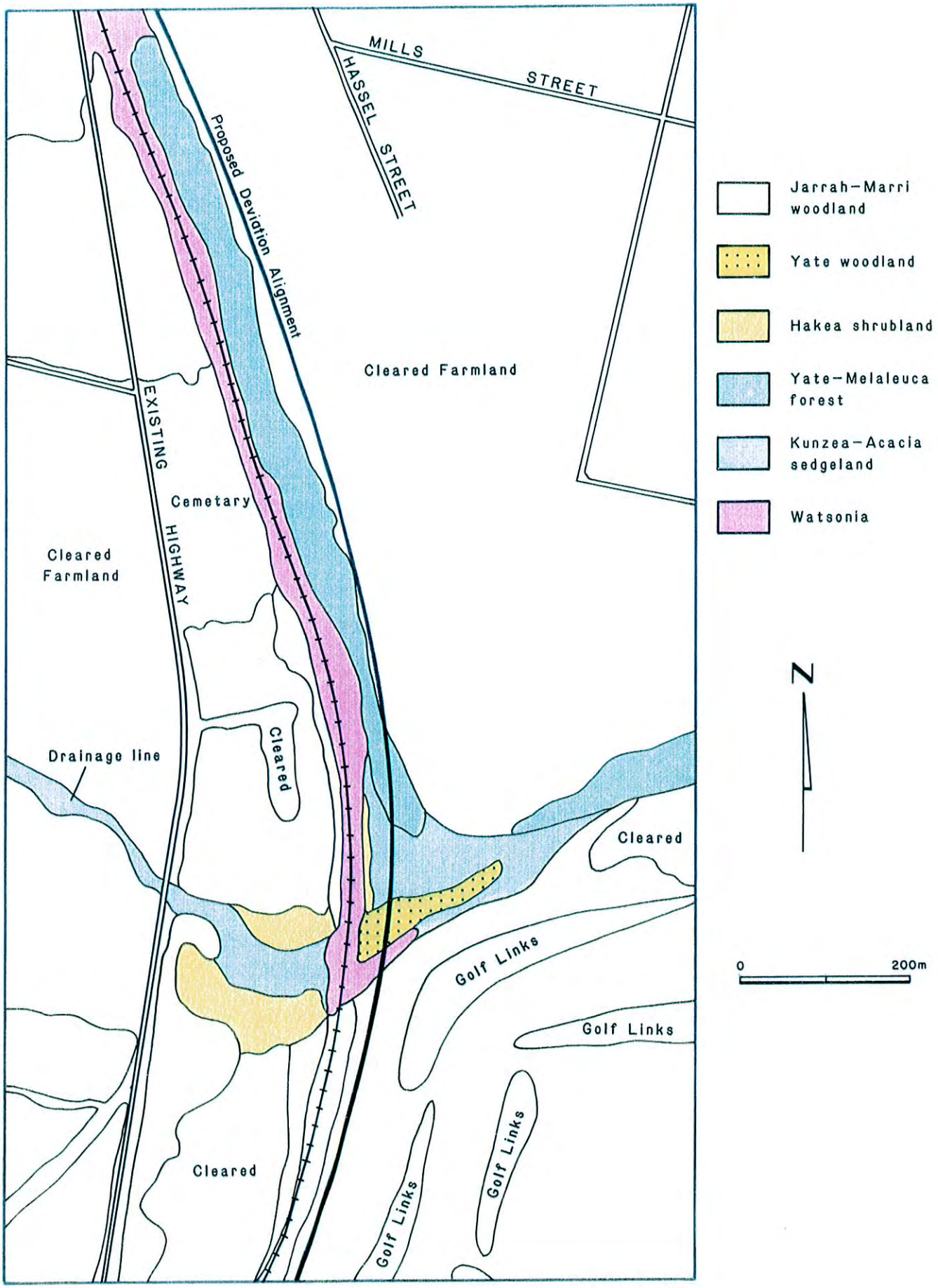
4. *Kunzea* - *Acacia* Shrubland: Tall shrubland up to 2 m and 80% cover of *Kunzea recurva*, *Beaufortia decussata*, *Acacia drummondii* and *A. pulchella* over sedges and *Watsonia*. Seasonally inundated flats adjoining creekline on alluvial sandy loams over clay. Scattered Swamp Yate and *Melaleuca* trees occur in this association. *Watsonia* has invaded some areas and eliminated all shrub species.

5. Swamp Yate - *Melaleuca* Forest: Fringing forest - woodland to 12 m of *Eucalyptus occidentalis* Swamp Yate and *Melaleuca preissiana* over scattered small shrubs and sedges. This association occurs along the intermittent creekline banks on alluvial sandy loams over clay. Dominate understorey species include *Acacia drummondii*, *Pimelea rosea*, *Astartea fascicularis* and *Lepidosperma* spp.

6. *Eucalyptus* - *Casuarina obesa* Woodland: Open woodland to 12 m with moderately dense, to 30% cover, canopy of *Eucalyptus occidentalis*, *E. calophylla* with *Casuarina obesa* over sparse understorey of *Acacia saligna*, *A. drummondii*, *Bossiaea linophylla* and *Watsonia* sp.. *Watsonia* dominates the understorey over much of this association choking out all but the trees and hardiest shrub species. Some areas contain pure stands of *Watsonia*.

Vegetation Association	Description	Percent
Jarrah - Marri Woodland	Semi-disturbed woodland with mid-dense understorey.	35
Yate - *Melaleuca* Forest	Dense forest/woodland with open understorey on creekline edge.	25
Kunzea - *Acacia* Shrubland	Tall shrubland over sedges and *Watsonia*, seasonally inundated.	10
Kunzea Heath - Sedgeland	Dense low heath over seasonally inundated sedgeland.	15
Hakea Shrubland	Dense shrubland on laterite areas.	5
Eucalyptus - *Casuarina* Woodland	Mid-dense canopy over sparse understorey cover, seasonally inundated.	10

TABLE 1: Vegetation Associations with approximate percent occurrence.



MT BARKER BANDICOOT SURVEY

Figure 3:

Vegetation of the core Bandicoot habitat

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2.4.1 Project Area Southern Brown Bandicoot Habitats

The macro-habitats available to Bandicoots in the project area comprise 3 major types; (1) Jarrah - Marri woodland, (2) the dense vegetated creekline and associated seasonally inundated flats, and (3) adjacent cleared farmland[23]. The utilisation of these habitats will vary in frequency with season and the requirements of the individual animal. Each habitat represents an area which provides differing resources and capabilities for supporting the species.

1. Jarrah - Marri Woodland. The surrounding woodlands with moderately dense shrub understorey play an integral role in the persistence of the population. Whilst the habitat is utilised for foraging year round, the role it plays during the winter is of greater significance. With inundation of the creek areas during the wet winter season Bandicoots move to the higher ground of the surrounding woodlands. Therefore the population is dependent upon this area to provide enough shelter and resource during a significant portion of the year.

2. Dense creekline and flats. This habitat is essential for the persistence of the population in the area. It provides critical cover in terms of shelter and predator avoidance. Additionally, the majority of food resources are located here. During winter with increased inundation the degree of utilisation of lower areas is reduced though still significant.

3. Cleared farmland. The open farmland, while providing no cover or other structural resources for Bandicoots, is a food source. Pastureland up to 20 m distant from adjacent cover is utilised for foraging, primarily for tuberous plants such as Guildford Grass *Romulea rosea* and invertebrates such as worms. As such this habitat may provide an important adjunct to food resources within more naturally vegetated areas.

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[23] *ecologia* Environmental Comsultants 1992 Mt Barker Albany Hwy Deviation Stage 2: Southern Brown Bandicoot *Isoodon obesulus* Population Survey.

