Mining bulletin

Proposed clay excavation, Lots 23 and 51 Apple Street, Upper Swan

Pilsley Investments Pty Ltd (Prestige Brick)

Report and recommendations of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 614
March 1992

THE PURPOSE OF THIS REPORT

This report contains the Environmental Protection Authority's environmental assessment and recommendations to the Minister for the Environment on the environmental acceptability of the proposal.

Immediately following the release of the report there is a 14-day period when anyone may appeal to the Minister against the Environmental Protection Authority's recommendations.

After the appeal period, and determination of any appeals, the Minister consults with the other relevant ministers and agencies and then issues his decision about whether the proposal may or may not proceed. The Minister also announces the legally binding environmental conditions which might apply to any approval.

APPEALS

If you disagree with any of the assessment report recommendations you may appeal in writing to the Minister for the Environment outlining the environmental reasons for your concern and enclosing the appeal fee of $10.

It is important that you clearly indicate the part of the report you disagree with and the reasons for your concern so that the grounds of your appeal can be properly considered by the Minister for the Environment.

ADDRESS

Hon Minister for the Environment
18th Floor, Allendale Square
77 St George's Terrace
PERTH WA 6000

CLOSING DATE

Your appeal (with the $10 fee) must reach the Minister's office no later than 5.00 p.m. on 27 March, 1992.

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Summary and recommendations

Pilsley Investments Pty Ltd (hereafter referred to as Prestige Brick) proposes to excavate clay on Lots 23 and 51 Apple Street, Upper Swan, west of the Great Northern Highway and about 14km north of Midland.

The property, which has been cleared of native vegetation and developed for pasture, is situated about 300 metres south-west of the fenced-off Wildlife Sanctuary at Ellen Brook Nature Reserve and less than 100 metres east of the Upper Swan townsite. The proposed excavation site would be about 120 metres from planned extensions to the Wildlife Sanctuary for the Western Swamp Tortoise.

The excavation would be for clay needed at the proponent's brickworks at Midland. The projected lifetime of the excavation is 10 years, with full scale operations to be preceded by a trial mining and monitoring phase in two to three years.

The Authority has assessed the environmental impact of the proposal by way of a Consultative Environmental Review, in conjunction with other nearby clay excavation proposals which potentially impact on the habitat of the extremely rare and endangered Western Swamp Tortoise (*Pseudemydura umbrina*). The clay excavation proposals are being assessed concurrently by the Environmental Protection Authority, and have been described in a common Consultative Environmental Review. The Consultative Environmental Review was open for public review in October, 1990 and the Authority received ten submissions on the proposals. The proponents held a public open day near the site in December, 1990, at which time further comments were received from some members of the local community.

Ellen Brook Nature Reserve has been especially created by the State Government to conserve the tortoise. About 20 to 30 short necked tortoises live in the fenced-off Wildlife Sanctuary within the reserve, and they are thought to be the only population of naturally occurring short necked tortoises in the world. A similar number of tortoises are the subject of a special breeding programme at the Perth Zoo. The population of short necked tortoises at the nearby Twin Swamps Reserve has declined from more than 100 animals in 1965, to virtual extinction by 1985.

The Authority has assessed the potential environmental impacts of the proposal, both as described in the Consultative Environmental Review and in the proponent's responses to issues raised in public submissions.

Major issues

The environmental impact of the clay excavations on all of the tortoise habitat at Ellen Brook Nature Reserve, specifically the area outside the tortoise swamp, required additional details.

In response to submissions (Appendix 2), Prestige Brick has acknowledged this and provided further information necessary to enable the Authority to adequately assess the impact of the clay excavation over the whole of the tortoise habitat area.

Runoff water from the clay excavation could impact upon the habitat of the rare and endangered short necked tortoise.

The Environmental Protection Authority believes that drainage impacts on the tortoise habitat can be managed by the proponent to the benefit of the tortoise, as a result of the following:

- Prestige Brick has stated that, no silt-laden run-off water occurring as a result of the excavation process would enter the road drainage system or the Ellen Brook Nature Reserve over the life of the excavation. This would be achieved by constructing earth bunds which would divert storm water into dams within the site and deflect clean run-off water away from areas disturbed by mining and road transport; and

- Prestige Brick has given a commitment to share, on an equitable basis with the other clay excavation proponents, the costs of diverting or modifying the existing drainage system outside Lots 23 and 51 leading to the Ellen Brook Nature Reserve from the excavation areas, provided that it is to an agreed and pre-arranged specification and is solely for the purposes of protecting the reserve;

The proposed drainage modifications have been further strengthened by the Authority's Recommendation 2 in this report for the proponent to prepare and implement a drainage management plan in consultation with appropriate government authorities and to the satisfaction of the Authority, which would enable Prestige Brick to:

- **detain all drainage waters on site during the life of the clay excavation operation, so that they do not enter the Wildlife Sanctuary at Ellen Brook Nature Reserve nor create an unacceptable impact elsewhere;**
- **divert all drainage waters from the south western side of Great Northern Highway from entering the Wildlife Sanctuary at Ellen Brook Nature Reserve within two years of approval of the proposal, and in so doing, ensure it does not create an unacceptable impact elsewhere.**
- **monitor drainage to detect, report on, and manage any drainage impacts on the Wildlife Sanctuary for the Western Swamp Tortoise at Ellen Brook Nature Reserve; and**
- **remedy any unacceptable drainage impacts on the Wildlife Sanctuary caused by this proposal;**

These requirements are in line with expert submissions which indicate that the tortoise would benefit by the elimination of external drainage waters into the reserve, as water requirements for the tortoise habitat can be met by rainfall.

The clay excavation proposals could lead to a more rapid drying of the winter-wet swamp habitat that is essential for the short necked tortoises to breed in, by draining perched groundwater from the area.

The proponent has presented substantial hydrological data to show that water levels in the main tortoise swamp habitat are predominantly dependent on rainfall, rather than surface flow or a hydraulic connection with other groundwater from outside the area.

The proponent acknowledges that there may be an element of uncertainty with perched groundwater and depressions of surface water in the reserve, particularly when quarrying is close to the boundary of the Wildlife Sanctuary.

The Environmental Protection Authority concludes that, from investigations undertaken and advice given, the proposal by Prestige Brick is most unlikely to impact on the groundwater of the tortoise habitat, provided that the following stringent controls and management procedures are adopted:

- **preparation of a staged excavation plan as part of an Environmental Management Programme (see Recommendation 3), with the first excavation to commence at the point furthermost point from the tortoise habitat; and**
- **preparation of an approved groundwater management and protection plan, as part of the Environmental Management Programme (see Recommendation 3), with the objective of delineating and monitoring perched groundwater levels and pit seepages, and developing suitable management practices to remedy any potentially unacceptable impacts.**

As the proposed excavation would come no closer than 300 metres to the existing Wildlife Sanctuary and 120 metres to the planned extensions, a recommendation specifying the 100 metre no quarrying buffer is not applicable to this proposal (but has been applied to other clay excavation proposals that do).

The three proponents for the clay excavation proposals in the locality could assist in the provision of additional habitat area for the short necked tortoise, particularly as many of their excavations are proposed in old habitat areas which would otherwise be difficult and expensive to rehabilitate for the benefit of the tortoise.

Improvements to the habitat area by mechanical deepening of some areas to provide sufficiently deep swamps for the tortoise to swim and eat in, providing suitable aestivating refuges, and rehabilitating the native vegetation are being investigated. Parts of the current reserve that do not hold water for extended periods each winter may also be deepened and rehabilitated. The fox-proof fence also would need to be extended.

In response to issues raised in submissions, Prestige Brick has indicated that a D6 bulldozer would be available for one week during the winter months to assist the Department of Conservation and Land Management in potential recontouring of the nature reserve extensions, or in existing areas. Another bulldozer may be available at other times during the year, depending on the proponent's schedule.

The Environmental Protection Authority encourages other companies and individuals who may wish to participate in the recovery and survival of this extremely endangered species of wildlife to liaise with the Department of Conservation and Land Management.

Clay excavations could affect groundwater supplies, particularly if dewatering of the superficial aquifer occurred or there was a major fuel spillage inside a pit.

Prestige Brick has stated that dewatering of the groundwater would not be conducted. The company is committed to not excavating below the permanent water table and, in the unlikely event that the excavation did reach the water table, the area would be backfilled to maintain at least one metre of cover.

Water for dust suppression would be obtained from local stand pipes or from the company's other excavation sites and trucked to the Apple Street site. As the operation proceeded, dams formed within the site would be used to collect run-off and rainfall to provide water for dust suppression. The only equipment to be refuelled on site would be the excavation machinery (hydraulic excavator and bulldozer), which would be done by a visiting tanker. Trucks would be refuelled elsewhere. If a substantial spillage occurred, the proponent has stated that the contaminated sediments would be excavated and removed to an approved disposal area.

The Environmental Protection Authority has recommended that Prestige Brick should prepare a groundwater management and protection plan as part of the Environmental Management Programme, in consultation with the Water Authority of Western Australia. The plan should outline procedures to be used by the proponent to protect the quality and quantity of groundwater from the impacts of the clay excavation and earth moving machinery (see Recommendation 3).

Concerns were expressed that, after the excavations cease, the resultant end use, such as urban residential, may indirectly lead to extinction of the short necked tortoise.

The Environmental Protection Authority previously made recommendations in 1983 that ways and means of providing a protective buffer zone around Ellen Brook Nature Reserve be sought through planning.

The proponent has made the following commitments:

- **to consult with planning authorities to facilitate the derivation of a long term strategic plan for the Upper Swan locality which recognises and accepts the interim priority land use of clay extraction; and**
- **to establish an inter-company liaison mechanism to enable a co-ordinated approach between all three proponents with respect to addressing potential cumulative operational effects and overall rehabilitation goals.**

These commitments have been further strengthened by:

- **the Authority's recommendation in this report for the joint preparation of a regional development, drainage and rehabilitation plan for the locality by all the clay excavation proponents, in consultation with government authorities, and within two years of approval (Recommendation 4).**

The proposed clay excavations could have the potential to impact on the comfort of local residents through noise, dust and visual impacts, unless managed.

Prestige Brick acknowledges the potential for noise, dust and visual impacts on nearby residents, particularly dust from prevailing north-easterly winds during summer. The proponent intends to implement a range of management practices which have been developed at the nearby Railway Parade excavation to minimise these impacts. These include sequential rehabilitation, bunding with overburden stockpiles and screening with vegetation.

To reduce the impact of the proposal on the local community, the proponent would liaise with Midland Brick to minimise the period when excavation programmes occur concurrently at the two Apple Street sites. The permanent access road would be positioned 30 metres from the boundary between Lots 22 and 23, to ensure that is is as far as possible from the Upper Swan townsite residences but also a safe distance from the entrance to the heavy haulage assembly area.

Prestige Brick has given an undertaking (Appendix 2) to conduct the excavation programmes at the site, to the greatest extent possible, during the months of November, December and April, and between 7.00am to 5.30pm, Monday to Friday.

The Environmental Protection Authority has recommended that the proponent should prepare, implement and regularly review noise, dust and visual impact management plans as part of the Environmental Management Programme, in consultation with the Shire of Swan and to the satisfaction of the Environmental Protection Authority. The timing of the preparation and review of the Environmental Management Programme and the levels of emissions of noise and dust off-site should be to the satisfaction of the Environmental Protection Authority. (see Recommendation 3). The plans should document the company's procedure for handling complaints, including the person responsible within the company for receiving and recording the complaints, for following them up and, if appropriate, for rectifying the cause of the complaint.

Unless well managed, the clay pits could become a source of mosquito nuisance or disease to the public, and may represent a danger to young children in the area.

To exclude public (especially children) from the site, the company has stated that the present fence would be repaired and sign-posted at frequent intervals with "danger - open pit" signs. If necessary, a low voltage electric fence would be placed inside the boundary to discourage people climbing over. Fluorescent ribbon or a supplementary warning fence would be placed around the open pit in areas where the sides were left relatively steep.

In regard to provision of alternative recreational areas to encourage local children away from the quarry, Prestige Brick is prepared to consider provision of assistance with the cost of materials and/or machine time (on a one third basis with Midland Brick and Metro Brick) for recreational areas provided by the Council, if this was considered of value in keeping children away from the site.

The Environmental Protection Authority considers that the proponent should liaise with the Shire of Swan and the Department of Conservation and Land Management to ensure that community health and safety issues are catered for in the management and rehabilitation of the clay excavations, and addressed in the Environmental Management Programme (Recommendation 3).

The Swan Valley area is known to have sites of major Aboriginal significance in both archaeological and ethnographic terms.

The Authority advises that the proponent should discuss with the Department of Aboriginal Sites of the Western Australian Museum appropriate ways of complying with the provisions of the Aboriginal Heritage Act 1972-80.

The Environmental Protection Authority recognises the very rare status of the short necked tortoise, and the requirement to protect its habitat. Accordingly, the Authority has set a very high onus of proof on this and other nearby quarrying proposals, to demonstrate that there will be no adverse impacts on the tortoises and their habitat. It is only after detailed study that the Authority considers that the proposal would not have any adverse impacts and therefore could proceed.

Based on its assessment of the proposal and additional information provided by the proponent in response to questions raised as a result of the assessment process, the Authority makes the following conclusions and recommendations:

Recommendation 1

The Environmental Protection Authority concludes that the proposal by Pilsley Investments Pty Ltd (Prestige Brick) to quarry clay on Lots 23 and 51 Apple Street, Upper Swan, as outlined in the Consultative Environmental Review and subsequently modified during the process of interaction between the proponent, the Environmental Protection Authority, government agencies, and those members of the public who were consulted, is environmentally acceptable.

In reaching this conclusion, the Authority identified the main issues requiring detailed consideration as:

- **protection of the habitat of the endangered Western Swamp Tortoise, *Pseudemydura umbrina*, at Ellen Brook Nature Reserve;**
- **management of drainage waters;**

- **protection of groundwater resources;**
- **rehabilitation of the quarried area;**
- **noise, dust and visual impacts from the quarrying operations; and**
- **public safety and management of mosquito breeding.**

The Environmental Protection Authority considers that these and other issues, such as planning considerations, have been addressed and are manageable, either by changes to the proposal by the proponent during assessment, the environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations in this report.

Accordingly, the Environmental Protection Authority recommends that the proposal could proceed, subject to the proponent's commitments (Appendix 1) and the Environmental Protection Authority's recommendations in this report. Any approval for the proposal should be for a maximum of 10 years from the time of commencement of quarrying activities.

A drainage management plan should be prepared to protect the habitat of the Western Swamp Tortoise at Ellen Brook Nature Reserve from external surface water drainage impacts affected by this proposal.