3.0 THE MANAGEMENT PLAN

This Management Plan contains environmental management strategies which will be implemented throughout the life of the Mount Barker Deviation Stage 2 project. Specific strategies are detailed for each of three project phases, Pre-construction, Construction and Post-construction

3.1 PRE-CONSTRUCTION PHASE

3.1.1 Induction Programme

The support of all project staff is essential if the Bandicoot management strategies are to be successful since the programme contained in the Management Plan is expensive in terms of both staff and finance. Upon inception of the Construction Phase of the project Main Roads Western Australia will implement an induction programme for all MRWA employees, contractors and sub-contractors which enhances awareness of the conservation value of the project area and Bandicoot population. The induction programme will include;

a) Information regarding the legislated conservation status of the Southern Brown Bandicoot in Western Australia. The species is considered rare and endangered and is protected by State legislation. The species was gazetted as Schedule 1 on the Department of Conservation & Land Management (CALM) Rare and Endangered Fauna Schedule as "fauna that is likely to become extinct , or is rare" during 1990.

   Under Section 14, Sub-section 2 (ba) of the Wildlife Conservation Act, 1950-1979, The Southern Brown Bandicoot is protected fauna and as such any person who "takes" rare fauna is committing an offence under Section 16 and "is liable ....to a penalty of $10,000."

   Within Section 6 Sub-section 1 of the Act the definition of "taking fauna" is as follows;

   '"to take" in relation to any (protected) **fauna, includes to kill or capture any fauna by any means or to disturb or molest any fauna by any means"..... "and every act of assistance to another person to "take fauna""**

   Due to the potential for construction activities within the project area region to contravene the Wildlife Conservation Act with respect to the species, Main Roads Western Australia has made a commitment to the regulatory authorities to develop and implement a specific management plan. The Management Plan contains strategies which will allow environmentally sensitive development of the project to be conducted within Bandicoot habitats.

b) Synthesis of this Management Plan including basic information on Bandicoot biology and ecology. All senior operations staff should read the Plan and have copies available for reference.

c) Details of relevant Bandicoot environmental management operations procedures and prescriptions developed for the project.

d) Individual and project responsibility. Ultimate responsibility of any disturbance or impact to Bandicoots or their habitat rests with the individual. Any penalty which may result from actions which contravenes the Wildlife Conservation Act Sections 6 and 14 is the responsibility of the person or persons concerned.

However, it is the responsibility of the supervising Project Engineer to adequately brief all employees, contractors and sub-contractors of their obligations while undertaking construction activities in Bandicoot habitats. In addition the supervising Project Engineers are responsible for monitoring the conduct of such employees, contractors and sub-contractors while construction is underway.

The Project Manager is responsible for supervision and implementation of the induction programme as outlined in this plan.

3.1.2 Translocation

The construction phase of the project poses a significant threat of direct impact to an estimated 60 % of the individuals in the population should the population remain in situ during construction. There will initially be major localised impacts within the territories of the greater portion of the population. While relocation of surviving individuals into adjacent habitats will occur, the diurnal behaviour of the species in remaining in nests and burrows when threatened will lead to many fatalities.

The aim of the translocation programme is to remove individuals predicted to be at direct risk during the construction phase. Prior to construction the designated impact zone (Figure 4) will be fenced with exclusion fencing to contain Bandicoots resident within the impact area and to prevent utilisation of the impact area by animals with adjacent territories or recolonisation during dispersal events. Subsequent removal and translocation of all impact area resident Bandicoots allows;

a) the process of construction to be carried out without contravening the Wildlife Protection Act 1950;

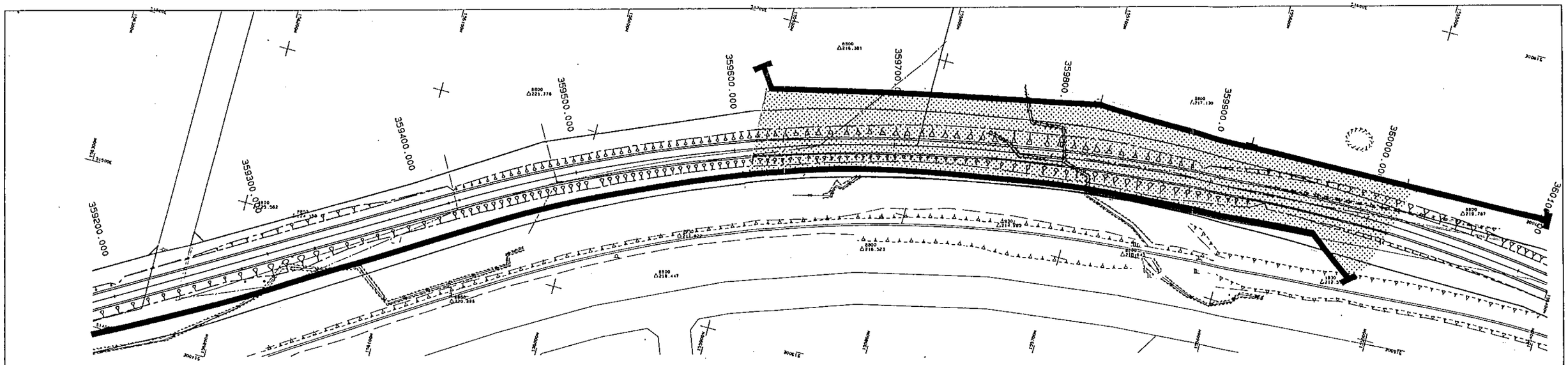
b) the preservation of the resident population for post-construction reintroduction to the project area.

✷ Isolation

The area of direct impact which contains either resident Bandicoots or suitable habitat which may be utilised by Bandicoots is to be encompassed by exclusion fencing prior to commencement of the translocation programme.

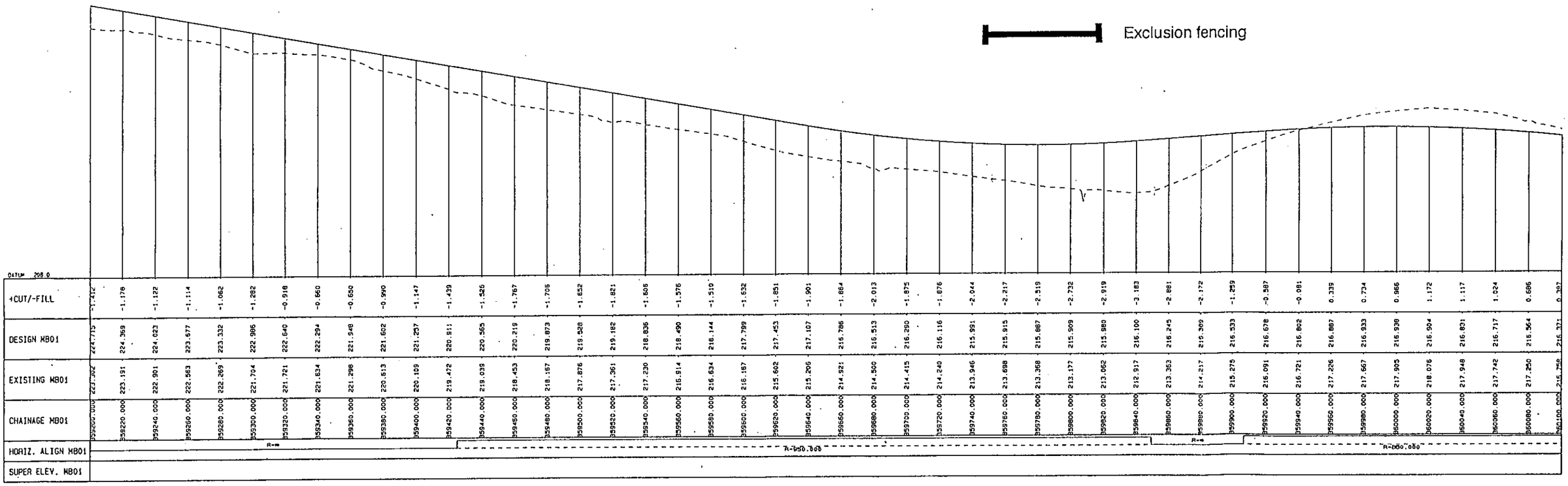
The exclusion fencing is required to be impermeable to Bandicoot movement and thus should be constructed of material with openings 30 mm or less. The small diameter is required to prevent passage of juvenile Bandicoots during post-weaning dispersal. Fencing material similar to "Chicken Wire" is adequate. The fence must be of a minimum erected height of 1.2 m, at least 90 cm to start of return, with a 30 cm apron covered by soil 30 cm deep (Figure 6A). The apron is to placed on the exterior side of the impact zone to prevent animals digging under the fence and entering the impact zone during the Construction Phase.