Recommendation 2

The Environmental Protection Authority recommends that, before the start of quarrying activities and in consultation with the appropriate government departments, including the Main Roads Department, the Department of Conservation and Land Management, the Swan River Trust and the Shire of Swan, Prestige Brick should prepare a drainage management plan as part of an Environmental Management Programme to the satisfaction of the Minister for the Environment on advice of the Environmental Protection Authority. This plan should enable the proponent to:

- **detain all drainage waters on site during the life of the clay excavation operation, so that they do not enter the Wildlife Sanctuary at Ellen Brook Nature Reserve nor create an unacceptable impact elsewhere;**
- **divert all drainage waters from the south western side of Great Northern Highway from entering the Wildlife Sanctuary at Ellen Brook Nature Reserve within two years of approval of the proposal, and in so doing, ensure it does not create an unacceptable impact elsewhere.**
- **monitor drainage to detect, report on, and manage any drainage impacts on the Wildlife Sanctuary for the Western Swamp Tortoise at Ellen Brook Nature Reserve; and**
- **remedy any unacceptable drainage impacts on the Wildlife Sanctuary caused by this proposal.**

The drainage management plan should be implemented and periodically reviewed to the satisfaction of the Environmental Protection Authority.

A comprehensive environmental management programme should be prepared to enable the proponent to detect, report on and manage any impacts on the environment, particularly the habitat of the Western Swamp Tortoise at Ellen Brook Nature Reserve.

Recommendation 3

The Environmental Protection Authority recommends that, before the start of quarrying activities and following consultation with the appropriate

government authorities, Prestige Brick should prepare an Environmental Management Programme to the satisfaction of the Minister for the Environment on advice of the Environmental Protection Authority. This programme should enable the proponent to detect, report on, and manage any impacts, and remedy any unacceptable impacts on the environment by this proposal, and should be implemented and periodically reviewed to the satisfaction of the Environmental Protection Authority. Details to be prepared as part of the Environmental Management Programme should include, but not necessarily be limited to:

- **a staged quarrying strategy;**
- **drainage management (see Recommendation 2);**
- **groundwater management and protection;**
- **progressive rehabilitation of the site;**
- **procedures to minimise noise, dust and visual impacts associated with the quarrying and transportation operations;**
- **public safety and mosquito breeding;**
- **periodic reporting of monitoring results, and**
- **consequential changes to project management to remedy unacceptable environmental impacts.**

The timing of the preparation and review of the Environmental Management Programme and the levels of emissions of noise and dust off-site should be to the satisfaction of the Environmental Protection Authority.

A regional development, drainage and rehabilitation strategy for the Upper Swan locality should be formulated to ensure that future developments in the area are compatible and are carried out in an environmentally sensitive manner, while at the same time the interests of current stakeholders in the area are looked after.

Recommendation 4

The Environmental Protection Authority recommends that Prestige Brick should contribute, to the satisfaction of the Environmental Protection Authority, to the preparation of a regional development, drainage and rehabilitation strategy for the Upper Swan locality, in consultation with the appropriate government departments, including the Main Roads Department, the Department of Planning and Urban Development, the Department of Conservation and Land Management, the Shire of Swan, and other current and known proposed clay producers in the area, such that a plan can be prepared within two years of approval of this proposal.

1. Introduction and background

Pilsley Investments Pty Ltd proposes to excavate clay on Lots 23 and 51 Apple Street, Upper Swan, west of the Great Northern Highway and about 14km north of Midland. Lots 23 and 51 are situated less than 100 metres north-east of the Upper Swan townsite, about 300 metres south-west of the fenced-off Wildlife Sanctuary at Ellen Brook Nature Reserve and about 150 metres from planned extensions to the Wildlife Sanctuary (Figure 1).

Pilsley Investments Pty Ltd, the proponent for this proposal, is the owner of Lots 23 and 51 and also the corporate owner of Prestige Brick. Prestige Brick operates the brickworks in Military Road, Midland where the clay will be used. For the purposes of this report the proponent for this proposal is hereafter referred to as Prestige Brick.

An Application for Approval to Commence Development on Lots 23 and 51 by Pilsley Investments Pty Ltd (Prestige Brick) was referred to the Environmental Protection Authority by the Shire of Swan in January 1988. The Authority determined that a formal level of assessment was necessary, to allow the Minister for the Environment to set environmental conditions on the project. In addition, four other proposals for the extraction of clay in the immediate vicinity of Ellen Brook Nature Reserve were also referred to the Authority.

In 1989 the Authority advised the proponents of all clay excavation proposals in the vicinity of the habitat of the rare and endangered short necked tortoise at Ellen Brook Nature Reserve that, prior to assessing their individual proposals, a study of the water relationships in the area would need to be undertaken. This work has subsequently been carried out and reported in a joint Consultative Environmental Review (CER) document, which was released for public review in October, 1990. Prestige Brick had previously submitted reports on surface water and groundwater impacts from their proposal on the Nature Reserve in 1989. Prestige Brick provided more information on the proposal in October 1991, in response to issues raised by the Authority as a result of the CER process (Appendix 2). Following an on-site meeting in February 1992, the company provided more details to clarify drainage and rehabilitation aspects of the operation (Appendix 3).

2. The Western Swamp Tortoise

The following section is a brief summary on the Western Swamp Tortoise and factors that have led to its endangered status. Much of the information is based on submissions by the Zoology Department of the University of Western Australia and the Department of Conservation and Land Management (Wildlife Management Programme No. 6), whose contributions are gratefully acknowledged. The reader is referred to Appendix 4, which provides a useful bibliography on some recent texts.

The Western Swamp Tortoise (*Pseudemydura umbrina*) which is more commonly known as the short necked tortoise, is generally recognised as the most endangered species of vertebrate animal in Australia. Ellen Brook Nature Reserve was declared in 1962, in order to protect one of the two known remaining populations of such tortoises in the world from extinction. The tortoise is only known to exist in the wild today at Ellen Brook Nature Reserve and the Twin Swamps Nature Reserve, 4km to the north.

The Western Swamp Tortoise is easily distinguishable from other fresh water tortoises in Western Australia by its short neck and the fact that it inhabits ephemeral (winter-only) swamps; it does not seem to occur in permanent rivers, creeks, lakes or swamps. The short necked tortoise aestivates (sleeps) in naturally occurring tunnels in the clay gilgai soils during summer and autumn. *Pseudemydura umbrina* is the smallest Australian chelid tortoise. It is the only species in which the female is smaller than the male. Maximum age attained is not known, but is at least 50 years. *Pseudemydura umbrina* is a relict species, apparently little changed since the Miocene (12 to 25 million years ago). The species is so different from other members of its family, Chelidae, that a separate sub-family, the Pseudemydurinae, has been proposed for it.

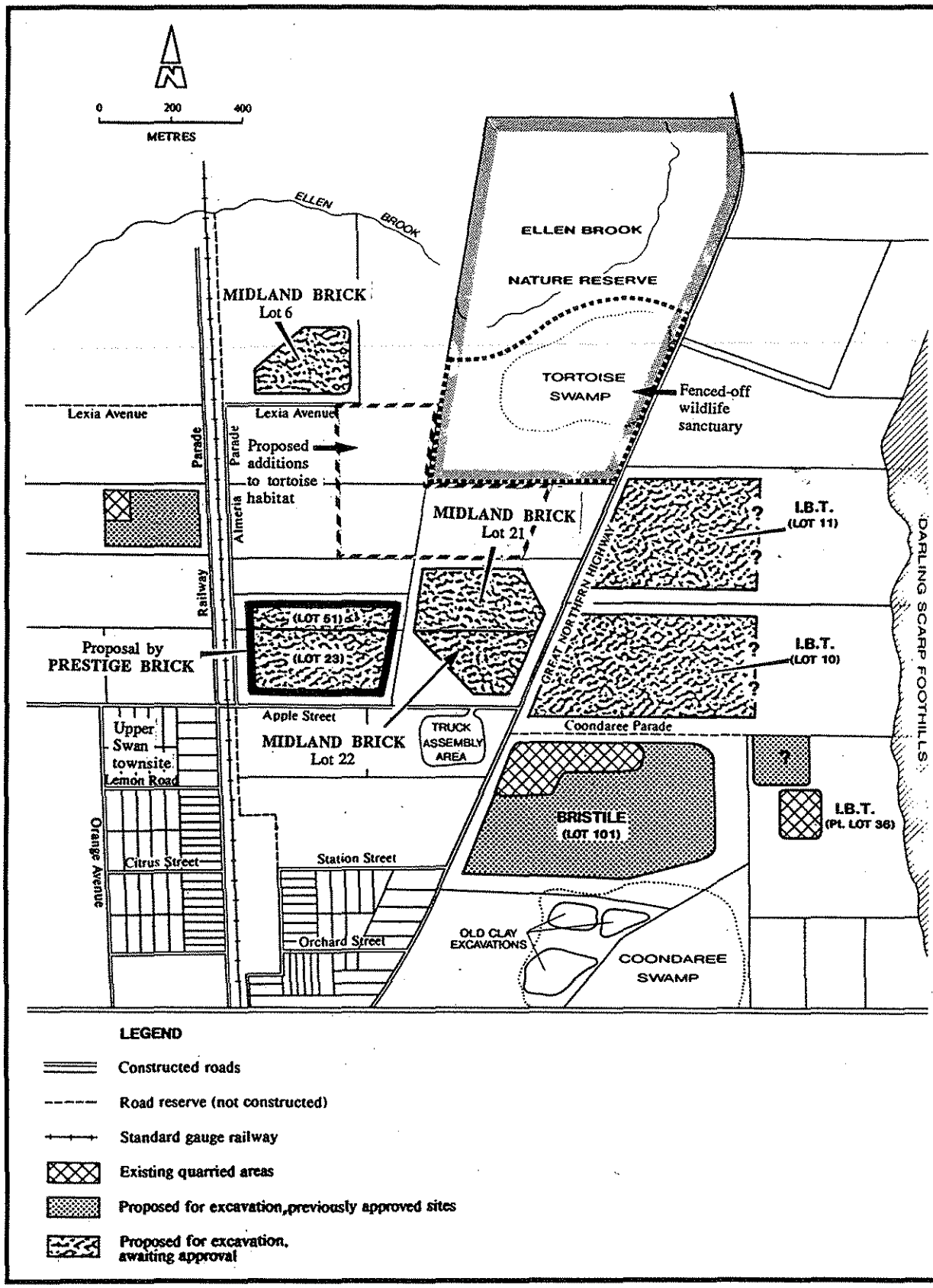


Figure 1. Location of proposal in relation to the Wildlife Sanctuary for the Western Swamp Tortoise at Ellen Brook Nature Reserve and other current and proposed clay excavation sites.

The population of short necked tortoises at Twin Swamps Reserve declined from over 100 animals in 1965, to virtual extinction by 1985. A specially fenced-off, fox-proof area within the nearby Ellen Brook Nature Reserve, constructed in 1990, now contains the only known, naturally occurring population of such short necked tortoises in the world, consisting of about 25 to 30 animals, including about eight adult females. A captive population of about 49 tortoises is held in the Perth Zoo as part of a special breeding programme.

The endangered status of the short necked tortoise is due to a combination of factors, including:

- a small geographic range, with most of the original habitat having been lost to agricultural, urban and industrial uses since European settlement;
- the protected habitat being in only two small nature reserves that are of marginal quality;
- a dependence on:
  - (i) an unusual habitat of winter-wet ephemeral swamps, with suitable aestivating (summer "hibernating") refuges nearby;
  - (ii) a wholly carnivorous diet of live food which is only available for a short time each year
- low fecundity (fertility) and slow growth rates;
- below average rainfall in the Perth area over the last 30 years, combined with a marginal habitat and prospects for drier climatic conditions in the future; and
- presence of exotic predators, particularly the European fox.

A Management Programme for the Western Swamp Tortoise was launched in November, 1990. The aim of the programme for the next 10 years is to create two viable populations in the wild. This will be achieved with a number of different strategies, including:

- management of the tortoise population (monitoring and a captive breeding programme);
- management of the tortoise reserves to maintain and improve the habitat (water availability and quality, predation, emigration);
- identification, acquisition and rehabilitation or construction of additional habitat (Twin Swamps and Ellen Brook Nature Reserves);
- recognition of the importance of the reserves at all levels of government when development proposals are considered for the area; and
- public support, including an educational programme.

In its report titled "Conservation Reserves for Western Australia - the Darling System - System 6" (commonly referred to as the "Red Book") in 1983, the Environmental Protection Authority recommended that ways and means of providing protective buffer areas around both Ellen Brook and Twin Swamps Nature Reserves (M17) be sought through planning procedures.

For the purposes of this report, the area which has been recently fenced off by the Department of Conservation and Land Management within the south-western sector of the Ellen Brook Nature Reserve for the purposes of protecting the Western Swamp Tortoise, is referred to as the Wildlife Sanctuary.

3. The proposal

3.1 Need for the proposal

The Swan Valley contains deposits of high quality plastic clays used in the manufacture of bricks, pavers and roof tiles. Manufacturing plants have traditionally been located in the Swan Valley, both for ease of access to raw materials and minimisation of transport costs.

The clays of the Swan Valley have specific properties of excellent fired colour, high fired strength, high plasticity and good green binding strength. The material represents the basic

bonding agent for all brick and tile products and comprises a minimum of 15% of raw material components.

Expansion of urban and special rural development has effectively sterilised large areas of land for clay excavation. A number of people who have chosen to lead a semi-rural lifestyle close to the city can be expected to be opposed to clay extraction proposals. As a consequence, brick and tile manufacturers have been forced to seek more of their raw materials further away from their plants.

About 70% of new dwellings in the Perth area use brick and tile construction, compared with about 40% in the Eastern States. The State Planning Commission estimated in 1987 that there would be a demand for an additional 171,000 houses by 2001. This demand for housing can be expected to be reflected in the rate of clay extraction.

The proposed clay excavations around Ellen Brook Nature Reserve are within areas identified as important resource areas in the Department of Planning and Urban Development's Basic Raw Materials Policy. More recently the Department recognised the need to protect the high quality clay resources north and east of the Upper Swan townsite for brick and tile manufacture in its public discussion paper -"The North-east corridor - planning issues and growth options", released in November, 1991.

3.2 Project description

The proposed excavation would be for clay needed at the proponent's brickworks at Midland. The projected lifetime of the excavation is ten years, although the proponent does not plan to commence operations at Lots 23 and 51 for another two to three years, as it still excavating clay at a nearby excavation off Railway Parade. Full scale operations would be preceded by a small trial mining programme, to gauge the hydrological impact of the operation on the nearby Wildlife Sanctuary.

Preliminary drilling by the proponent has indicated that a deposit of clay which is suitable for brickmaking purposes exists on the property. The clay could extend down to a depth of 12 metres and is overlain by three to four metres of overburden. The precise boundaries of the clay excavation would depend on (yet to be implemented) closer-spaced drilling and sample testing. Prestige Brick are committed to not excavating below the water table.

In order to minimise the area disturbed at any one time, the proponent intends to quarry the clay in four stages, with each stage being rehabilitated as soon as practical after being filled in. It was initially proposed to completely backfill the excavation to the original surface level with suitable fill, such as building rubble (reject bricks and clay from the brickworks) followed by overburden and topsoil. However, in their response to submissions, Prestige Brick subsequently indicated that if it was more desirable to leave a lake or dam, then this would be the preferred option and included in the rehabilitation programme.

More recently (Appendix 3), the proponent indicated that the end-use of the site had been reassessed, and has advised the Authority that the small amenity lakes which are considered more practical and aesthetically pleasing than the land fill option, would be left as each quadrant is mined, and may be formed into one long lake along the northern boundary of Lot 51 at a later stage.