Isolation exclusion fencing is required from Chainage 359620 to 360000 on both sides of the impact zone (Figure 4), 380 m total. The placement of the fencing should be along the alignment of the road reserve boundary or no more than 15 m distant from the area of direct surface soil-vegetation disturbance impact due to construction activities. The objective is to encompass the minimum necessary impact zone area. Temporary fencing should enclose the ends of the impact zone to prevent reinvasion by Bandicoots until construction begins



Impact zone

Exclusion fencing

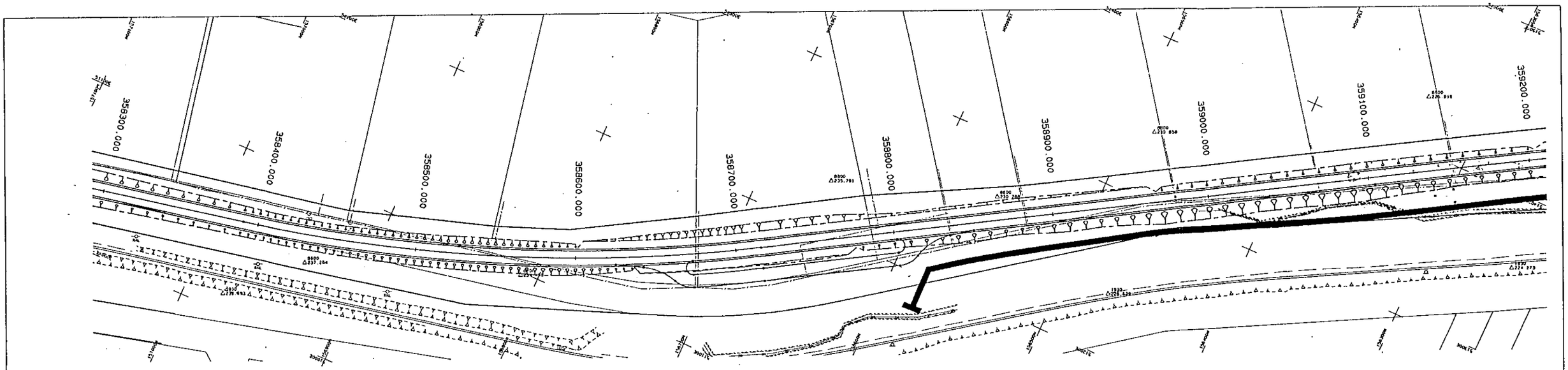


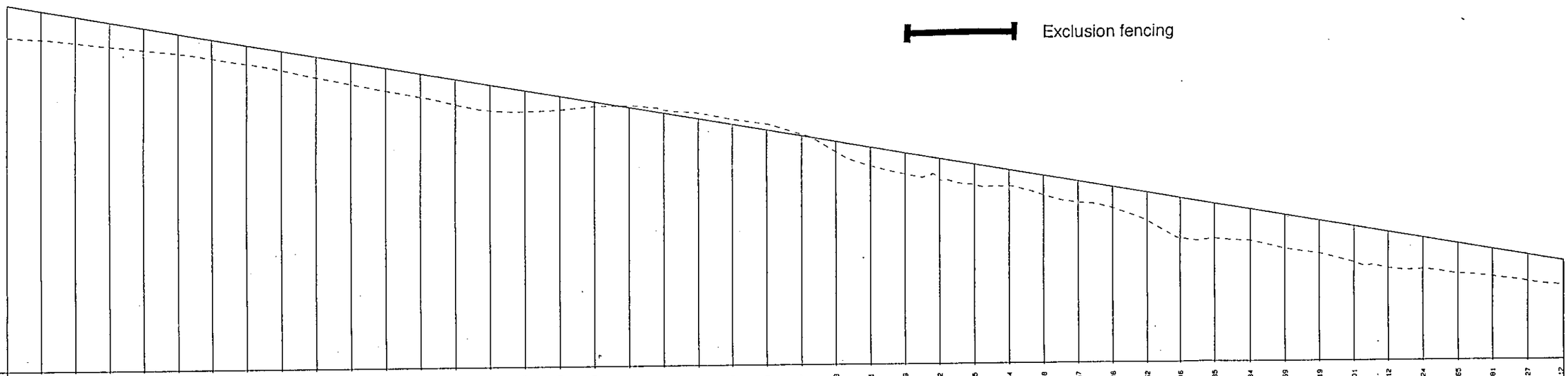
MT BARKER DEVIATION STAGE II

BANDICOOT IMPACT ZONE

Figure 4

MT. BARKER DEVIATION
PLAN/PROFILE-SHEET (3) OF (5)
HORIZ. SCALE 1:1000
VERT. SCALE 1:100
S.HILL 11/4/94





MT BARKER DEVIATION
PLAN / PROFILE - SHEET ② OF ⑤
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FREE... SUBJECT TO ... DLY

MT BARKER DEVIATION STAGE II
EXCLUSION FENCING ALIGNMENT

Figure 5

Additional exclusion fencing may be required from Chainage 358800 to 359620, 820 m total, on the western boundary of the road reserve (Figure 5). This fencing may be necessary to preclude reinvasion following Bandicoot removal within the narrow band of vegetation which will be directly impacted in this area.

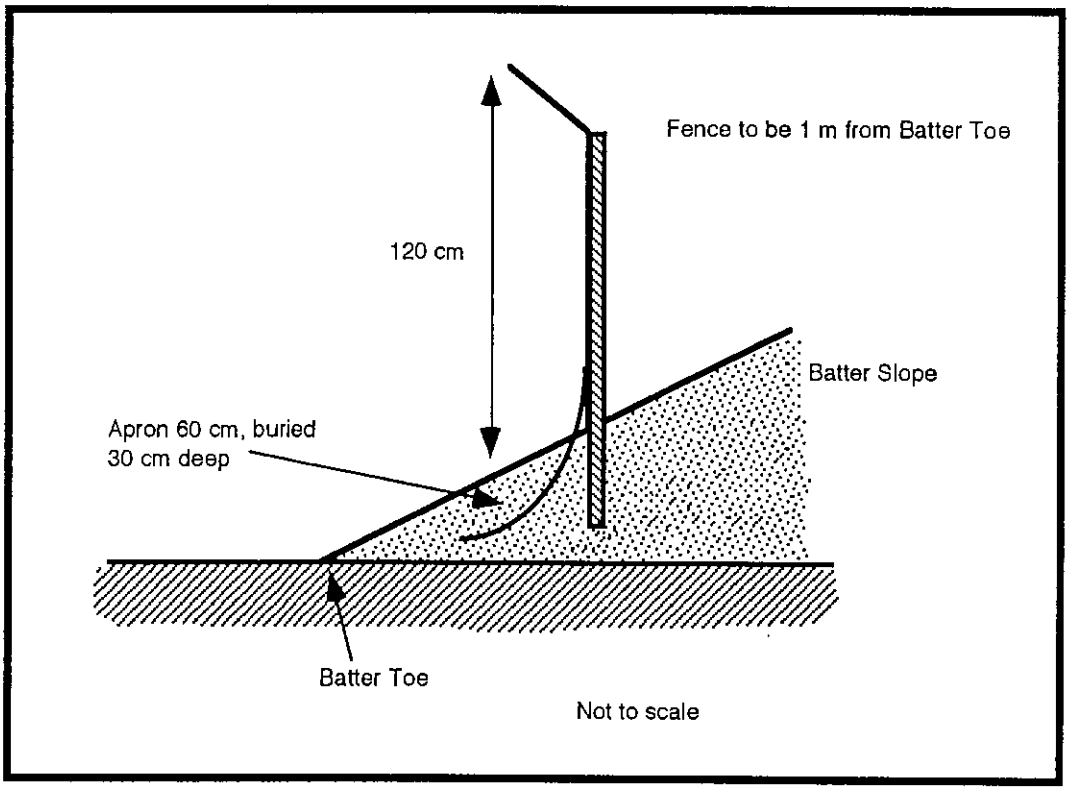

Figure 6A: Exclusion fencing erection layout.