The proponent is committed to progressive rehabilitation of the site. Prestige Brick indicates that topsoil would be replaced on mined areas as soon as practical, and the area seeded with sub-clover and fertilised to reinstate the ground for pastural purposes.

Immediate visual screening and noise buffering would be achieved by the overburden stockpiles. These stockpiles would be formed into bunds around the disturbed ground of each excavation cell and along the property boundaries and hydro-mulched for grass cover. The same bunds would be used to deflect clean runoff water from the area and contain contaminated

water within the site. To further reduce visual impacts, Prestige Brick proposes to plant up to 180 native trees around the perimeter of the property as soon as approval is given.

The proponent has given an undertaking to conduct the excavation programmes at the site, to the greatest extent possible, during the months of November, December and April, and within the hours of 7.00am to 5.30pm, Monday to Friday. Between 60 and 100 truck movements are expected over each 6 week annual excavation programme. Trucks would access the site from Apple Street and travel to the Midland brickworks via Great Northern Highway (see Figure 1 of Appendix 2).

4. Existing environment

Lots 23 and 51, which are located at the corner of Apple Street and Almeria Parade, have been cleared of native vegetation and developed for pasture. The area is flat and the clay soils are poorly drained.

The site is situated less than 100 metres north-east of the Upper Swan townsite, with 40 residences within 500 metres (Figure 1). The proposed excavation would be about 300 metres south-west of the fenced-off Wildlife Sanctuary for the Western Swamp Tortoise at Ellen Brook Nature Reserve and could extend to 120 metres from planned extensions to the Wildlife Sanctuary.

Ellen Brook Nature Reserve (A27620) is an A Class reserve vested in the National Parks and Nature Conservation Authority and managed by the Department of Conservation and Land Management. Apart from its function in providing a natural habitat for the last remaining population of Western Swamp Tortoises, the reserve has high conservation value because it is particularly rich in aquatic plants and contains a number of rare plants and a variety of invertebrates and fish. Depressions within the fenced-off wildlife area fill up with water in winter and spring. These depressions carry shrubland of robin redbreast bush, sedges and aquatic species including *Chara australis* and *Hydrocotyle lemnoides*. The higher ground between the depressions carries shrubs including *Acacia salinga,* swishbush and stinkwood, and annuals such as sundews *Drosera gigantea* and *Neurachne alopecuroides* and at least fourteen species of orchids.

5. Public consultation

The proponent prepared a Consultative Environmental Review document which was released for public review in October, 1990. Seven Government submissions and three private submissions were received by the Authority. A list of those who made written submissions is given in Appendix 5.

The clay excavation proposal was amongst about 70 proposals that were selected for expedited assessment at this time. However, due to the complex nature of the clay excavation proposals, the Authority determined that its assessment of the issues was not amenable to the expedited process, and the proposals were removed from the "expedited list".

An open day was held near the site in December, 1990, which was attended by approximately 25 local residents and representatives from the Shire of Swan, the three clay excavation proponents, the Social Impact Unit and the Environmental Protection Authority. Issues of noise, dust, visual impacts and public safety were discussed.

A more detailed submission was received from the Department of Planning and Urban Development in July, 1991 in relation to regional planning issues.

6. Environmental impacts and management

6.1 Definition of the habitat area of the short necked tortoise

In attempting to address the impact of the clay excavation proposal on the short necked tortoise, the CER was deficient in fully defining the habitat area used by the tortoise. It was understood by the proponent at the time of preparing the CER that the swamp was the principal habitat area which required protection.

The swamp covers only about 30% of the area which the Zoology Department of the University of Western Australia and the Department of Conservation and Land Management now regard as the important habitat area of the short necked tortoise. The actual area used by the tortoise includes all of the nature reserve south and south-east of Ellen Brook, plus the areas of semi-natural vegetation on private property to the south and west of the nature reserve. Although most of the tortoises live in the swamp area, 13% of all tortoises found between 1988 and 1990 were outside the swamp and in or south of the natural drainage channel which passes through the fenced-off area, and south of the swamp.

The proponent has recognised this deficiency in the CER documentation, and has provided further information to the Authority in its response to issues raised in submissions (Appendix 2).

6.2 Impact of surface drainage waters on tortoise habitat

The main factors identified as likely to impact on the tortoise habitat are the quality and quantity of the water in which the tortoises swim and eat.

The proponent has investigated the potential sources of water coming into the swamp. Substantial evidence is presented in the CER, including survey data on ground levels, surface water flow directions, and water qualities (chemical and suspended solids content), to suggest direct rainfall is the main contributor to the water coming into the main swamp habitat area, rather than surface water flowing into the area from outside the reserve.

A natural drainage channel runs through the southern end of the Wildlife Sanctuary and carries runoff waters from Great Northern Highway and farmland to the south, west and east into the reserve (Figure 2). This situation represents a potential risk to the health of the short necked tortoises in the Wildlife Sanctuary and an interference to their movements. Nutrients washed into the reserve could encourage the growth of exotic species over native plants, and may lead to eutrophication of small pools of water when the tortoises are actively feeding in spring. A major truck parking area is located within the catchment of the reserve, at the corner of the highway and Apple Street, and a spillage of petroleum products or other harmful materials could have disastrous consequences for the tortoise. Surface waters emanating from any ground disturbance, such as the proposed clay excavations in the area, could lead to a further deterioration in the quality of drainage water into the reserve, and possibly siltation of the water course.

In their submission to the Authority and in further discussions, both the Zoology Department of the University of Western Australia and the Department of Conservation and Land Management have advised that the tortoise would benefit by the elimination of external drainage waters into the reserve. Water requirements for the reserve would be met by rainfall.

The topography in the area is very flat, with surface drainage waters from Lots 23 and 51 flowing into the Wildlife Sanctuary in two ways. During intense rainfall periods, surface flow can be northwards and overland, eventually running into a tributary of the main drainage channel in the Wildlife Sanctuary. Water can also flow into drains along Almeria Parade and Apple Street, which intersect shallow subsurface seepage, and flow east towards Great Northern Highway. The drain along Great Northern Highway presently runs into the natural drainage channel of the Wildlife Sanctuary and then into Ellen Brook.

To ensure that discharged pit water and run-off water from Lots 23 and 51 do not enter the existing and proposed tortoise habitat areas, Prestige Brick propose to institute the following hierarchy of water handling options:

- installation of a simple bund and/or drain, with associated internal drainage system, to direct all site run-off from disturbed areas to the open pit;
- utilisation of pit water for dust suppression purposes; and
- discharge of pit water, if required prior to additional excavation, in the form of low volume sheet run-off to adjacent land for evaporation.

In its most recent response to the Authority (Appendix 3), Prestige Brick has stated that no silt-laden run-off water occurring as a result of the excavation process would enter the road drainage system or the Ellen Brook Nature Reserve over the life of the excavation. This would be achieved by constructing earth bunds which would divert storm water into dams within the site and deflect clean run-off water away from areas disturbed by mining and road transport.

In regard to diverting regional surface drainage from the south west side of Great Northern Highway away from the Wildlife Sanctuary, the favoured option in initial discussions with the other clay excavation proponents was to reverse the slope of the highway culvert so that drainage flowed eastward under the highway. Drainage waters from both sides of the highway could then be directed northwards, before linking up with another west-flowing stream which carries water under the highway and through the Nature Reserve, but outside the fenced-off Wildlife Sanctuary.

In recent discussions between the Authority and the Department of Conservation and Land Management, another alternative drainage diversion is being considered, which would involve directing drainage further north along the western side of the highway. Although this option could involve the use of some of the Nature Reserve land, the drain and suitable bunding could result in better protection of the tortoise habitat from external drainage impacts, particularly any spillages in the immediate vicinity of the Wildlife Sanctuary. Possible arrangements for the modified drainage emanating from the proposed clay excavations in the area around the Wildlife Sanctuary are shown in Figure 3, but are subject to further discussion with affected parties (refer to section 6.6 and Recommendation 2).

Prestige Brick has given a commitment to share, on an equitable basis with the other clay excavation proponents, the costs of diverting or modifying the existing drainage system outside Lots 23 and 51 leading to the Ellen Brook Nature Reserve from the excavation areas, provided that it is to an agreed and pre-arranged specification and is solely for the purposes of protecting the reserve.

The Environmental Protection Authority believes that all clay excavation proponents in the vicinity of the Ellen Brook Nature Reserve should carry out appropriate modifications to the drainage systems with which their proposals interact, to ensure that the habitat of the Western Swamp Tortoise is protected. The Authority considers that Prestige Brick's site drainage modifications are generally consistent with the objectives of protecting the habitat of the tortoise. Although the regional drainage works need to be given more consideration, they should be carried out in a reasonable time frame, so that the work meshes with the preparation of new habitat areas planned by the Department of Conservation and Land Management on the reserve and any proposed extensions. The Authority believes this work should be carried out within two years of approval of the proposal and in consultation with the Department of Conservation and Land Management, the Main Roads Department, the Swan River Trust, the Shire of Swan and other proposed and existing clay producers in the area (see Recommendations 2 and 4). The Authority believes that the drainage management plan should enable the company to:

- detain all drainage waters on site during the life of the clay excavation operation, so that they do not enter the Wildlife Sanctuary at Ellen Brook Nature Reserve nor create an unacceptable impact elsewhere;

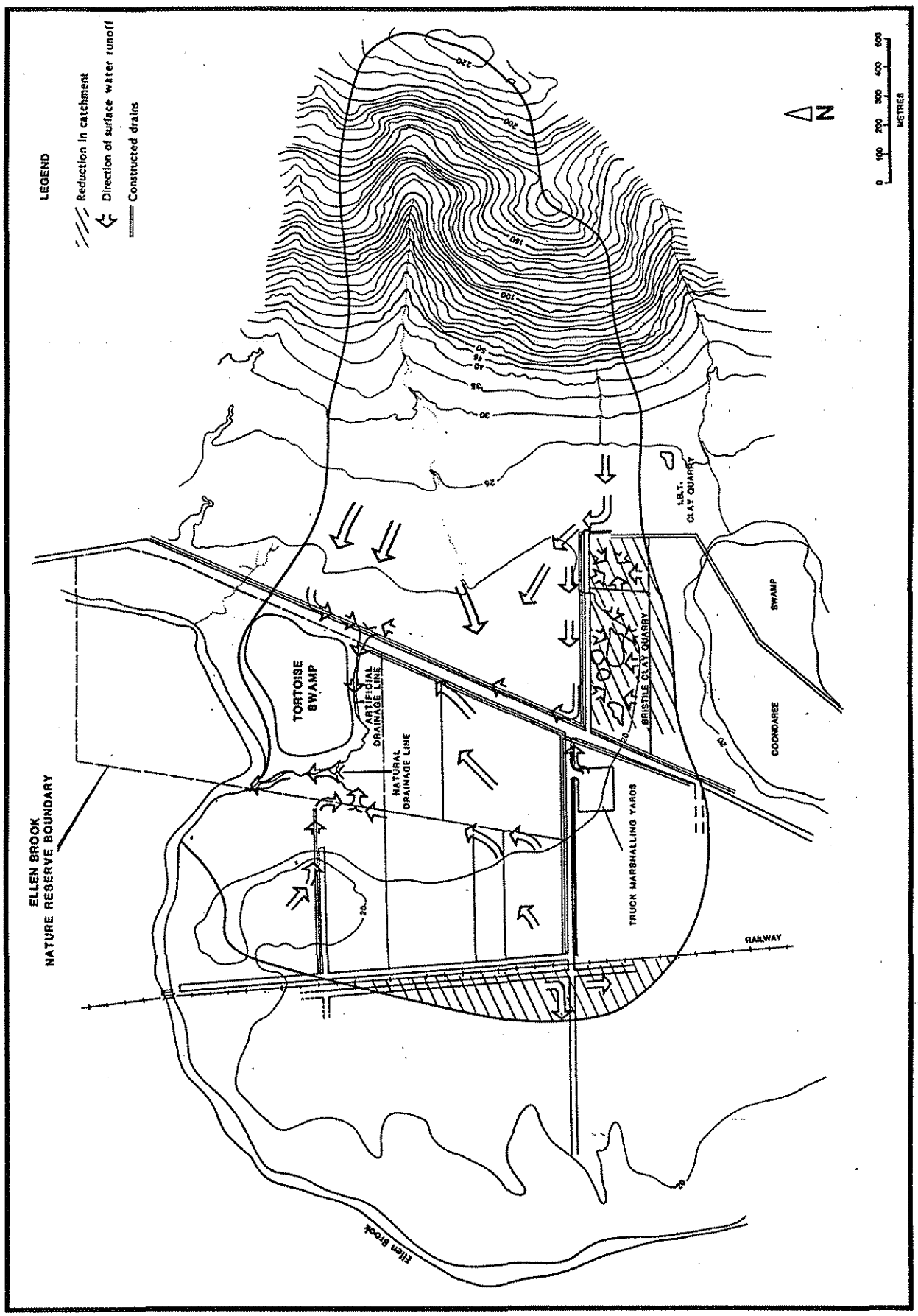
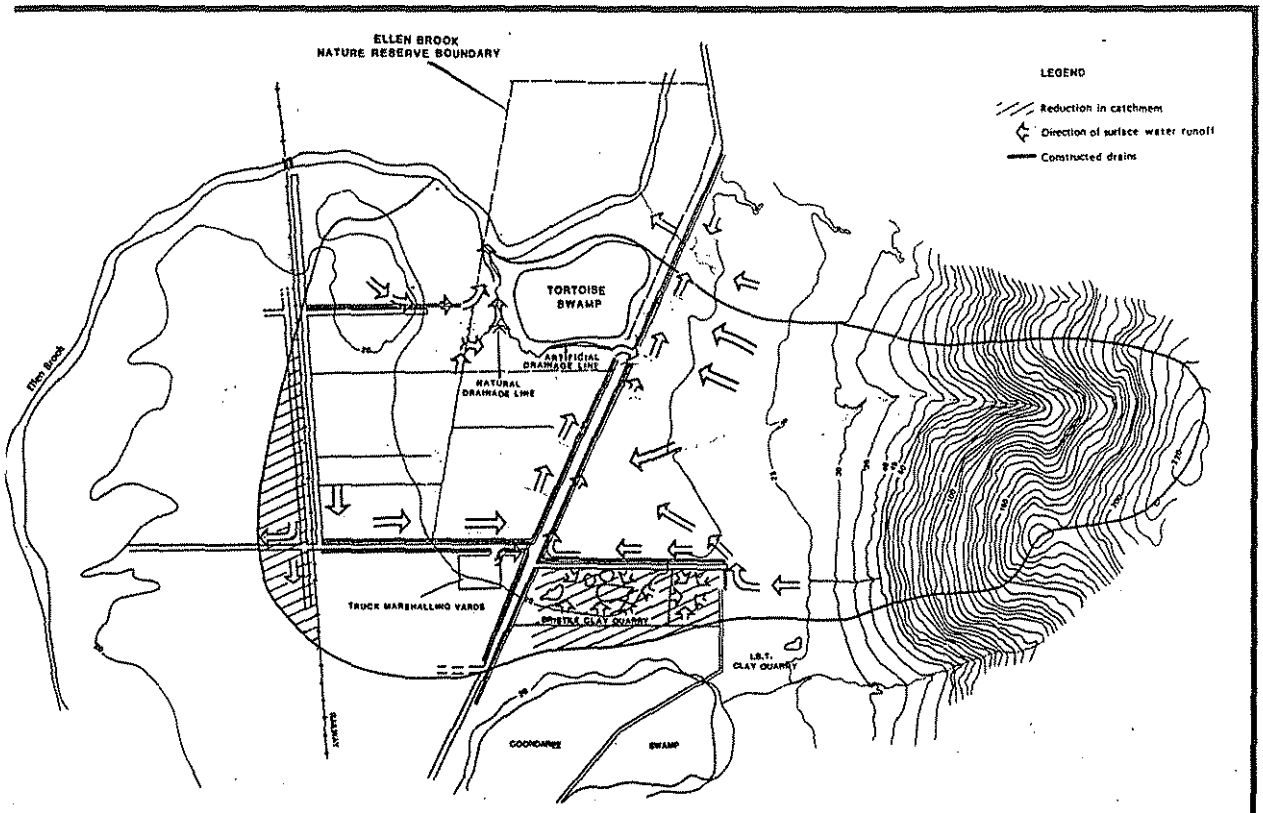
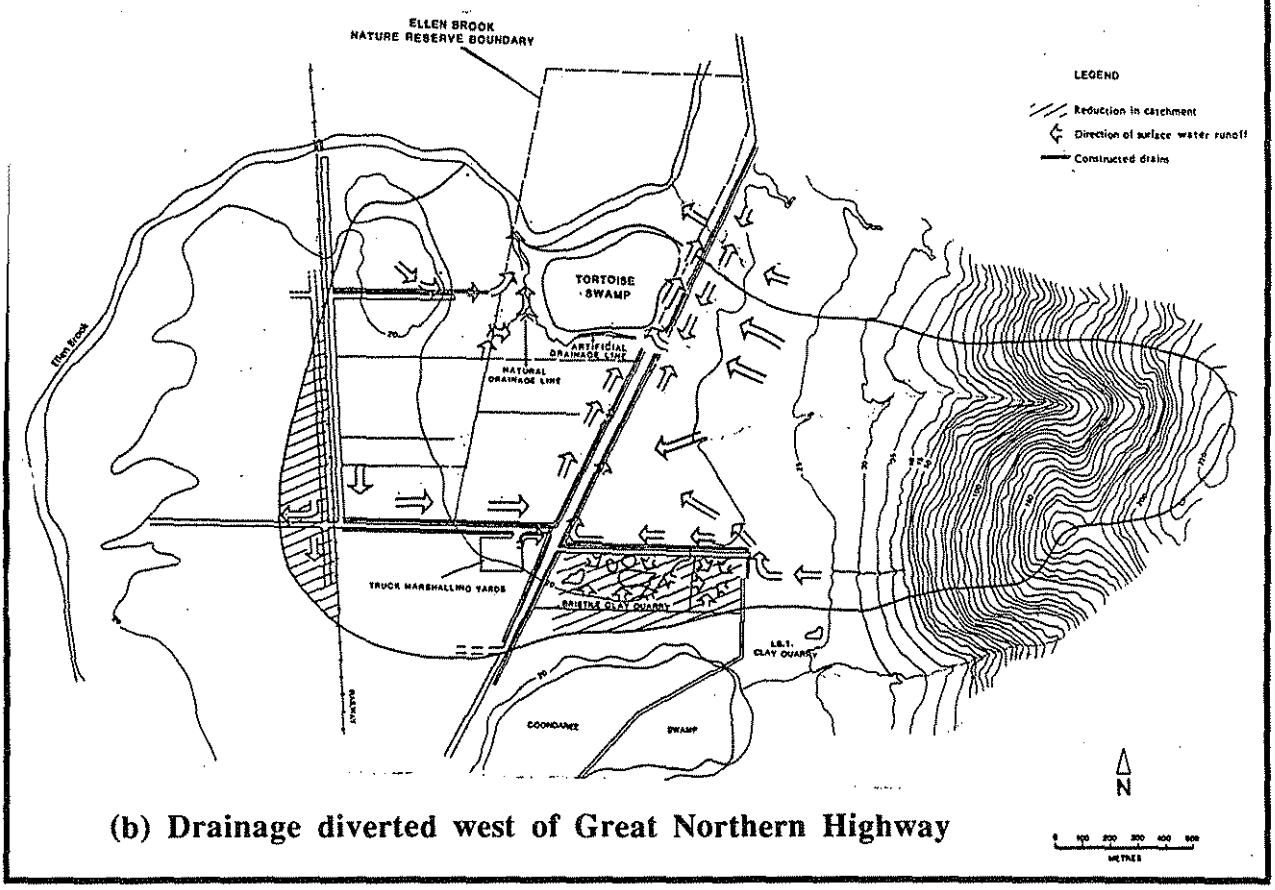


Figure 2. Existing drainage patterns into Ellen Brook Nature Reserve



(a) Drainage diverted east of Great Northern Highway



(b) Drainage diverted west of Great Northern Highway

Figure 3. Possible arrangements for the modified drainage emanating from the proposed clay excavations in the area around the Wildlife Sanctuary within two years of approval

- divert all drainage waters from the south west side of Great Northern Highway from entering the Wildlife Sanctuary at Ellen Brook Nature Reserve within two years of approval of the proposal, and in so doing, ensure it does not create an unacceptable impact elsewhere;
- monitor drainage to detect, report on, and manage any drainage impacts on the Wildlife Sanctuary for the Western Swamp Tortoise at Ellen Brook Nature Reserve; and
- remedy any unacceptable drainage impacts on the Wildlife Sanctuary caused by this proposal.

The drainage management plan should be implemented and periodically reviewed to the satisfaction of the Environmental Protection Authority.

6.3 Groundwater impacts on tortoise habitat

The Environmental Protection Authority is concerned that excavations around the tortoise habitat area could lead to a more rapid drying up of the wet areas which represent essential feeding environments for the tortoise.

The proponent has investigated and reported on the depth of the water table and the presence and extent of perched groundwater, which are the two principal aspects of the groundwater regime that are likely to impact on the hydrology of the tortoise habitat.

Based on topographical information, the proponent considers that the main swamp habitat is an isolated clay pan that is not hydraulically linked to adjoining land. The swamp is cut off to the north by Ellen Brook and to the south and west by the drain through the reserve. There is the the possibility of some sub-surface hydraulic link between land to the east (which was probably originally part of the tortoise habitat prior to clearing), although the potential for this is low, based on the nature of sediments at the base of the swamp, and the probability of compaction during construction of the highway which would have formed a barrier to sub-surface flow in the direction of the swamp.

As mentioned in Section 6.2, the proponent has been able to establish with a reasonable degree of certainty that water levels in the main swamp habitat are principally dependant on rainfall. The proponent concludes that the main groundwater aquifer is not a source of water for the swamp, based on the observation that regional groundwater levels, which approximate the water levels in the nearby Ellen Brook in summer, are always significantly lower than the swamp water levels. This conclusion is supported by the fact that water levels in the swamp are maintained long after rainfall has ceased, presumably due to impervious clay sediments at the base of the swamp which prevent rapid movement of the water through the profile and into the superficial aquifer, thus precluding a direct hydraulic connection between the two.

Of less certainty is the impact of clay excavations on the perched water table within the present Wildlife Sanctuary and any future extensions to the Sanctuary. Should there be a link between the perched water table and water levels in the swamp or other tortoise habitat, then a nearby clay excavation could potentially lead to a reduction in the wet area available to the tortoise by interfering with the subsurface water flow.

During winter and into spring the groundwater can sit above the layer of plastic clay, which (in most areas) commences about three to four metres below the surface. It is generally a temporary occurrence which dissipates relatively quickly via evaporation and infiltration. The perched water is not continuous, tending to occur in lenses or pockets within shallow sediments above the clay. In the environmental report provided to the Authority on Part Lot 36 operations in 1989, monitoring of the clay pit showed that there was no shallow seepage back into the pit. Prestige Brick's experience with clay pits in the locality is that large bodies of perched groundwater are very much the exception.

In Figure 11 of the CER, the proponents have noted the presence of perched groundwater in the area around the Wildlife Sanctuary, with 14 of the 26 shallow bores intersecting perched groundwater. However, most of this perched groundwater dissipated over the summer months, as only one hole remained wet after March.

The Water Authority of WA has submitted that the proponents' conclusions in the joint CER about the groundwater relationships with the swamp may be an over-simplification of the hydrology of the area. The CER shows the perched groundwater upstream is higher than the the swamp level. The Water Authority considers that, while the nature reserve drain intercepts some groundwater flowing from the south east, it is probable that the groundwater system provides upward pressure to the swamp, thereby limiting the infiltration of water from the swamp to the groundwater system. The Geological Survey of WA has agreed with the proponent in that interception of the perched groundwater by the quarrying should have no effect. The Environmental Protection Authority considers that the proposals by Prestige Brick and other clay excavation proponents are most unlikely to impact on the groundwater of the tortoise habitat, provided that stringent controls and management procedures are adopted (see below).

Of concern to the Authority are the impacts that the clay excavations might have on tortoise habitat areas within the fenced-off reserve but outside the swamp area, particularly as these impacts were not been addressed in detail by the proponent in the CER. The Department of Conservation and Land Management has submitted that a no-quarrying buffer of 100 metres be established to guard against any error in the proponent's management practices or predictions.

In response to submissions, Prestige Brick acknowledges that there is insufficient evidence to say that there is negligible risk to the tortoise swamp habitat from the clay excavation, especially when in close proximity to the to the nature reserve. The company considers that the principal element of uncertainty rests with the shallow perched groundwater regime and the degree of hydraulic connection between surface water in depressions within the habitat area and any sub-surface water which may be present. Lateral continuity of the shallow groundwater would need to be clarified on a case by case basis for each excavation site.

Prestige Brick are committed to the preparation of an environmental management programme to the satisfaction of the Environmental Protection Authority prior to the commencement of operations at the site. The fundamental approach in this programme would be to outline a trial excavation on the site and the manner in which it would be monitored to verify the acceptability of the operation.

The Environmental Protection Authority concludes that, from investigations undertaken and advice given, the proposals by Prestige Brick and other clay excavation proponents are most unlikely to impact on the groundwater of the tortoise habitat, provided that the following stringent controls and management procedures are adopted for each proposal:

- Preparation of an approved staged excavation plan (including a trial mining phase) as part of an Environmental Management Programme, prior to excavation and in consultation with the Department of Conservation and Land Management (see Recommendation 3). This plan should be implemented to the satisfaction of the Environmental Protection Authority, with the first excavation to commence at the furthermost point away from the Wildlife Sanctuary.
- Preparation of an approved groundwater management and protection plan, as part of the Environmental Management Programme, prior to excavation and in consultation with the Department of Conservation and Land Management, the Water Authority of WA, and the Geological Survey of WA (see Recommendation 3). This plan should be implemented to the satisfaction of the Environmental Protection Authority, with the objective of delineating and monitoring perched groundwater levels and pit seepages, and developing suitable management practices to remedy any potentially unacceptable impacts.

- Establishment of a no-quarrying buffer of 100 metres around the Wildlife Sanctuary, until further investigations are able to conclusively demonstrate to the satisfaction of the Environmental Protection Authority that no adverse effect could occur.

The Authority notes that, as the proposed excavation would come no closer than 300 metres to the existing Wildlife Sanctuary and 120 metres to the planned extensions, a recommendation specifying the 100 metre no quarrying buffer is not applicable to this proposal (but has been applied to other clay excavation proposals that do).

6.4 Rehabilitation

Prestige Brick is committed to introduce sequential rehabilitation of previously worked areas as soon as practicable, and in accordance with the rehabilitation objectives developed in consultation with planning authorities.

The Environmental Protection Authority considers that the resultant end use of the rehabilitated site should not affect the habitat of the Western Swamp Tortoise in the nearby Wildlife Sanctuary and should be consistent with the regional development, rehabilitation and drainage strategy which the Authority believes should be developed within the next two years (see Section 6.6 and Recommendation 4).

The Authority considers that the proponent should prepare an approved rehabilitation plan as part of the Environmental Management Programme, prior to the start of excavation operations and in consultation with the Shire of Swan and the Department of Conservation and Land Management. The plan should be prepared and implemented to the satisfaction of the Environmental Protection Authority (see Recommendation 3).

6.5 Provision of additional tortoise habitat

In the joint CER, the proponents have suggested that there may be some difficulty in re-establishing the existing tortoise habitat following excavation of the clay. The clay pans that the tortoises inhabit only hold water in winter, compared with clay quarries which are substantially deeper and tend to have water in them all year. Additionally the soil profile is significantly altered in the excavation process. The proponent has suggested that it might be more cost-effective and practical to expand the tortoise habitat by recovering adjoining land that may have previously supported the tortoises and rehabilitate the area to its original form.

The Department of Conservation and Land Management has also indicated that, under the current proposals for rehabilitation to a series of lakes or dams, the excavated sites in the area would be of no value to the tortoise. Any such site would need to be gazetted as a Nature Reserve if it was to be restocked with the short necked tortoise, and it could be expensive to construct to specific standards and manage to the benefit of the tortoise.

An extension to the existing (fenced-off) Wildlife Sanctuary is regarded by the Department of Conservation and Land Management and the Zoology Department of the University of Western Australia as one of the best ways to help increase the numbers of short necked tortoises in the wild. Earthworks to isolate the reserve and divert the existing drainage waters to an area outside the reserve is considered essential to improving and protecting the quality of water in the current and future habitat areas. Recontouring of some areas within the existing or extended reserve would be required. The Department of Conservation and Land Management has recently acquired the western portion of the adjoining Lot 14 to the north-east of Lot 53 (see Figure 1), which is now planned to form part of the extensions to the Wildlife Sanctuary.

Prestige Brick has indicated that a D6 bulldozer would be available for one week during the winter months to assist the Department of Conservation and Land Management in potential

recontouring of the the nature reserve extensions, or within existing areas. Another bulldozer may be available at other times during the year, depending on the proponent's schedule.

The Environmental Protection Authority notes the intention of Prestige Brick to assist with the provision of additional habitat for the short necked tortoise, and encourages other companies and individuals who may wish to participate in the recovery and survival of this extremely endangered species of wildlife, to liaise with the Department of Conservation and Land Management.

6.6 Regional development, drainage and rehabilitation

The Authority notes that a large extent of land in the area between the Swan River and Ellen Brook is likely to be affected by future proposals for clay extraction. These clay excavations are within an important resource area identified by the Department of Planning and Urban Development in its Basic Raw Materials Policy for the State.

In its submission to the Authority, the Department of Planning and Urban Development has indicated the following:

- Any structure plan for the locality would reflect the need to protect the clay resource areas from incompatible developments.
- Only limited future urban development will occur in the Upper Swan locality, due to the need to protect the clay resource, and the remoteness of the area from the existing sewerage system.
- The Department would most likely not support the subdivision of existing rural lots in the immediate locality of the clay excavations into "Special Rural" sized lots, as this would lead to more intensive uses that would be incompatible with the clay excavation operations and possibly prejudice future long term planning options for the locality.
- It would be appropriate for the proponents of the different excavation proposals to prepare a comprehensive long term rehabilitation/development strategy for the locality, in consultation with the Swan Shire Council, Environmental Protection Authority and the Department of Planning and Urban Development. The strategy could be based on transforming the excavation sites into a wetland system surrounded by compatible recreation and tourism developments.