✹ Site Selection

Translocations will only be attempted in areas lacking resident Bandicoot populations. Selection criteria for translocation sites will include;

a) land that is managed by CALM or is subject to an agreement with CALM;

b) of an area capable of supporting a population of up to 50 Bandicoots;

c) the area must be free of Bandicoots prior to translocation. This is required so that the translocated bandicoots do not displace resident animals or are threatened by territorial behaviour of existing residents;

d) contains suitable habitat, preferably of a similar nature with a seasonally inundated wetland surrounded by Jarrah - Marri forest with a near intact understorey;

e) is in close proximity to the project area to reduce translocation travel time, optimally to within three hours;

f) an area suitable for cost effective feral predator control throughout the duration of occupancy by the translocated population.

✷ **Removal**

METHODOLOGY:
Systematic trapping of the impact zone (Figure 4) using a combination of cage traps (50 cm x 20 cm x 25 cm) and large and medium sized Elliott box traps. Traps should be situated in grids of 10 large traps at 20 m intervals in two rows of five traps with 20 interspersed medium Elliott traps 20 meters apart. The medium Elliott traps facilitate the capture of juvenile and sub-adult animals. A minimum of five trapping grids is required to ensure adequate coverage of the designated impact zone.

Trapping should be conducted concurrently over a minimum period of five nights. The trapping period should be extended should captures still occur on the last trap night. Removal trapping may be considered to be complete after three nights of no captures. All animals captured should be sexed, weighed, measured (pes length), reproductive status recorded and uniquely tagged with magnetic transponder tags for future monitoring. Condition of the Bandicoots can be quantified using a condition index which is a function of body weight against the pes length. A selection of animals should be fitted with radio-tracking collars to allow monitoring in the initial post -translocation stage.

Bandicoots should be transported in hessian bags to reduce stress from external stimuli and minimise physical injury.

TIMING:
Timing of the translocation of Bandicoots is critical. Removal should begin immediately prior, less than four weeks, to the commencement of construction operations. In order to minimise trauma to animals which will be stressed through translocation, isolation fencing should only be erected immediately prior, less than two weeks, to the commencement of the removal trapping. This allows the population to function normally up to the point of removal.

Based on the experience of previous CALM translocation programmes[24], the optimal period for removal is spring. Breeding occurs during late summer to winter, additionally food resources are low during Autumn. Translocation during these periods may result in mortality.

3.1.3 Predator Control

The success of the Bandicoot translocation programme will not only be dependent upon on the selection of a suitable site and appropriate removal methods but also upon feral predator control. The population to be translocated will only number 10 - 20 animals, which will be under stress from the translocation process and moving to an unfamiliar location and or habitat. During the initial establishment phase the Bandicoots will be highly vulnerable to predation pressures.

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[24] G. Wyre CALM Como.

An appropriate feral predator control program will need to be implemented in consultation with the Agriculture Protection Board (APB). The programme would consist of 1080 poison baiting the entire recipient site and a large surrounding buffers zone. Due to the high mobility of predators such as foxes and cats approximately 10 km^2 may need to be baited. The baiting programme should be implemented four weeks prior to translocation with two baiting sessions to ensure a significant reduction in resident predators. The programme would need to be ongoing throughout the duration of occupancy to remove transient predators and prevent recolonisation.

3.1.4 Post-Translocation Management

A monitoring program will be required to assess the success of the translocation program. The welfare of all Bandicoots translocated during the Pre-Construction Phase must be monitored to allow development of any necessary modifications of subsequent management of the translocated population.

Initial population monitoring through radio tracking, trapping and visual searches to ensure that the translocated animals have been successfully introduced to the temporary site. Further monitoring of the translocated population should coincide with the breeding and dispersal phases of the Bandicoot lifecycle so that information on survivorship and reproduction can be obtained. All animals captured should be sexed, weighed, measured (pes length), reproductive status recorded and new animals tagged with magnetic transponder tags

3.2 CONSTRUCTION PHASE

3.2.1 Structural Design Concepts

In order to achieve the aims of the Management Plan the implementation of appropriate designs which restrict Bandicoot access to hazardous areas and allow access between the remaining habitat patches on either side of the new alignment is required. Appropriate fencing along the road margin is necessary to remove the threat of road fatalities. To facilitate seasonal movements and access to all available habitat, suitable passageways under the road need to be constructed.

✹ Fauna Underpasses

The Mount Barker Albany Highway Deviation Stage 2 requires the incorporation of fauna underpasses to allow Bandicoot movement. Access via the underpasses to all habitat remnants will greatly facilitate the maintenance of the integrity of the population. The underpasses are required to be of two types;

A) 1.2 m X 1.2 m culverts,

B) 300 mm diameter concrete pipes.

A representative fauna underpass design concept is illustrated in Figure 6. The usage of the two types of underpass addresses two areas of concern 1) the lack of currently available knowledge of the optimal Bandicoot underpass design and 2) the constraints imposed by the proposed road design in areas with limited fill requirements. All size and placements of fauna underpasses have been designed to remain within the constraints of the desired road design. The larger culvert fauna underpasses will be located in areas of high Bandicoot activity which also coincide with maximal fill requirement areas.

The usage of the culvert underpasses addresses concerns regarding the efficacy of the smaller pipe underpasses which have been employed elsewhere. However, it is considered that Bandicoot access routes are required at frequent intervals within the core habitat area encompassed by the direct impact zone. The lack of sufficient fill requirements and budget constraints prohibit the greater use of culvert underpasses. In addition the current Post-Construction monitoring programme provides an opportunity to empirically test the effectiveness of Bandicoot underpass type, placement and frequency. This data would then allow informed cost-effective design and implementation of Bandicoot management strategies for other linear impact projects, including roads, elsewhere in south-western Western Australia.

A) 1.2 m X 1.2 m Culverts.

LOCATION:
The placement of two 1.2 m X 1.2 m culverts with earth bases is required at;

Chainage 359850 SLK,
Chainage 359750 SLK.

The placement of the culverts is in the area of the central core habitat of seasonal dampland and coincides with an area of maximal fill of approximately, +2.30 m and +2.95 m respectively. The size of the culverts may be between 1 m X 1 m to 1.5 m X 1.5 m. This is dependent on which is the most cost effective standard size employed by MRWA.

LENGTH:
Culvert length is to be the minimum possible consistent with safe road design practices. The objective is to install culverts of minimum length to encourage utilisation. While Bandicoots are highly mobile it is widely acknowledged that the longer the underpass the lower the level of utilisation[25].

POSITION:
The culverts are to be placed approximately 1.0 meter above the toe of the batter to minimize culvert length while retaining batter angle of 1:3.

[25] J.A. Friend CALM Woodvale, P. Lilburne MRWA East Perth.

INTERNAL DESIGN;
The culvert underpasses require the placement of a raised bench which occupies 30% - 50% of cross-sectional area and is approximately 40 cm - 50 cm high as indicated in Figure 7. The bench is to be constructed from earth and rock fill to provide a natural substrate. The raised bench and access ramps allows Bandicoot utilisation of the underpass during periods of seasonal inundation. The access ramps are to extend away from the bench with slopes of no more than 1:6.

Vegetation debris, rocks and small logs are to be placed within the culvert both, on the base and the raised bench, to provide shelter from predators and a more secure natural passageway.