The Authority notes the proponent's commitment to consult with planning authorities to facilitate the derivation of a long term strategic plan for the Upper Swan locality which recognises and accepts the interim priority land use of clay extraction. Prestige Brick is also committed to establishing an inter-company liaison mechanism to enable a coordinated approach between all three proponents with respect to addressing potential cumulative operational effects and overall rehabilitation goals.

The Authority considers that the proponents of all clay excavations in the Upper Swan locality, including Prestige Brick, should jointly prepare a regional development, drainage and rehabilitation plan for the locality, and the objectives of the plan should include the protection of the habitat of the Western Swamp Tortoise (see Recommendation 4). Following agreement of the plan by all affected parties, implementation should occur through the normal approval processes of the government agencies concerned.

6.7 Groundwater impacts generally

The proposed clay excavations are situated in the Swan Groundwater Area. In the area east of the Great Northern Highway, the Leederville Formation, which is a major aquifer for the Perth area and an important source for private users, is recharged directly from the Superficial Formation.

The Water Authority of WA stated in their submission that a groundwater licence would be required by the proponents of clay excavations to draw groundwater. Pollution of the Leederville Formation by contaminants such as diesel fuel would be impossible to clean up and could render parts of the aquifer unusable. The Water Authority has indicated that safeguards should be built into the clay excavations to prevent water pollution, and fuels and oils should not be stored inside the catchment area. The Water Authority indicated that excavation and dewatering activities could cause drawdown in the local water table and affect up to six neighbouring private wells. The proponents should monitor private shallow wells and make good any supplies if they were affected.

In October, 1989 the proponent submitted a report to the Authority summarising the results of a groundwater monitoring programme carried out over that year around the proposed excavation site. Maximum water table heights were recorded in September at 8.7 metres below the surface in the eastern part of Lot 23, and 10.5 metres below the surface in the western side of Lot 51. The amount of clay situated below the water table on Lots 23 and 51 (if any) would be determined from the close spaced drilling which, by necessity, would precede quarrying activities.

In response to issues raised (Appendix 2), Prestige Brick has stated that dewatering of the groundwater from the main aquifer would not be conducted. The company is committed to not excavating below the permanent water table and, if the excavation did reach the water table, the area would be backfilled to maintain at least one metre of cover. The existing monitoring bores would be used to establish the position of the water table prior to excavation.

In the joint CER, the proponents point out that it is uncommon for clay excavations to be carried out below the water table because of logistical difficulties. Excavation of wet plastic clay is extremely difficult, and the operator would be required to continuously dewater the pit to successfully excavate below the water table. In addition, this clay is generally of inferior quality and would need to be blended with higher quality clay to be of use.

The proponent states that water for dust suppression purposes would be obtained from local stand pipes or from the company's other excavation sites and trucked to the Apple Street site. As the operation proceeded, dams formed within the site would be used to collect run-off and rainfall to provide water for dust suppression. The only equipment to be refuelled on site would be the excavation machinery (hydraulic excavator and bulldozer), which would be done by a visiting tanker. Trucks would be refuelled elsewhere. If a substantial spillage occurred, the proponent has stated that the contaminated sediments would be excavated and removed to an approved disposal area.

The Environmental Protection Authority considers that Prestige Brick should prepare an approved groundwater management and protection plan as part of the Environmental Management Programme, in consultation with the Water Authority of Western Australia, prior to the extraction of clay on Lots 23 and 51. The plan should identify areas where the clay to be mined is in close proximity to the water table, and should outline procedures to be used by the proponent to protect the quality and quantity of groundwater from the impacts of the clay excavation and earth moving machinery. The plan should be implemented and reviewed regularly to the satisfaction of the Environmental Protection Authority (see Recommendation 3).

6.8 Noise, dust and visual impacts

All of the proposed clay excavations in the area have the potential to affect the comfort of local residents to varying degrees, through noise, dust and visual impacts. The proposed excavation by Prestige Brick on Lots 23 and 51 is particularly sensitive to these issues, as it is located less than 100 metres from the Upper Swan townsite and there are about 40 houses within 500 metres of the site.

The noise environment of the Upper Swan locality is already influenced by a number of non-rural activities. These include the standard gauge railway, the Great Northern Highway, the truck marshalling yard, and the existing clay excavations in the area. Noise would be generated at the quarry sites when overburden and clay are excavated, and along trucking routes when the clay is moved off-site. In the CER, the proponents indicate that the excavation season encompasses the summer months, for up to 12 hours per day, six days per week, although it is unlikely that all proponents would be operating simultaneously for this period.

The clay excavation proponents recognise that noise control and minimisation is a prerequisite to community acceptance and would incorporate a range of routine management practices to reduce the potential for noise disturbance, including:

- strategic placement of both topsoil and overburden stockpiles to shield nearby residences from noise generated from within the quarries;
- ensuring that only licensed vehicles are utilised and that they are adequately maintained to comply with relevant noise level regulations;
- location of driveways to the quarries at points which are optimally positioned to minimise noise disturbance to nearby residences from the effects of trucks braking, turning and accelerating;
- careful inventory management of clay stockpiles and logistics of storage at each plant to ensure that the number of excavations and trucking campaigns is minimised during each excavation season; and
- introduction of a co-ordinated approach to the timing of individual campaigns at the various quarries, if necessary, to avoid excessive truck movements on local roads.

The proponents recognise the potential for dust pollution from the quarry sites, particularly as much of the activity would occur in the drier summer months. North-easterly winds, which would tend to transport dust in the direction of the Upper Swan townsite, are quite strong and frequent during this time. When the clay is dry, dust pollution could occur from worked surfaces within the pits, unsealed access tracks, and stockpiles of clay, overburden and topsoil.

However, previous clay excavation experience by the proponents in the area indicates that a dust is unlikely to be a problem, due to various factors which include:

- when freshly dug, the clay retains some moisture and tends to stick together, and is therefore not mobile;
- most of the proposed excavations are accessed directly off sealed roads, and would not require long service roads;
- major sources of dust are easily controlled using a watering truck;
- stockpiles of overburden and topsoil tend to be self-sealing once exposed to rain, although hydro-mulching is a viable option; and
- the sequential rehabilitation programme, which minimises the area left open at any one time, and is generally a standard condition on excavation licences issued by the Shire of Swan.

Following an analysis of wind data and the potential impact of noise and dust on nearby residents, the proponent has given an undertaking to conduct the excavation programmes at the site, to the greatest extent possible, during the months of November, December and April, and is prepared to restrict operating hours within 7.00am and 5.30pm, Monday to Friday. Between 60 and 100 truck movements are expected over each 6 week annual excavation programme. Trucks would access the site from Apple Street and travel to the brickworks at Midland via Great Northern Highway (see Figure 1 of Appendix 2). Prestige Brick have recently indicated (Appendix 3) that the permanent access road would be positioned 30 metres from the (eastern) boundary between Lots 22 and 23, to ensure that is is as far as possible from the Upper Swan

townsite residences but also a safe distance from the entrance to the heavy haulage assembly area.

In response to submissions, Prestige Brick indicates that it intends to operate the clay quarry within noise and dust limits which can be tolerated by the local community with minimal inconvenience. Prestige Brick is aware of public sensitivities regarding noise and dust issues in the area around the corner of Apple Street and Almeria Parade. The company has operated a nearby clay quarry in Railway Parade for a number of years, and has developed management practices which are designed to prevent undue noise and dust disturbance to the Upper Swan community. These practices include:

- provision of grassed, earthen embankments along Apple Street and Almeria Parade boundaries for visual and noise screening;
- planting of trees within the boundary set-back for aesthetic and wind-fencing functions;
- ensuring that the working area where the excavator loads the trucks is always as low as possible in the profile; and
- rigid adherence to track watering and road washdown at the entrance to each site.

The most likely source of dust emissions is from working areas and the access track when traversed by trucks and machinery. The company considers it essential to wet haul roads and work areas to control the dust situation. Prestige Brick acknowledges the potential for cumulative dust impacts on nearby residents, particularly from prevailing north-easterly winds during summer. The company would liaise with Midland Brick to ensure that the excavation programmes at the two Apple Street sites occur concurrently for as short a period as possible, to minimise potential cumulative dust emissions, particularly during the drier part of the season. Hydro mulching of stockpiles, tree screens and progressive rehabilitation should also assist in minimising dust emissions.

The flat terrain of the area, coupled with the extensive clearing of vegetation in the past, means that the proposed clay excavations would be visible to local residents and traffic. The proponent points out that the flat terrain could be advantageous to some extent, in that the pit faces would be generally excluded from view because they would be below ground level. However the proponent recognises the potential of the excavations to impair visual quality to the area in the short to medium term, and that there is a need to incorporate some landscape planning during the operational life of the the quarry, in addition to the final rehabilitation plan. Prestige Brick has indicated that trees would be planted around the perimeter of the excavation site, to provide shade and to screen the workings from adjoining properties and road reserves.

The proponent has stated that about four weeks prior to the start of operations it would notify the Environmental Protection Authority, the Shire of Swan and local residents living within 500 metres of the site boundary who may be potentially affected by the proposal. The following information would be advised:

- the nature of the work and the period over which the excavation campaigns would be conducted;
- the company's objectives in minimising noise and dust levels within realistic and achievable levels; and
- contact details of the appropriate officer to whom any concerns or objections should be raised.

The Environmental Protection Authority considers that noise, dust and visual impacts from Prestige Brick's proposed clay operation on Lots 23 and 51 are likely to be manageable to the extent that they do not cause an unacceptable impact on the environment. In order that these impacts are monitored and managed correctly, the Authority believes the proponent should prepare, implement and regularly review noise, dust and visual impact management plans as

part of the Environmental Management Programme, in consultation with the Shire of Swan and to the satisfaction of the Environmental Protection Authority (see Recommendation 3). The timing of the preparation and review of the Environmental Management Programme and the levels of emissions of noise and dust off-site should be to the satisfaction of the Environmental Protection Authority. The plans should document the company's procedure for handling complaints, including the person responsible within the company for receiving and recording the complaints, for following them up and, if appropriate, for rectifying the cause of the complaint.

6.9 Public safety and mosquito breeding management

Some of the clay pits would be in close proximity to residences, particularly the Upper Swan townsite, and could be left open with deep expanses of water prior to final rehabilitation. The pits could become a source of mosquito nuisance or disease to the public, and may represent a danger to young children in the area.

In response to these issues, Prestige Brick indicates that it has had discussions with the Shire of Swan. To preclude mosquito breeding activity, it has been recommended to the company that relatively sharp edges are maintained in the rehabilitated pits and that the sides are kept free of vegetation, to minimise the area of sheltered water that the water in which the mosquitoes breed. According to the proponent, this would be readily accomplished in the clay pits during their operational life.

To exclude public access (especially children) from the site, the company has stated that the present fence would be repaired and sign-posted at frequent intervals with "danger - open pit" signs. If necessary, a low voltage electric fence would be placed inside the boundary to discourage people climbing over the fence and into the property. Fluorescent ribbon or a supplementary warning fence would be placed around the open pit in areas where the sides were left relatively steep. In regard to provision of alternative recreational areas to encourage local children away from the quarry, Prestige Brick is prepared to consider provision of assistance with the cost of materials and/or machine time (on a one third basis with Midland Brick and Metro Brick) for recreational areas provided by the Council, if this was considered of value in keeping children away from the site.

The Environmental Protection Authority is concerned that the clay excavation and subsequent rehabilitated site does not create a public nuisance, and considers that the proponent should liaise with the Shire of Swan and the Department of Conservation and Land Management to ensure that these issues are addressed in the Environmental Management Programme.

6.10 Aboriginal sites

Through a literature search, the proponent identified an Aboriginal site of archaeological significance which is located about two kilometres away, on the north side of the Swan River and near the Great Northern Highway bridge. However a register search at the Department of Aboriginal Sites of the Western Australian Museum has shown there are no recorded sites for the proposed quarry areas around Ellen Brook Nature Reserve.

The Department of Aboriginal Sites has advised the Authority that the Swan Valley area is known to have sites of major Aboriginal significance, in both archaeological and ethnographic terms. The Department of Aboriginal Sites has suggested that a survey of such sites should be carried out prior to approval, and it may also be desirable to carry out some monitoring of subsurface material during excavation.

The Authority suggests that the proponent discuss with the Department of Aboriginal Sites of the Western Australian Museum appropriate ways of complying with the provisions of the Aboriginal Heritage Act 1972-80.

8. Conclusions and recommendations

The Environmental Protection Authority recognises the very rare status of the short necked tortoise, and the requirement to protect its habitat. Accordingly, the Authority has set a very high onus of proof on this and other nearby quarrying proposals, to demonstrate that there will be no adverse impacts on the tortoises and their habitat. It is only after detailed study that the Authority considers that the proposal would not have any adverse impacts and therefore could proceed.

Based on its assessment of the proposal and additional information provided by the proponent in response to questions raised as a result of the assessment process, the Authority makes the following conclusions and recommendations:

Recommendation 1

The Environmental Protection Authority concludes that the proposal by Pilsley Investments Pty Ltd (Prestige Brick) to quarry clay on Lots 23 and 51 Apple Street, Upper Swan, as outlined in the Consultative Environmental Review and subsequently modified during the process of interaction between the proponent, the Environmental Protection Authority, government agencies, and those members of the public who were consulted, is environmentally acceptable.

In reaching this conclusion, the Authority identified the main issues requiring detailed consideration as:

- **protection of the habitat of the endangered Western Swamp Tortoise, *Pseudemydura umbrina*, at Ellen Brook Nature Reserve;**
- **management of drainage waters;**
- **protection of groundwater resources;**
- **rehabilitation of the quarried area;**
- **noise, dust and visual impacts from the quarrying operations; and**
- **public safety and management of mosquito breeding.**

The Environmental Protection Authority considers that these and other issues, such as planning considerations, have been addressed and are manageable, either by changes to the proposal by the proponent during assessment, the environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations in this report.

Accordingly, the Environmental Protection Authority recommends that the proposal could proceed, subject to the proponent's commitments (Appendix 1) and the Environmental Protection Authority's recommendations in this report. Any approval for the proposal should be for a maximum of 10 years from the time of commencement of quarrying activities.

A drainage management plan should be prepared to protect the habitat of the Western Swamp Tortoise at Ellen Brook Nature Reserve from external surface water drainage impacts affected by this proposal.

Recommendation 2

The Environmental Protection Authority recommends that, before the start of quarrying activities and in consultation with the appropriate government

departments, including the Main Roads Department, the Department of Conservation and Land Management, the Swan River Trust and the Shire of Swan, Prestige Brick should prepare a drainage management plan as part of an Environmental Management Programme to the satisfaction of the Minister for the Environment on advice of the Environmental Protection Authority. This plan should enable the proponent to:

- **detain all drainage waters on site during the life of the clay excavation operation, so that they do not enter the Wildlife Sanctuary at Ellen Brook Nature Reserve nor create an unacceptable impact elsewhere;**
- **divert all drainage waters from the south western side of Great Northern Highway from entering the Wildlife Sanctuary at Ellen Brook Nature Reserve within two years of approval of the proposal, and in so doing, ensure it does not create an unacceptable impact elsewhere.**
- **monitor drainage to detect, report on, and manage any drainage impacts on the Wildlife Sanctuary for the Western Swamp Tortoise at Ellen Brook Nature Reserve; and**
- **remedy any unacceptable drainage impacts on the Wildlife Sanctuary caused by this proposal.**

The drainage management plan should be implemented and periodically reviewed to the satisfaction of the Environmental Protection Authority.

A comprehensive environmental management programme should be prepared to enable the proponent to detect, report on and manage any impacts on the environment, particularly the habitat of the Western Swamp Tortoise at Ellen Brook Nature Reserve.

Recommendation 3

The Environmental Protection Authority recommends that, before the start of quarrying activities and following consultation with the appropriate government authorities, Prestige Brick should prepare an Environmental Management Programme to the satisfaction of the Minister for the Environment on advice of the Environmental Protection Authority. This programme should enable the proponent to detect, report on, and manage any impacts, and remedy any unacceptable impacts on the environment by this proposal, and should be implemented and periodically reviewed to the satisfaction of the Environmental Protection Authority. Details to be prepared as part of the Environmental Management Programme should include, but not necessarily be limited to:

- **a staged quarrying strategy;**
- **drainage management (see Recommendation 2);**
- **groundwater management and protection;**
- **progressive rehabilitation of the site;**
- **procedures to minimise noise, dust and visual impacts associated with the quarrying and transportation operations;**
- **public safety and mosquito breeding;**
- **periodic reporting of monitoring results, and**
- **consequential changes to project management to remedy unacceptable environmental impacts.**

The timing of the preparation and review of the Environmental Management Programme and the levels of emissions of noise and dust off-site should be to the satisfaction of the Environmental Protection Authority.

A regional development, drainage and rehabilitation strategy for the Upper Swan locality should be formulated to ensure that future developments in the area are compatible and are carried out in an environmentally sensitive manner, whilst at the same time the interests of current stakeholders in the area are looked after.

Recommendation 4

The Environmental Protection Authority recommends that Prestige Brick should contribute, to the satisfaction of the Environmental Protection Authority, to the preparation of a regional development, drainage and rehabilitation strategy for the Upper Swan locality, in consultation with the appropriate government departments, including the Main Roads Department, the Department of Planning and Urban Development, the Department of Conservation and Land Management, the Shire of Swan, and other current and known proposed clay producers in the area, such that a plan can be prepared within two years of approval of this proposal.

The Authority considers that any approval for the proposal based on this assessment should be limited to five years. Accordingly, if the proposal has not been substantially commenced within five years of the date of this report, then such approval should lapse. After that time, further consideration of the proposal should occur only following a new referral to the Authority.

The Authority notes that during the detailed implementation of proposals, it is often necessary to make minor and non-substantial changes to the designs and specification which have been examined as part of the Authority's assessment. The Authority considers that subsequent statutory approvals for this proposal could make provision for such changes, where it can be shown that the changes are not likely to have a significant effect on the environment.

Appendix 1

Environmental management commitments by Pilsley Investments Pty Ltd

The proponent hereby commits itself to the overall environmental management and rehabilitation philosophy outlined in the Consultative Environmental Review and subsequent modifications as outlined in Appendices 2 and 3 of this report. In specific terms, this means the proponent will;

(i) Consult with Planning Authorities to facilitate the derivation of a long term strategic plan for the locality which recognises and accepts the interim priority land use of clay extraction.

(ii) Establish an inter-company liaison mechanism to enable a co-ordinated approach between all three proponents with respect to addressing potential cumulative operational effects and overall rehabilitation goals.

(iii) Implement the management techniques described in both Sections 5 and 6 of the CER to ensure that adverse effects are not experienced in relation to:

- potential visual intrusion for residents at Upper Swan and through-traffic on Great Northern Highway;
- potential noise and dust disturbance of the residents at Upper Swan, particularly near the road junction of Apple Street and Almeria Parade;
- potential erosion of working areas and stockpiles and consequent silt transport to local drainage;
- dewatering of accumulated rainfall and (perhaps) groundwater seepage from the working area of the pit which may be necessary to allow excavation to proceed.

(iv) Implement routine surveillance of the quarries at regular intervals throughout the year to assess the critical parameters identified in the monitoring program.

(v) Comply with excavation licence conditions negotiated with the Shire of Swan and in consultation with the Environmental Protection Authority.

(vi) Introduce sequential rehabilitation of previously worked area ass soon as practicable in accordance with the rehabilitation objectives developed in consultation with Planning Authorities and the landowner (ie. in respect of leasehold arrangements).

(vii) Share, on an equitable basis with the other clay excavation proponents, the costs of diverting or modifying the existing drainage system outside Lots 23 and 51 leading to the Ellen Brook Nature Reserve from the excavation areas, provided that it is to an agreed and pre-arranged specification and is solely for the purposes of protecting the reserve.

(viii) Conduct the excavation programmes at the site, to the greatest extent possible, during the months of November, December and April, and is prepared to restrict operating hours within 7.00am and 5.30pm, Monday to Friday.

(ix) Liaise with Midland Brick to ensure that the excavation programmes at the two Apple Street sites occur concurrently for as short a period as possible, to minimise potential cumulative dust emissions.

(x) Verify that no adverse hydrological effects are experienced within the tortoise habitat from the excavation by appropriate staging and monitoring of the excavation.

(x) Undertake progressive restoration of the pits during the clay excavation at the site, to the greatest extent possible.

(xi) Prepare an Environmental Management Programme to the satisfaction of the Environmental Protection Authority prior to commencement of operations at the site.

(x) Not excavate below the permanent water table and, if the excavation did reach the water table, the area will be backfilled to maintain at least one metre of cover.

Appendix 2

Proponent's response to issues raised in public submissions

PRESTIGE BRICK PTY LTD
LOT 23 APPLE STREET
LOT 51 ALMERIA PARADE

Responses to Questions and Comments in Relation to Proposed Clay Excavations near Ellen Brook Nature Reserve (EBNR).

Preamble

The following responses have been prepared in order to meet the requirements of the formal assessment process for our proposed clay excavation at Upper Swan. The company is confident that the principal issues have been satisfactorily addressed to enable on-going assessment of this proposal.

Noise, Dust, Visual and Safety Issues

Q1. What are the numbers of residences and people living in residences (approximately) within:

(i) 100 metres
(ii) 500 metres
(iii) 1000 metres

of the boundaries of each clay mining proposal?

The following information has been interpreted from an aerial photograph at a scale of 1:20,000 (date of photography = 4.1.91).

(i) Only one house is within 100 metres of the site (i.e. to the east, on the property where Midland Brick have an agreement to excavate clay).

- Four houses are approximately 100 metres from the site's boundaries:
  - 1 house to the north
  - 1 house to the west
  - 2 houses to the south-west

(ii) When the search area is extended to 500 metres, the additional houses recorded with respect to item (i) above are:

- 1 house to the north
- 7 houses to the south
- 27 houses to the south-west

(iii) When the search area is extended to 1000 metres, the additional houses recorded are:

- 3 houses to the north
- 3 houses to the north-west
- 3 houses to the west
- 32 houses to the south
- 39 houses to the south-west

(iv) In summary, the number of residences for the three distance classes are:

- 100m - 5 (4@100m)
- 500m - 40
- 1000m - 120.

Q2. What noise and dust limits will the proponents be operating to - refer to page 45 in the CER. Will monitoring be done to ensure operations are within these limits? How many trucks per hour are likely to operate from the quarries each hour? What are the dominant wind directions and velocities for the area during the proposed times of mining? How is this likely to affect nearby residences or major traffic routes, with respect to noise and dust impacts?- P46.

(i) Noise and Dust Limits

It is the intention of Prestige Brick to operate the clay quarry within noise and dust limits which can be tolerated by the local community with minimal inconvenience. The company believes that a proactive consultative approach to neighbouring residents will be of benefit

in ensuring the operations are conducted within acceptable limits, by allowing a two-way feedback mechanism, because the company will be active in the community for several years.

More importantly, Prestige is confident that the range of management techniques proposed to be instituted will prevent undue noise and dust disturbance. The principal techniques include:

- provision of grassed, earthen embankments along the Almeria Parade and Apple Street boundaries for visual and noise screening (temporary embankments will be maintained around the pit and loading area during each season's campaigns);
- planting of trees within the boundary set-back for aesthetic and 'wind-fencing' functions;
- ensuring that placement of the excavator and loading area is always as low as possible in the profile;
- rigid adherence to access track watering and road washdown at the entrance to the site.

The process of consultation with affected neighbours would be initiated by the company approximately four weeks prior to the commencement of operations. This would involve a 'letter-drop' to all residences within 500 metres of the site's boundaries advising the following information:

- The nature of the work and the period(s) over which the excavation campaigns are proposed to be conducted;
- The company's objectives in terms of minimising noise and dust emissions to within realistic and achievable levels;
- The contact details of the appropriate company officer to whom any concerns or objections should be raised.

The Shire of Swan and the EPA would also be advised of the impending programme as it is acknowledged that some residents may prefer not to liaise directly with the company.

(ii) Truck Movements

Whilst it is difficult to estimate the number of truck movements that may be experienced at this site, given that it will not be excavated for another 5 years or so, a likely figure would be 30 to 50 'truck-and-dog' combinations each way, each day. That is, about 60 to 100 truck movements per day over a total period each season encompassing about 6 weeks.

(iii) Wind Data

Wind frequency analyses (speed and direction) have been obtained from the Bureau of Meteorology for wind data recorded at the nearby Department of Agriculture's Upper Swan Research Station. These monthly analyses were first produced for this station in April 1991. The complete data set is attached for information purposes. Summary statistics are presented in Tables 1, 2 and 3.

North-easterly winds are noted as the main winds of concern with respect to potential dust impacts on the nearest residential area within the Upper Swan townsite. Consideration of the data in Tables 1 and 2 reveals that:

- From the perspective of wind direction analysis, May is the worst month because the prevailing morning wind is north-easterly, although the wind speeds at this time of the year are generally lighter.

- From the perspective of wind speed analysis, the period December to March has a relatively higher frequency of stronger north-easterly winds, but only in the morning.

- December and April may be considered as the optimum months (October and November are also favourable but it is unlikely that access would be possible due to wet soil conditions). Obviously, soil moisture content would be higher early in the excavation season, with a consequent reduced dust generation risk.

From Table 3 it is clear that the period December to March is characterised by relatively frequent and strong easterly winds in the mornings and, in February and March, these winds are also more common in the afternoons. Fortunately, the residential density due west of the site in the immediate vicinity is extremely low.

Table 1

Analysis of North-Easterly Winds During Potential Excavation Season

North-Easterlies		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Morning winds	% Occurrence	13	13	14	15	15	19	17	30
(0900 hrs)	Wind Strength:								
	% moderate 11-20km/hr	32	32	43	32	32	38	35	27
	% Strong, >20km/hr	8	16	21	32	26	22	12	10
Afternoon Winds	% Occurrence	4	2	3	4	4	5	5	10
(1500 hrs)	Wind Strength:								
	% moderate, 11-20km/hr	29	50	33	25	25	23	20	29
	% Strong, >20km/hr	0	0	0	0	0	0	20	0

Table 2

Prevailing Wind Directions

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Morning	E,NE	E,SW	E,SW	E,SW	E	E, NE	E,Calm	NE
Afternoon	SW	SW	SW	SW	SW	SW	SW	SW, W

Notes: Prevailing wind (or winds) defined as % occurrence equal to 30% or more. Where two wind directions are given, each component wind has less than 30% occurrence, but are the two most frequent wind directions.

Table 3

Analysis of Easterly Winds During Potential Excavation Season

Easterlies		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Morning Winds	% Occurrence	20	21	26	28	38	29	20	12
(0900 hrs)	Wind Strength:								
	% Moderate, 11-20km/hr	36	30	34	39	32	24	30	24
	% Strong, >20km/hr	41	44	38	39	45	52	45	40
Afternoon Winds	% Occurrence	10	10	9	12	18	18	15	12
(1500 hrs)	Wind Strength:								
	% Moderate, 11-20km/hr	30	32	36	33	33	39	27	25
	% Strong, >20km/hr	20	21	12	17	28	22	20	17

As a result of the above analysis, Prestige Brick undertakes to conduct excavation programmes at this site, to the greatest extent possible, during the months of November, December and April. In addition, the company will liaise with Midland Brick to ensure that excavation programmes at the two Apple Street sites occur concurrently for as short a period as possible, to minimise potential cumulative dust emissions. This would be more important during the drier part of the season (i.e. April) in comparison to November when soil moisture content is likely to be higher.

(iv) Conclusion

Whilst north-easterly winds are recognised as the most unfavourable in terms of potential dust effects on the nearby area of high residential density, it is emphasized that these winds do not occur frequently. They occur for 13-19% of the time in the mornings (November to April) and for 2-5% of the time in the afternoons.

In addition, assuming that the excavation season is similarly defined (i.e. November to April), then the frequency of actual excavation activity during this period is only 25%.

Q3. With the removal of overburden, have the proponents considered the use of alternative (quieter) machinery to bulldozers e.g. scrapers, in an effort to reduce noise levels? -P42.

The problem with scrapers is that, because of their speed of travel, they are significantly dustier on the soil types which occur in the Upper Swan area. In addition, they often require a dozer to push them through 'heavy' material so there may be cumulatively higher noise levels.

From an operational viewpoint, the scrapers traverse the top of a stockpile as it is being created, whereas a dozer pushes from the 'floor' to near the top. More often than not, the dozer can operate below the top of a stockpile or bunded wall, thus generally remaining below 'noise exposure level'.

Whilst scrapers have the advantage of speed and therefore the period of potential noise and

dust effects would be relatively short in comparison to dozers, they are considered uneconomic on the small scale of operation proposed at this site and have a much higher potential for dust generation.

Q4. What are the transport routes and access points for each site? Have the proponents considered the potential noise and dust impacts on residents in their selection?

The access point and transport route are shown on Figure 1. The objective in selection of access was to be as far as possible from the residential area on the western side of the railway, but also to give due consideration to the house on the adjoining property and the 'road-train' assembly area (re convergence of traffic).

Q5. Mining and trucking activities should be restricted to something less than daylight hours. Are the proponents prepared to commit to specific operating days and hours, to allay any concerns of affected residents?-P42 & 53. Could the life of each pit be reduced by excavating for longer periods of time?

In view of the presumed sensitivity of this site, Prestige Brick are prepared to restrict operating times to the hours of 7.00am to 5.30pm, Monday to Friday.

The life of the pit is dictated by demand for bricks and the availability of stockpiling areas at the brickworks in Military Road, Midland. There is insufficient space at the brickworks to stockpile much more than one winter season's clay requirements, hence there is little scope to reduce the lifetime of the pit by creating larger stockpiles.

Q6. Most of the clay pits are within reasonable proximity to residences and are likely to be left open for a considerable period of time, prior to final rehabilitation. Are the pits likely to be a breeding ground for mosquitos and any other public health nuisance? If so, how are these impacts to be managed? The presence of large expanses of water could also attract younger members of the population. What measures do the proponents intend carrying out to exclude and discourage children and other members of

the public from using the area? Are the proponents prepared to assist the local community in providing alternative recreation areas (e.g. parks) for children away from the site?