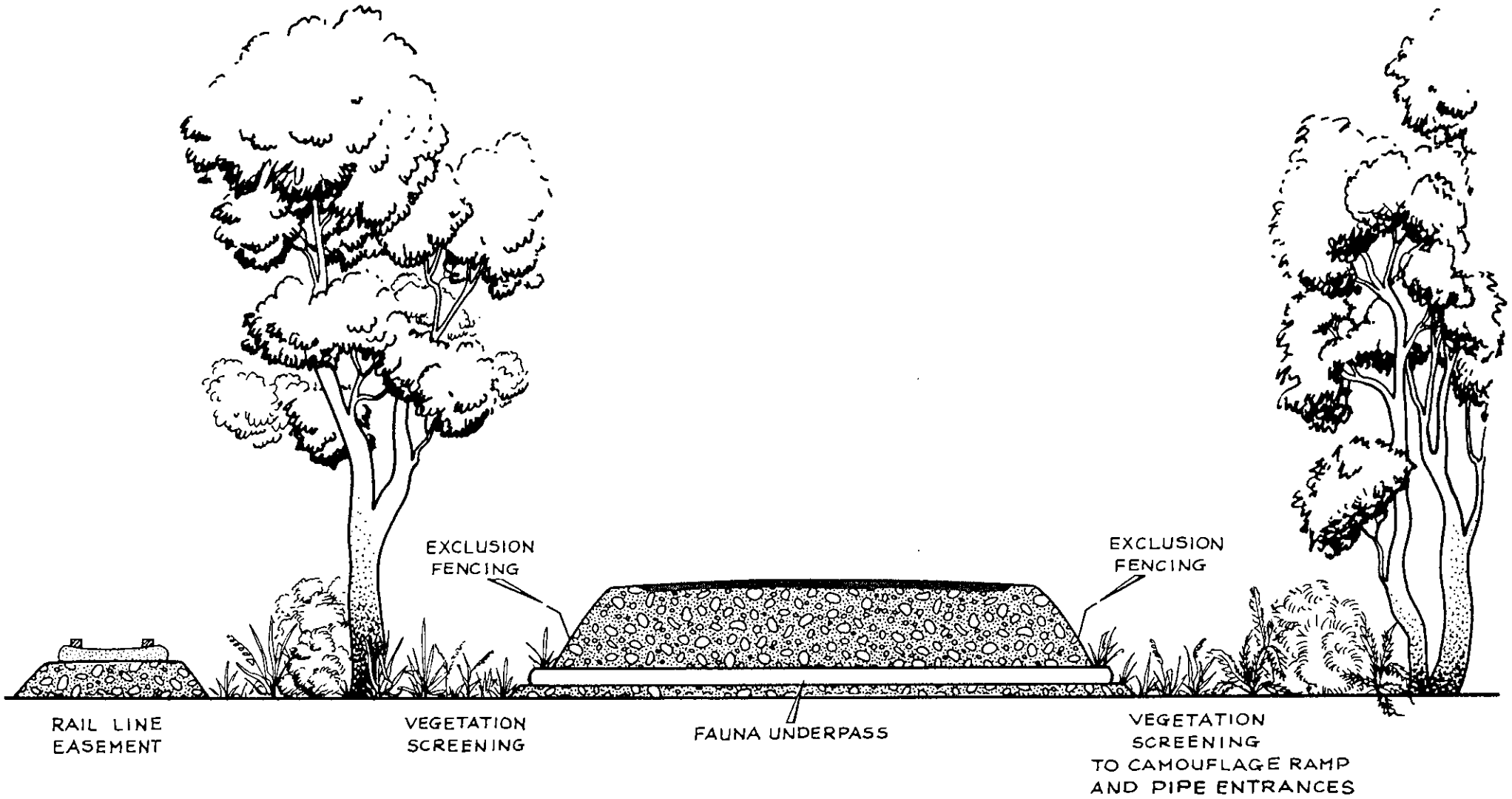
B) 300 mm Diameter Concrete Pipes

LOCATION:
Three smaller fauna underpasses constructed from 300 mm diameter concrete pipes will be required at;

Chainage 359680 SLK	+ 2.013 m	fill requirement,
Chainage 359720 SLK	+ 1.876 m	fill requirement,
Chainage 359880 SLK	+ 2.172 m	fill requirement.

LENGTH:
Pipe underpass length is to be the minimum possible consistent with safe road design practices.

POSITION:
The pipes are to be raised 20 cm - 30 cm above the general level of surrounding terrain. The raised position and associated access ramps allows Bandicoot utilisation of the underpass during periods of seasonal inundation. A length of 30 cm - 50 cm of pipe is to be left protruding at each end (Figure 8). The protruding pipe ends are to be positioned on a raised earth embankment with a 1:6 slope for the access ramps on all three sides.



MOUNT BARKER DEVIATION STAGE II

Figure 6: CONCEPT SECTION OF FAUNA UNDERPASS

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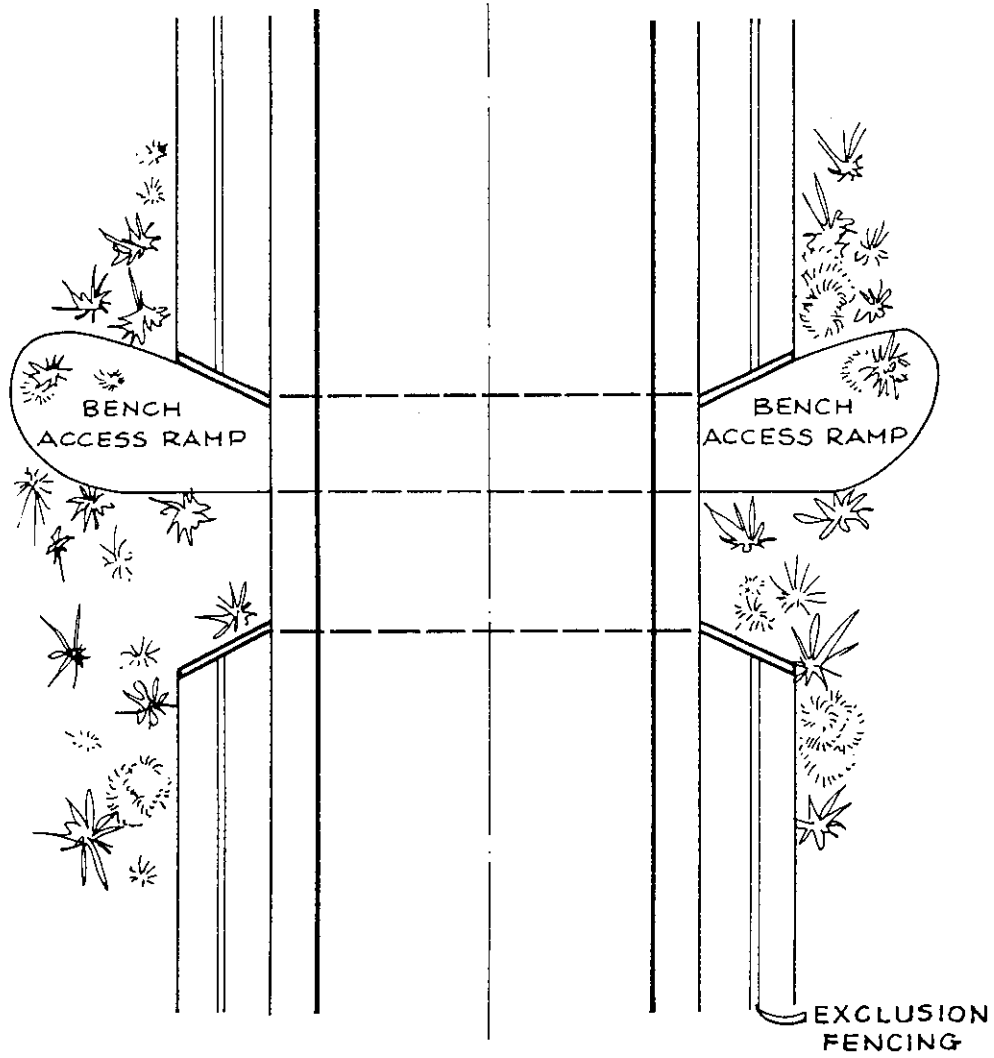
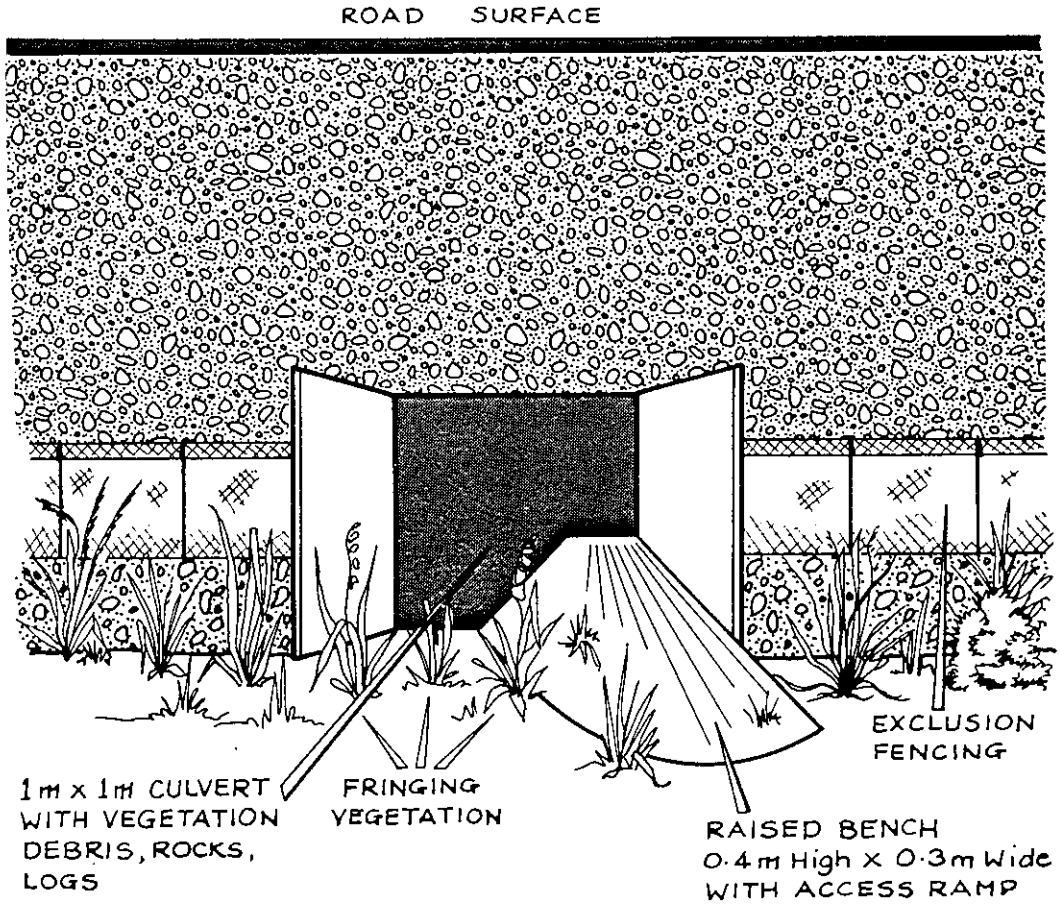


PLAN VIEW



SIDE ELEVATION

MOUNT BARKER DEVIATION STAGE II

Figure 7: **CULVERT FAUNA UNDERPASS**

AT CHAINAGE 359825 & 359780

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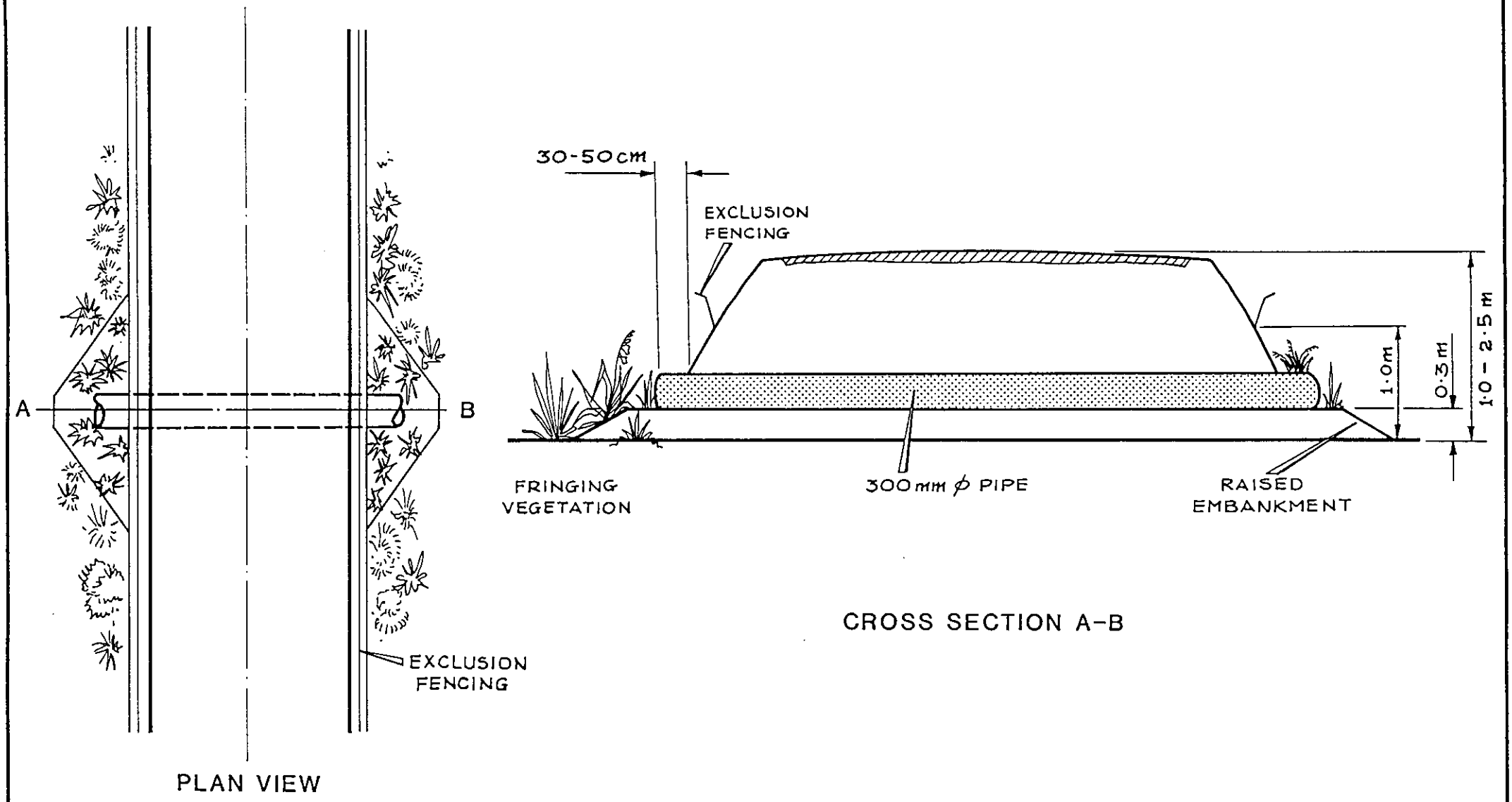

MOUNT BARKER DEVIATION STAGE II

Figure 8: 300mm PIPE FAUNA UNDERPASS

ecologia

✹ Fencing Designs

EXCLUSION FENCING:
The exclusion fencing of identical materials and dimensions used for the impact zone isolation (Section 3.1.2) is required to prevent traffic induced mortality from the movement of Bandicoots across the road surface. The fencing material is to be similar to "Chicken Wire" and of a minimum erected height of 1.2 m, at least 90 cm to start of return, with a 30 cm apron covered by soil 30 cm deep (Figure 6A). The apron is to placed on the exterior side of the road pavement to prevent animals digging under the fence and crossing the road.

The optimum position for the exclusion fencing is 1 meter up from the toe of the road embankment batter. The frequency of attempts to scale the exclusion fencing in this position is expected to be low due to the Bandicoot preference for avoiding open ground.

Exclusion fencing is required from Chainage 359620 to 360000 on both sides of the road, 380 m total. Additional exclusion fencing is required from Chainage 358800 to 359620, 820 m total, on the western road embankment.

PERIMETER FENCING:
Perimeter fencing is required by local landholders to be placed around the road reserve boundary upon completion of construction. The perimeter fencing employed must be of a type to allow rapid and safe passage by Bandicoots due to the presence of predators. The adjacent open farmland on the eastern boundary of the project, while providing no cover or other structural resources for Bandicoots, is a food source. Pastureland up to 20 m distant from adjacent cover is utilised for foraging, primarily for tuberous plants such as Guildford Grass *Romulea rosea* and invertebrates such as worms. As such this habitat may provide an important adjunct to food resources within more naturally vegetated areas. Bandicoot access to these areas must be maintained.