Discussions have been held with a health surveyor from the Shire of Swan in relation to the mosquito issue. There is potential for open water areas to be a breeding ground for mosquitos wherever there is sufficient shelter to prevent wind-induced turbulence of the water's surface.

To preclude mosquito breeding activity, the Shire's health surveyor recommends that the pits are maintained with relatively sharp edges (i.e. no shallow water areas where small pools may form as water levels decline in summer) and the sides are maintained clear of vegetation which would otherwise provide sheltered water. This will be readily accomplished in the clay pit during its operational life.

Ultimately, if a lake is formed during the rehabilitation programme, attention will be devoted to contouring of the sides to minimise mosquito breeding risk. The lake could also be stocked with fish, as is the case at Ballajura Lakes Estate, to predate on mosquito larvae.

To exclude public access (especially children) to the site, the present fence will be repaired and signposted at frequent intervals with "danger - open pit" signs. If necessary, a low-intensity electric fence would be placed inside the boundary fence to discourage people climbing over. Fluorescent ribbon or a supplementary warning fence would be placed around the open pit in areas where the sides were left relatively steep.

Prestige Brick are prepared to consider provision of assistance with the cost of materials and/or machine time (on a one-third basis with Midland Brick and Metro Brick) for recreational areas provided by Council if this was considered of value in keeping children away from the site.

Short-Necked Tortoise Habitat Generally

Q7. Only 20 to 30 short-necked tortoises exist in the EBNR. The Zoo considers that this number is critically low for the survival of the population. It is understood that only minor environmental disturbances have caused the virtual loss of the whole tortoise population at the Twin Swamps Reserve, estimated in the mid-1960's to be over 100. There is insufficient evidence in the CER to conclusively show that the proposed operations will have no impact on the last surviving short necked tortoises (see conflicting statements on P30, 38, 39).

Whilst it would appear that on the balance of probabilities there is negligible risk to the tortoise swamp habitat from the proposed clay excavations, it is accepted that there is insufficient evidence to remove all uncertainty. The principal element of uncertainty rests with the shallow, perched groundwater regime and the degree of hydraulic connection between surface water in 'depressions' within the tortoise habitat area and any sub-surface water that may be present. In this regard, the extent of lateral continuity of the shallow groundwater needs to be clarified on a case-by-case basis for each of the excavation sites.

Q8. A major problem with the CER is that discussion of the habitat of the tortoise is confined to the swamp (a restricted clay pan area) which covers only about 30% of the important habitat area of the short necked tortoise. 13% of all tortoises found between 1988 and 1990 were outside the swamp and in or south of the drain.

The conclusions drawn in the CER relate mainly to the clay pan swamp because the hydrological data collected indicates strongly that this area is isolated from external hydrological influences other than direct rainfall. It was understood at the time that this clay pan was the principal habitat which required protection.

Given the fact that tortoises exist outside of this clay pan (data which we have only recently been made aware) and that the nature reserve is presently being expanded to encompass additional land to the south and west, then it is accepted that there may still be a

risk, albeit slight, of hydrological effects between the excavation site and the nearest habitat area. Prestige Brick is committed to verifying that no adverse effects are experienced by appropriate staging and monitoring of excavation at this site.

Q9. An extension to the existing (fenced-off) reserve may be required to help increase the numbers of short necked tortoises. Earthworks to close and divert the existing drain to an area outside the reserve is essential to improving and protecting the quality of water in the habitat area. Recontouring of some areas within the existing or extended reserve may be required. To what degree and how might the proponents be prepared to assist CALM in this regard?

A bulldozer (D6) is available for one week during the "winter" months (May to October) to assist CALM in potential recontouring of the nature reserve extension, or within existing areas. If machine time was required in other months then it would have to fit in with Prestige Brick's working arrangements and access would have to be available directly from our site to the CALM site so that the machine could be "walked" across country. In these other months the machine could only be spared for one or two days, but the machine would be a D9 not a D6.

Q10. Is the Lot 6, Almeria Parade deposit part of the original habitat occupied by the short necked tortoise? What is the potential for excavation of this site to impact on the habitat of the tortoise?

Question not relevant to Prestige Brick.

Q11. Figure 8 shows most of the estimated original swamp habitat (for short necked tortoises) lies east of the swamp. What is the basis for this delineation? Why is this are not favoured as a logical extension of the habitat for the short necked tortoise as opposed to land south and west of the current fenced off area?

In Figure 8 of the CER, the basis for delineation of the 'original' swamp habitat is essentially arbitrary, in that it stems from the present natural hydrological boundaries of

the residual clay pan area. The remnant clay pan is bounded to the north by slightly elevated land on the edge of Ellen Brook and to the west/south-west by a natural drainage channel. Therefore, it was considered logical to assume that this habitat area originally extended to the east and south, on low-lying terrain where surface ponding still occurs today.

The probability that additional tortoise habitat originally existed on land further to the south and south-west of the nature reserve is also acknowledged and indeed, much of the land encompassed by the 20 metre topographical contour on Figure 8 could have supported suitable habitat for the short-necked tortoise. It is low-lying and would have been poorly drained prior to establishment of the existing drainage system. The original vegetation would have prevented rapid loss of surface water to Ellen Brook, thus maintaining pools of water in the spring months which is an important time for the tortoises.

It is assumed that land to the east of the nature reserve is not favoured by CALM as an extension of the habitat because of the position of Great Northern Highway. Land to the south and west, which is presently being targeted for inclusion within the nature reserve, has the advantages of:

- some native vegetation is still present in these areas, and
- there are no physical barriers (outside CALM's control) to inclusion of these areas within the nature reserve.

Prestige Brick's site is not being considered by CALM for future tortoise habitat. The site has no remnant native vegetation and the soil profile has been substantially disturbed as a result of past agricultural practises.

Surface Water Impacts on Tortoise Habitat

Q12. Since the tortoise is well known to habitat the drain and area to the south of the swamp, any deterioration in water quality of the habitat could potentially lead to the extinction of the sub-population which inhabits the area. What

steps can the proponents take to ensure that discharged pit water and run-off water from the clay excavations does not enter the habitat of the tortoise?-P47.

To ensure that discharged pit water and runoff water from the site does not enter the tortoise habitat (existing and proposed), Prestige Brick propose to institute the following hierarchy of water handling options:

- Installation of a simple perimeter bund and/or drain, with associated internal drainage system, to direct all site runoff from disturbed areas to the open pit;

- Utilisation of pit water for dust suppression;

- Discharge of pit water, if required prior to additional excavation, in the form of low volume sheet runoff to adjacent land for evaporative loss (a method that has been successfully conducted at the nearby Railway Parade site).

Q13. What options are there for diversion of the drainage channel away from EBNR, if it is necessary to close it off to ensure the survival of the short-necked tortoise? Could the proponents assist in this regard?-Fig.6.

Apparently, CALM are now keen to have the drainage channel through the nature reserve diverted away from the EBNR. There are basically two options available for consideration:

- Diversion of the drain through private property on the southern and western sides of the nature reserve;

- Diversion of the drain along the eastern side of Great Northern Highway to discharge into Ellen Brook, around the north-eastern corner of the tortoise habitat.

The latter option appears to be the most economic and practical of the alternatives on the basis of distances involved and engineering and logistical constraints. The cooperation of

the Main Roads Department would be required with respect to such aspects as utilisation of the road reserve for drainage purposes and design/installation of appropriate culverts underneath Great Northern Highway etc.

Prestige Brick would be prepared to assist in drain construction by offering earthmoving machinery similarly to the offer under question 9 above, in the event that excess water from the excavation site would be routinely discharged to this drainage system. However, it is not intended to discharge water off-site from disturbed areas, under current plans.

Q14. Does WAWA still consider Ellen Brook as a potential source of domestic water? If so, where is it likely to be dammed? Would damming upstream affect the tortoise habitat?-P23.

The Water Authority still considers Ellen Brook as a potential source of domestic water (Mauger, G.: Planning Future Sources for Perth's Water Supply - 1989 Revision). It is a currently preferred option, although further investigation is required. The most likely implementation date is post 2012.

A preliminary dam site, as indicated in the above planning document, is located near to the confluence of Ellen Brook and the Swan River. It would only be a pipehead dam and the constraints of nearby residential land suggests that the dam height would need to be relatively low. (Pipehead dams are designed to inject water directly into the reticulation system, with or without treatment and therefore only function during the winter months. They are not water storages for the summer period).

The Water Authority would need to demonstrate that the proposal would not affect the tortoise habitat.

Ground Water Impacts on Short-Necked Tortoise Habitat

Q15. What data has been used to show the presence and depths of perched water tables and groundwater table levels?-P26. Does the perched groundwater sit on the plastic clay zone to be mined? If it does, won't the mining of clay cause these perched groundwater pockets or lenses to drain into the excavation? If such a scenario is possible and happens, wouldn't this affect the water levels in the current and future tortoise habitat areas?

Groundwater data has been collected from numerous monitor bores installed during a number of studies conducted in the area since November 1986 (refer to Table 1 in the CER). Prior to about mid-1989, investigations at each of the proposed excavation sites were conducted in isolation and monitoring has not been conducted on a continuous basis at each site. Monitor bores (simple tube piezometers) were installed and generally only monitored for one season to establish the principal groundwater characteristics such as relative depths of the main groundwater table, perched groundwater and the target clay layer.

The only long term records available are from two Water Authority monitor bores near to Ellen Brook, in the vicinity of Lexia Avenue. (See Figure 2 for approximate locations). Up-dated hydrographs have recently been obtained from the Water Authority (Figures 3 and 4).

Figure 3 (Bore A) shows that the permanent water table is at about 12 metres AHD in the vicinity of Lexia Avenue and has fluctuated within a 1.0 metre range during the eight year period 1979 to 1987. Seasonal fluctuations as little as 0.4m have been recorded. Well EE9 (Figure 4) exhibits larger fluctuations in water level which probably reflects its proximity to Ellen Brook and interaction with winter flood levels in the watercourse.

The locations of monitor bores installed by Prestige Brick are shown on Figure 5, along with dates of installation and the initial monitoring period. Monitoring was conducted to establish a groundwater minimum (end of summer) and a groundwater maximum (end of winter recharge period). The three deep bores were installed to a depth of 15 metres and

the ten shallow bores installed at depths between 3 and 4 metres below ground level. Maximum groundwater levels recorded during the period of monitoring are provided below.

(i) Deep Bores

Number	m(AHD)
2	11.94
10	10.99
14	10.32

(ii) Shallow Bores

Number	m(AHD)	
1	15.95	dry, March to July
3	15.35	dry, March to July
4	19.70	dry, March to July
5	(always dry)	
6	16.63	always wet
7	19.20	dry, March to June
8	16.08	dry, March to July
9	(always dry)	
11	17.83	dry, March to July
15	(always dry)	

The large variations in water levels in the shallow bores over relatively short distances are taken to indicate strong heterogeneity in recharge characteristics and very localized, perched groundwater systems. In addition, whilst care was taken in siting the bores away from flood-prone land and the bore casings were sealed at ground level, the possibility that surface water has leaked into some of the bores down the outer annulus, can not be discounted. In this instance, a shallow bore would give a false water level record, and shallow groundwater may be absent at that specific site.

The perched groundwater occurs above the plastic clay layer to be mined, but is not

necessarily perched on the clay layer. That is, the full thickness of overburden sediments is not necessarily a 'continuous' aquifer. There is considered to be a high degree of variability in the hydraulic conductivity of the shallow sediments as they are known to vary from almost 'pure' sand to strong sandy clays and gravelly clays. In addition, the experience of the clay extraction industry in the Swan Valley is that there is a high degree of lateral variability in the characteristics of both the overburden and the clay. The clay itself is not continuous, therefore it is highly unlikely that perched groundwater occurs other than in small 'pockets'.

If, in the process of clay mining, the excavation intersects a shallow zone of water-bearing sediments, then it is acknowledged that water would most likely drain into the excavation. However, this would only affect water levels in the current and future tortoise habitat areas if the following circumstances apply:

- that surface water levels in the tortoise habitat areas are maintained or augmented by the presence of shallow groundwater (rainfall could be the sole source of ponded water);

- that the shallow groundwater is continuous from the habitat areas to the clay excavation site.

Experience with existing clay pits in the locality strongly suggests that large 'bodies' of perched groundwater are very much the exception. This is supported by the monitor bore data.

Q16. Land east and south of the EBNR could be hydraulically linked to the tortoise habitat area. For example, data presented on P35 and Figure 11 shows a potential link between the perched water tables and the current and future tortoise habitat areas, and Figure 12 shows the perched groundwater level is higher than the tortoise swamp. Without more conclusive data to show that the water levels in the habitat areas are independent of the proposed excavations, then any mining east and south of the current and proposed extensions to the tortoise habitats should be progressed with great caution.

Are the proponents prepared to make a commitment not to mine within a specified distance from the reserve without further investigations and the approval of EPA?

It is noted that CALM has suggested an arbitrary distance of 100 metres as a buffer zone for the nature reserve, where clay quarrying should not occur unless proven to pose no risk to the tortoise habitat.

Prestige Brick's property is at least 100 metres from the proposed southerly extension of the nature reserve and may in fact be 150 metres or more if current 'land-swap' initiatives are not fruitful.

Q17. To assist EPA's assessment of likely impacts on the short necked tortoises' habitats, could the proponents provide a cross-section showing the perched and permanent water table levels relative to the water levels in the swamp, reserve, creeks and drain.-P.28.

A schematic cross-section is provided in Figure 6 (see Figure 5 for the approximate location). It is schematic only because, unfortunately, we have insufficient accurate data on reduced levels of the ground surface to draw a complete cross-section for the area traversed.

Q18. Mining should stay 1 to 2 metres above the water table and the proponents should be prepared to make a commitment to this effect. Groundwater table levels need to be established prior to mining to ensure this doesn't happen.

Prestige Brick commit to not excavating below the permanent water table and if the excavation did reach the water table, the area would be backfilled to maintain at least 1 metre of cover. The existing monitor bores would be used to establish the position of the water table prior to excavation. If the existing deep bores are no longer useable, a new bore would be installed.

Q19. Detail on the presence and lateral continuity of the perched water table seems critical in achieving an understanding of the hydrology of the tortoise habitat area. Is there more data than that presented in Figure 11 that could assist EPA in evaluating these proposals?

Additional data from the groundwater investigations conducted by Prestige Brick is provided under question 15 above and on Figures 5 and 6.

Q20. Has there been coring of the swamp to substantiate the claim that clayey sediments of the swamp represent a strong aquitard?-P39.

No coring of the swamp has been conducted. The claim that the clayey sediments represent a strong aquitard is based on direct observation of the strong, grey clay in the swamp and the fact that it 'holds' water so effectively once rainfall has ceased. Note that the swamp is bounded by 'drainage-depressions' on the northern side (Ellen Brook) and to the west, south-west and south (nature reserve drain). If the swamp sediments were not a strong aquitard and did allow water to infiltrate into the sub-surface, then water levels would be observed to decline more rapidly via:

- vertical sub-surface drainage to the underlying deep water table, or
- horizontal sub-surface drainage to the adjacent 'drainage-depressions'.

Q21. What is the source of water for dust suppression and does this affect other water users in the area?