The recommended fencing to be utilised should have as a minimum 45 cm X 17.5 cm openings. Standard 5/70/45 Ringlock Sheep Fence is suitable. This material provides a total height of 70 cm and 5 supporting wire strands. This is the smallest sized fencing which will allow rapid and safe passage by Bandicoots. Ringlock with smaller openings should not be used between Cha 359600 and 3600200 where Bandicoots predominantly cross into the adjacent open pasture.

3.2.2 Monitoring

Monitoring of the remnant population which resides outside the impact zone (Figure 4) should be undertaken to determine the success of the site management protocols. Population assessment should be undertaken during the construction phase to assess the well-being of the resident bandicoots. Parameters such as recruitment, mortality, and demography as well as habitat utilisation patterns will need to be addressed. The monitoring database is critical to the modification or development of appropriate management strategies to ameliorate any impacts arising during construction which are unforeseen. Monitoring techniques identical to Section 3.1.4 should be utilised.

3.2.3 Operational Procedures

✹ Timing

DIURNAL OPERATIONS:
All works operations within the project area are to be limited to daylight hours. Bandicoots are nocturnal. Restriction of activities to daylight hours minimises the impact from activity disturbance to normal individual behaviour and results in lower stress levels to the population.

✹ Construction Works Operations

CLEARING:
Clearing of vegetation and topsoil disturbance for all works operations should be kept to an absolute minimum in the project area to reduce impact on surrounding habitats which are utilised by Bandicoots. This is particularly critical within the designated direct impact zone (Figure 6) which contains the core habitat area supporting the greater portion of the population.

The top soil, vegetation and litter layer of all areas to be disturbed should be stockpiled for later rehabilitation programmes. Vegetation debris, logs, topsoil and rocks should be returned to areas which have been disturbed and in need of rehabilitation. These substrates assist with rehabilitation by providing seed stores, moisture traps and fauna micro-habitats.

DUST:
Dust suppression techniques should be applied to reduce impact to adjacent vegetation from excess dust during construction activities.

ACTIVITY RESTRICTION:
Prohibit off road-driving and shooting in the project area during the construction phase of the project.

✹ Dieback

There is extensive evidence of the presence of dieback within the project area, particularly in the southern sector[26,27]. The disease has been attributed to the pathogenic fungi of the genus *Phytophthora*[28] and is most evident in the Jarrah - Marri woodlands. Indicator species are lacking due to understorey degradation over much of the remaining area. However, it is thought that dieback may have attributed to the loss of the original

The implementation of a full dieback hygiene and management plan is not warranted due to the existing high level of infection. A containment policy must be employed to safeguard against the risk of transferal of infection to other external areas. Standard hygiene washdown procedures should be adopted for all vehicles moving out of the project area. The major impact of the presence of dieback will be the limitation of the range of native plant species which may be used for rehabilitation programmes. Dieback susceptible species are unlikely to yield long-term success.

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[26] Napier & Associates, 1989 Botanical Survey of the Mt Barker Deviation (Stage 2).

[27] M. Grant CALM Albany, 1994

[28] Landscape Architectural Services 1989 Mt Barker Deviation - Stage 2 Albany Highway Environmental Assessment.

3.3 POST-CONSTRUCTION PHASE

3.3.1 Habitat Rehabilitation and Enhancement

The maintenance and rehabilitation of major macro-vegetation associations identified as primary Bandicoot habitat in the project area is essential for the long term survival of this species at this site. The primary goal of the rehabilitation programme must be the re-establishment of a mosaic of understorey species representative of original associations.

Areas to be rehabilitated should be ripped, reseeded and replanted using local species. As detailed is Section 3.2.2, the presence of dieback limits the range of plants species suitable for revegetation. Appendix A contains a list of recommended species which are known to have a low dieback hazard susceptibility. Micro-relief should be provided in all rehabilitated areas to maximise water permeability, maintain soil friability and maximise seed lodgement.

An active vegetation rehabilitation / enhancement programme is needed in degraded areas along the mid-upper creekline from Chainage 357800 SLK to Chainage 359300 SLK. The re-establishment of the shrub understorey would greatly enhance the conservation value of the area for Bandicoots.

While the exotic bulb *Watsonia* is considered to be a significant weed invader which leads to the degradation of low lying habitats in wetter areas, the species currently provides an ideal Bandicoot habitat in the project area. The dense *Watsonia* stands contain the highest Bandicoot densities and provide optimum resources in terms of food, shelter, protection from predators and nesting sites. During the 1992 survey spool tracked animals utilised the *Watsonia* habitat with almost double the frequency of any other habitat[29]

It is acknowledged that the removal of the *Watsonia* habitat would have a highly significant negative impact upon the Bandicoot population in the project area[30], possibly leading to the extinction of the population. Under no circumstances should the *Watsonia* habitat be removed in the short to medium term life of the project, 3 to 5 years. Removal of the *Watsonia* by staged clearing and revegetation with native species may be undertaken once the Bandicoot population is stabilised and firmly established.

✷ Fauna Underpasses

The fauna underpasses detailed in Section 3.2.1 require extensive revegetation around the entrances, and internally were possible, for the culvert underpasses. The presence of a dense cover of natural vegetation will encourage Bandicoot usage of the passage ways by providing essential protection and shelter.

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[29] *ecologia* Environmental Comsultants 1992 Mt Barker Albany Hwy Deviation Stage 2: Southern Brown Bandicoot *Isoodon obesulus* Population Survey.

[30] J.A. Friend CALM, Woodvale; G.W. Connell, *ecologia*.

The areas surrounding the underpass entrances should be planted with a mixture of shrubs and herbs selected from Appendix A to promote a dense cover (Figures 7 & 8). For the short to medium term, 3 to 5 years post reintroduction of the translocated Bandicoot populations, the usage of dense stands of *Watsonia* would provide a highly cost-effective measure.

3.3.2 Reintroduction

Reintroduction of the translocated animals back to the original site is to be undertaken once rehabilitation enhancement programmes have been completed.

METHODOLOGY:
The methods used are to be similar to the removal programme detailed in Section 3.1.2. Systematic trapping of the area using a combination of cage traps (50 cm x 20 cm x 25 cm) and large and medium sized Elliott. Traps should be situated at 20 m intervals and baited with bread and peanut butter.

TIMING:
Relocation of Bandicoots should commence once the rehabilitation and enhancement of Bandicoot habitats has been completed. As with the Translocation phase (Section 3.1.2), timing of the reintroduction of the Bandicoots is critical. The optimal period is during spring to reduce the chance of mortality.

3.3.3 Population Linkage

Protection of the northeastern access corridor needs to be secured. Agreement with the landholder should be reached if at all possible regarding management of the corridor. The corridor occurs along the drainage line east to another population, 800 m distant, The corridor ideally needs to be fenced and revegetated to ensure adequate cover and allow regular seasonal dispersal events between populations. The provision of the corridor significantly enhances the long term viability of both populations.

3.3.4 Monitoring

Monitoring of the Bandicoots to determine the success of reintroduction and the use of the underpasses is required. Population parameters such as recruitment, mortality, and demography as well as habitat utilisation patterns will need to be addressed. The monitoring database is critical to the modification or development of appropriate management strategies to ameliorate any impacts which are unforeseen or arise at a later date. Census is to be carried out using a variety of techniques including visual census for signs of activity, such as diggings, tracks and droppings, trapping, radio tracking, spool tracking and passive monitoring magnetic transponders.

RADIO TRACKING:
Radio tracking of individual Bandicoots to identify night time movement patterns and daytime burrow and nest usage. This information can be used to determine the home range size, habitat usage and use of the underpasses.

SPOOL TRACKING:
A 280 m spool of thread is attached to the animal with the free end fastened to a trap or vegetation and the animal released. Spools are tracked the following day, with all major directional changes marked, and the distances between the bearings on the animal moved recorded. Details of habitat, frequency of foraging diggings, and refuges (burrows and nests), should be recorded. This information provides information on home range size, activity patterns and habitat utilisation.

TRAPPING:
Methods to be employed are similar to those detailed in Section 3.1.2. Systematic trapping of the area using a combination of Tomahawk cage traps (50 cm x 20 cm x 25 cm) and large and medium sized Elliott. Traps should be situated at 20 m intervals and baited with bread and peanut butter.

3.3.5 Predator Control

The success of the Bandicoot reintroduction programme will also be dependent upon both adequate rehabilitation programmes and suitable predator controls. The population to be reintroduced will only number up to 20 animals, which will be under stress from the translocation process and possibly moving to a habitat which may initially be sub-optimal. During the initial establishment phase the Bandicoots will be highly vulnerable to the high level of predation pressure which exists in the project area.

While it is acknowledged that the close proximity of urban areas creates difficulties with respect to the eradication of feral predators from the site, it is nevertheless considered essential for the success of the project. An appropriate feral predator control program will need to be developed in consultation with the APB and CALM. The control programme is most likely to consist of a 1080 poison baiting programme similar to that employed for the control of predators and at the recipient translocation site.

6.0 TERM & IMPLEMENTATION OF THE MANAGEMENT PLAN

6.1 Bandicoot Management Team

Implementation of the Mount Barker Albany Highway Deviation Stage 2 Bandicoot Management Plan will be carried out by a working group comprised of representatives from Main Roads Western Australia (including Albany Division), CALM (including Woodvale Research Centre, Como Wildlife Protection and Albany Regional Office), Plantagenet Shire Council and local community groups.

6.2 Term of the Management Plan

Unless superseded the term of this plan will be 3 years.

6.3 Implementation of Management Plan

The successful implementation of this Management Plan will require the cooperation and assistance of all members of the Management Team. Main Roads Western Australia will be responsible for the implementation of the Construction Phase design strategies and Post Construction Phase monitoring and habitat enhancement. The Department of Conservation and Land Management is expected to be responsible for the Pre Construction Phase translocation programme. Some external agencies may also have some involvement with the implementation of the Plan, in particular the Agriculture Protection Board.

A plan for implementation is shown in Table 2. It includes;

(a) a brief description of the strategy;

(b) a timetable for implementation;

(c) the expected outcome of the strategy.

Strategy	Prescription	Timetable	Expected Outcome
Pre-Construction Phase			
3.1.1 Induction Programme	(i) Information regarding legislated conservation status	Effective immediately. Ongoing	Promote awareness in workforce of the conservation value of project area Bandicoot population and habitats
	(ii) Synthesis of Management Plan	Ditto	Ditto
	(iii) Individual and project responsibility	Ditto	Inform workforce of responsibilities under Sections 6 and 14 of Wildlife Conservation Act.
3.1.2 Translocation	(i) Erection of isolation fencing	Maximum 4 weeks prior to commencement of construction	Inhibit Bandicoot movement to and from impact area
	(ii) Translocation site selection	Prior to translocation	Identification of suitable recipient site for establishment of translocated population
	(iii) Resident population removal	Maximum 4 weeks prior to commencement of construction, following erection of isolation fencing	Translocation of all bandicoots within impact area to recipient site
3.1.3 Predator Control	(i) Conduct feral predator baiting programme	4 weeks & 1 week prior to translocation	Significantly reduce the density of resident predators in the area of the recipient site
3.1.4 Post-Translocation Management			
	(i) Undertake post-translocation management, including feral predator control	Following release	Maximise viability of translocated population
	(ii) Undertake post-translocation monitoring	Following release	Assess success of translocation programme

TABLE 2: Implementation of Mount Barker Devitaion Stage 2 Southern Brown Bandicoot Management Plan.

Strategy	Prescription	Timetable	Expected Outcome
Construction Phase			
3.2.1 Management Structures	(i) Fauna underpasses: Two 1.2 m x 1.2 m culverts & three 300 mm diam. pipes.	Prior to reintroduction of translocated population	Allow Bandicoot access to all habitat remnants
	(ii) Exclusion fencing	Prior to reintroduction of translocated population	Prohibit Bandicoot access to road surface to reduce risk of road mortalities
	(iii) Perimeter fencing, minimum openings to be 45 cm X 17.5 cm	Implement when required	Allow Bandicoots easy & safe passage
3.2.2 Monitoring	(i) Monitor remnant population outside impact zone	During construction phase, every 6 months	Assesment of effectiveness of site management protocols
3.2.3 Operational Procedures	(i) Diurnal operations	Duration of construction phase	Limit disturbance to Bandicoot activity in adjacent non-impact area
	(ii) Clearing minimisation	Ongoing	Limit impact to adjacent Bandicoot habitat
	(iii) Dust suppression	Duration of construction phase	Limit impact to adjacent vegetation / Bandicoot habitat
	(iv) Activity restriction: Prohibit off-road driving & shooting	Duration of construction phase	Limit impact to adjacent Bandicoot population & habitat
Post-Construction Phase			
3.3.1 Rehabilitation	(i) Habitat rehabilitation & enhancement	Prior to reintroduction	Re-establish suitable vegetation / habitat in impacted areas
	(ii) Vegetate entrances to fauna underpasses	Prior to reintroduction	Provide cover which encourages Bandicoot usage of underpass

TABLE 2 cont.: Implementation of Mount Barker Devitaion Stage 2 Southern Brown Bandicoot Management Plan.

Strategy	Prescription	Timetable	Expected Outcome
Post-Construction Phase cont.			
3.3.2 Reintroduction	(i) Reintroduce translocated bandicoots back to project area	Late summer, 6 - 12 months after rehabilitation completed	
3.3.3 Population Linkage	(i) Protection of north-east corridor	Effective immediately	Agreement with landholder to protect vegetation along corridor. Maintenance of Bandicoot dispersal between populations.
3.3.4 Monitoring	(i) Undertake post-reintroduction monitoring	Following release. Ongoing for term of Management Plan	Assess success of management programme
3.3.5 Predator Control	(i) Implement predator control programme	Commence 3 months prior to reintroduction. Ongoing for term of Management Plan	Reduction in density of feral predators to maximise viability of Bandicoot population

TABLE 2 cont.: Implementation of Mount Barker Devitaion Stage 2 Southern Brown Bandicoot Management Plan.

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In addition;

1 Dr. J. A. Friend CALM Woodvale, kindly assisted with discussions regarding the development of appropriate management strategies.

APPENDIX A

Suggested Revegetation
Flora Species List

APPENDIX A: Suggested Flora Species Suitable for Revegetation

	Listed in Seed Catalogues
Taller Trees	
Casuarina obesa	√
Eucalyptus calophylla	√
Small Trees to Tall Shrubs	
Melaleuca preissiana	√
Melaleuca rhaphiophylla	√
Tall Shrubs	
Acacia extensa	√
Acacia saligna	√
Agonis juniperina	√
Kunzea recurva	√
Melaleuca cuticularis	√
Melaleuca viminea	√
Paraserianthes lophantha	√
Small shrubs (<1.5 m)	
Acacia drummondii	√
Acacia idiomorpha	
Acacia lateriticola	√
Acacia nervosa	√
Acacia pulchella	√
Acacia shuttleworthiana	
Acacia wildenowiana	√
Agonis hypericifolia	√
Allocasuarina humilis	√
Calectasia cyanea	
Caladenia flava	
Caladenia filamentosa	
Caladenia gemmata	
Caladenia huegelii	
Caladenia sericea	
Hemiandra pungens	
Conostylis aculeata	√
Conostylis setigera	√
Tall Sedge-like Plants	
Gahnia trifida	
Juncus bufonius	
Mesomelaena pseudostygia	
Mesomelaena tetragona	√
Low Sedge-like Plants	
Lepidosperma angustatum	
Lepidosperma gladiatum	
Loxocarya fasciculatis	
Grasses	
Neuarachne alopecuroidea	
Small Herb-like Plants	
Sowerbaea lasiflora	
Stylidiium brunonianum	√
Stylidium crassifolium	√
Stylidium schoenoides	√