Water for dust suppression would initially be obtained from local stand pipes (the appropriate charges would be paid) or the company's other excavation sites at Muchea. Subsequently, 'dams' would be formed within the excavation to collect runoff and direct rainfall to provide water for this purpose.

Impacts on Other Water Users

Q22. The superficial aquifers of the area directly recharge the Leederville Formation, which is an important source of water for both private and public water supply. What measures will the proponents take (and commit to) to ensure diesel or oil spillage does not contaminate the aquifer?

Only the excavation machinery (dozer and hydraulic excavator) will be refuelled on-site; the trucks will be refuelled elsewhere. On-site refuelling will be conducted by visiting tanker, which is considered to pose negligible risk of a serious diesel spill.

If a substantial spillage occurs, the contaminated sediments will be excavated and removed from the site to an approved disposal location. The Red Hill tip site or the Shire of Chittering's Muchea tip site would be the most secure landfill sites in the vicinity.

Q23. Do the proponents intend to monitor private well levels prior, during and after mining the area to gauge and manage the impact of dewatering of the pits?

No. Dewatering of groundwater from the main aquifer will not be conducted.

Rehabilitation

Q24. What are the proposed and potential long term uses for the site after excavations are complete? Who will be consulted and to whose satisfaction will the work be carried out?

The proposed use of the site after excavation is complete is either rural-residential (low density) or agricultural (grazing etc).

Rehabilitation will be conducted to the satisfaction of the Shire of Swan under the terms of an excavation licence. Prestige's initial application for an excavation licence proposed that the site would be completely backfilled, however, if it is considered more desirable to leave a lake or dam then this would be a preferred option.

Q25. Given a swell factor of 35% for over-burden, how quickly does the material settle down to a stable surface following rehabilitation of the pit? What restrictions on land use are there after rehabilitation of the pits?

From Prestige Brick's experience most of the settling occurs in the first two years with respect to suitability for general agricultural use. It may take many years (5-10) before the site could be used for building upon, although it is believed to offer suitable foundations in the long term.

Q26. Midland Brick's proposal on the corner of Apple Street and Great Northern Highway is not considered short term (8 years!) and, being close to the highway, is exposed to constant observation by the public. The area may require special rehabilitation treatment, such as sequential rehabilitation after excavation, screens of trees and strategically placed overburden stockpiles, to minimise visual impacts-P17.

Question not relevant to Prestige Brick.

Q27. Do the proponents intend to hydro-mulch overburden stockpiles which are not put back (rehabilitated) in the same season to minimise dust and visual impacts?-P46.

It is proposed to use overburden stockpiles for visual screening and noise buffering purposes and therefore, hydro-mulching for grass cover is intended. This has been conducted at the Railway Parade pit (near to the Upper Swan Research Station) and elsewhere with excellent results.

The company also intends to plant native trees along Apple Street and Almeria Parade boundaries for screening purposes. Planting would commence as soon as approval is given which will hopefully be 3-4 years in advance of excavation.

Q28. EPA would prefer a commitment from proponents to progressively restore the pits to a landform with an enhanced aesthetic appeal, to the satisfaction of EPA.

Prestige Brick are prepared to commit to progressive restoration of the pits (presumably an annual restoration effort is being suggested as satisfactory to EPA). However, other environmental management prerequisites may preclude sequential rehabilitation for a number of years. For example, the use of overburden for visual and noise screening means that this proportion of material will not be available for restoration work until the end of the programme. In addition, the potential requirement to retain runoff on-site for the purpose of protecting nearby tortoise habitat, may mean that the maximum area/volume of excavated land should be retained for water handling purposes.

Q29. Some setback requirements near property boundaries could possibly be eliminated in a regional rehabilitation scheme, to allow efficient utilisation of the clay resource and rehabilitation to wetlands-P58. What pro-active work have the proponents carried out to introduce a regional rehabilitation strategy for the areas being mined in the Upper Swan Valley?

The setback requirements could possibly be relaxed between this site and the adjoining site to the east, to be quarried by Midland Brick. However, this would be dependent on the owner of the adjoining lot, who will still be in residence as clay quarrying is conducted.

In relation to a regional rehabilitation strategy, an approach was made to DPUD in 1990 to advise of the extent of quarrying that was proposed in the area. This approach was made when it was found that DPUD was initiating a Structure Plan for the 'foothills' region north of Midland. Discussions were held with Mr Tim Aurett who advised that the Structure Planning exercise is preliminary only, and that the area would remain available for clay excavation because of the scarcity of this resource. In the long term it should be assumed that the area will become urban. However, this is not likely to occur for at least 25 years.

Rehabilitation of the area with a mix of lakes and recontoured land would be consistent with future urban development intermingled with open space for passive recreation. The company is prepared to liaise further with Planning Authorities, as required during the lifetime of the excavation, to ensure compatibility with long-term plans for the area.

Q30. What is meant by amenity lakes?-P56.

An amenity lake in this context refers to a clay pit which has been recontoured to form a basin that collects and holds water. Its primary purpose is to provide a landscape with aesthetic value. Open water areas are generally regarded as visually attractive and can form the basis of 'added-value' for future development or as a focal point for public open space.

Aboriginal Sites

Q31. The proponents should keep in mind the requirements of the Aboriginal Heritage Act. -P20. Do the proponents intend consulting with traditional landowners as well as current ones? Will a survey for sites of significant archaeological and ethnographic interest be carried out?

In response to a letter addressed to the company's environmental consultant from the Swan Valley Fringedwellers, an approach was made to both the Robert Bropho group and the Corrie Bodney group for the purposes of facilitating further consultations. A direct approach was made at the suggestion of the WA Museum, because at the time, Robert Bropho in particular, had indicated a reluctance to consult with any of the practising ethnographic/archaeological consultants in Perth.

A follow-up consultation attempt will be made once environmental approval is granted, with the objective of establishing the need for a detailed ethnographic/archaeological survey to satisfy the requirements of the Aboriginal Heritage Act.

Other Rare Species Impacts

Q32. CALM notes the existence of declared endangered flora *Hydrocotyle lemniodes* (Aquatic pennywart). No mention of this species occurs in the text. Does rehabilitation lend itself to propagation of this species?-P21.

Q33. CALM does not mention the shield shrimp. What is the distribution of this species? Does rehabilitation of the clay pits lend itself to the propagation of this species?-P22.

No further investigations have been conducted in relation to the matters raised here. On page 59 of the CER, the option of rehabilitation of clay quarries for tortoise habitat was briefly considered, along with the alternative option of expanding the existing nature reserve into areas that are not proposed for clay excavation. It is noted that CALM is presently pursuing the second option.

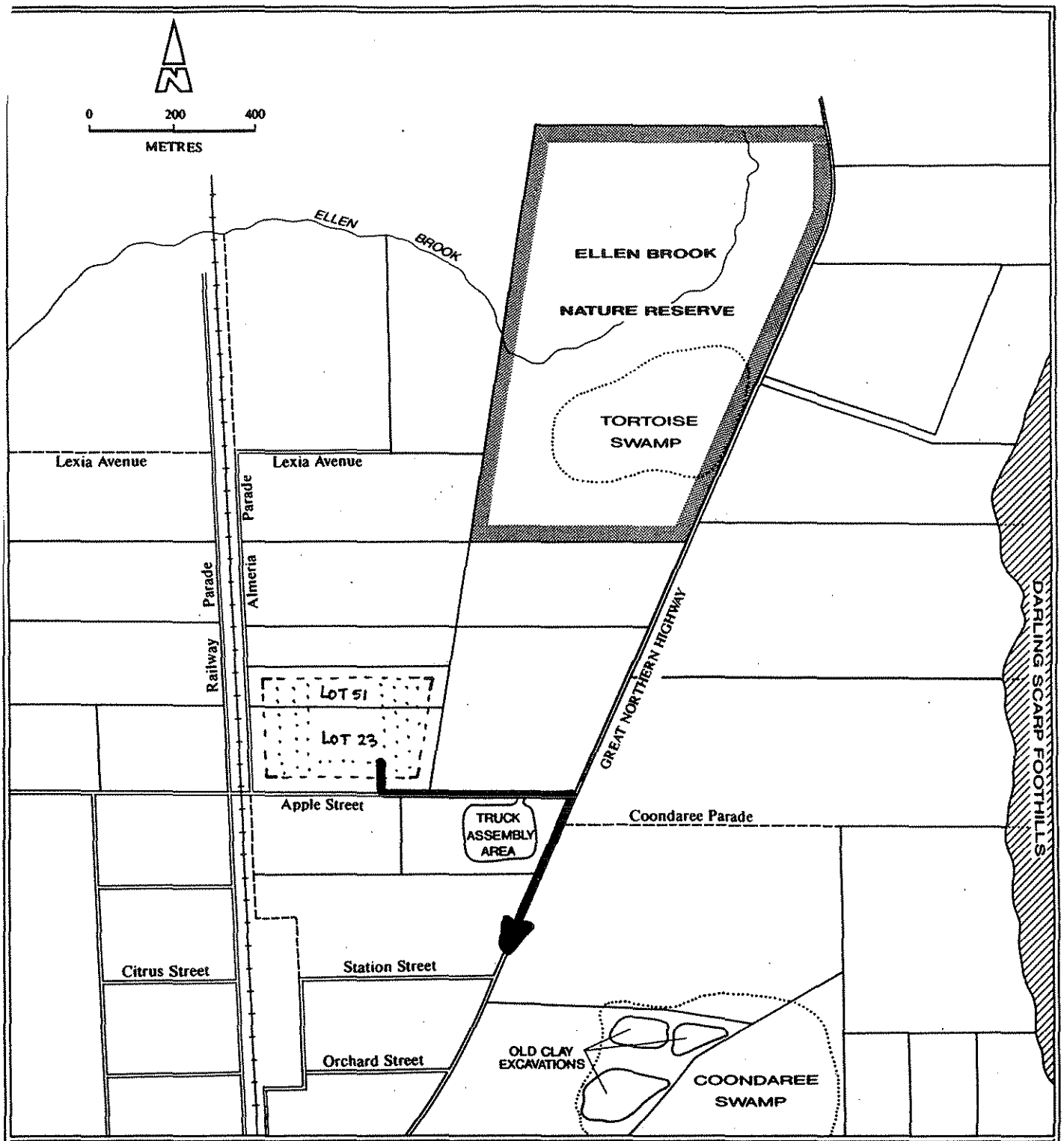
Environmental Monitoring and Management Programme (EMMP)

Q34. Management practices (P43&56) should be prepared for each proposal and either made as commitments or incorporated into an EPA - approved EMMP.

Prestige Brick commits to preparation of an EMMP to the satisfaction of EPA prior to commencement of operations at the site.

The fundamental approach in the EMMP would be to outline a trial excavation on the site and the manner in which it would be monitored to verify the acceptability of the operation. It is considered premature to prepare the EMMP at this stage for the following reasons:

- it would further delay the process of Ministerial approval, without which there seems little point in conducting further preparatory work;
- the company does not intend excavating the site for at least four years and in this time, there are likely to be alterations to the existing drainage regime which may influence the management requirements of the proposed operations;
- the future boundaries of the expanded nature reserve have not yet been defined, which may also affect the approach required in excavation management and monitoring.



LEGEND

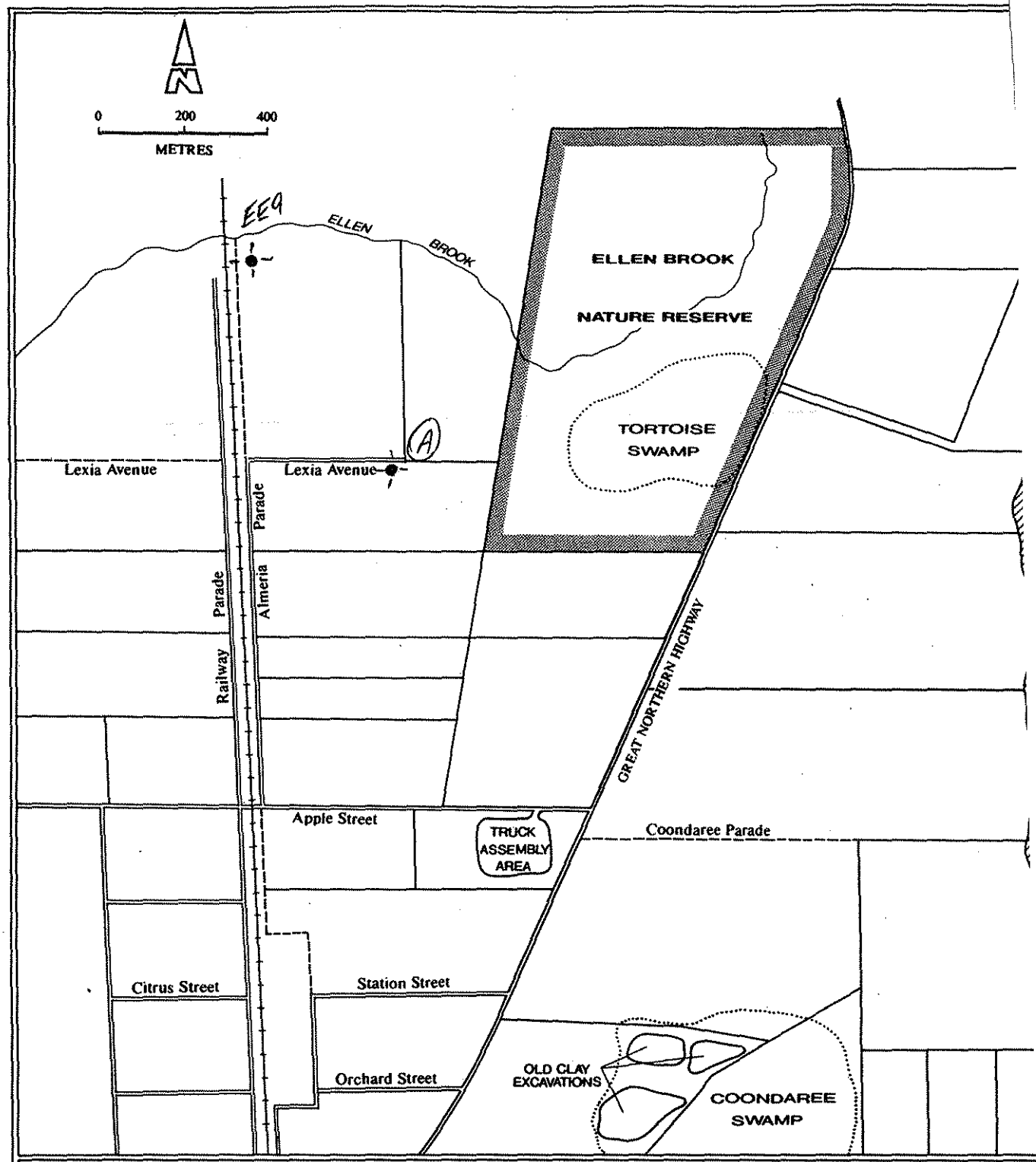
Constructed roads

Road reserve (not constructed)

Standard gauge railway

PROPOSED ACCESS

FIGURE 1



LEGEND

Constructed roads

Road reserve (not constructed)

Standard gauge railway

Water Authority Monitor Bores

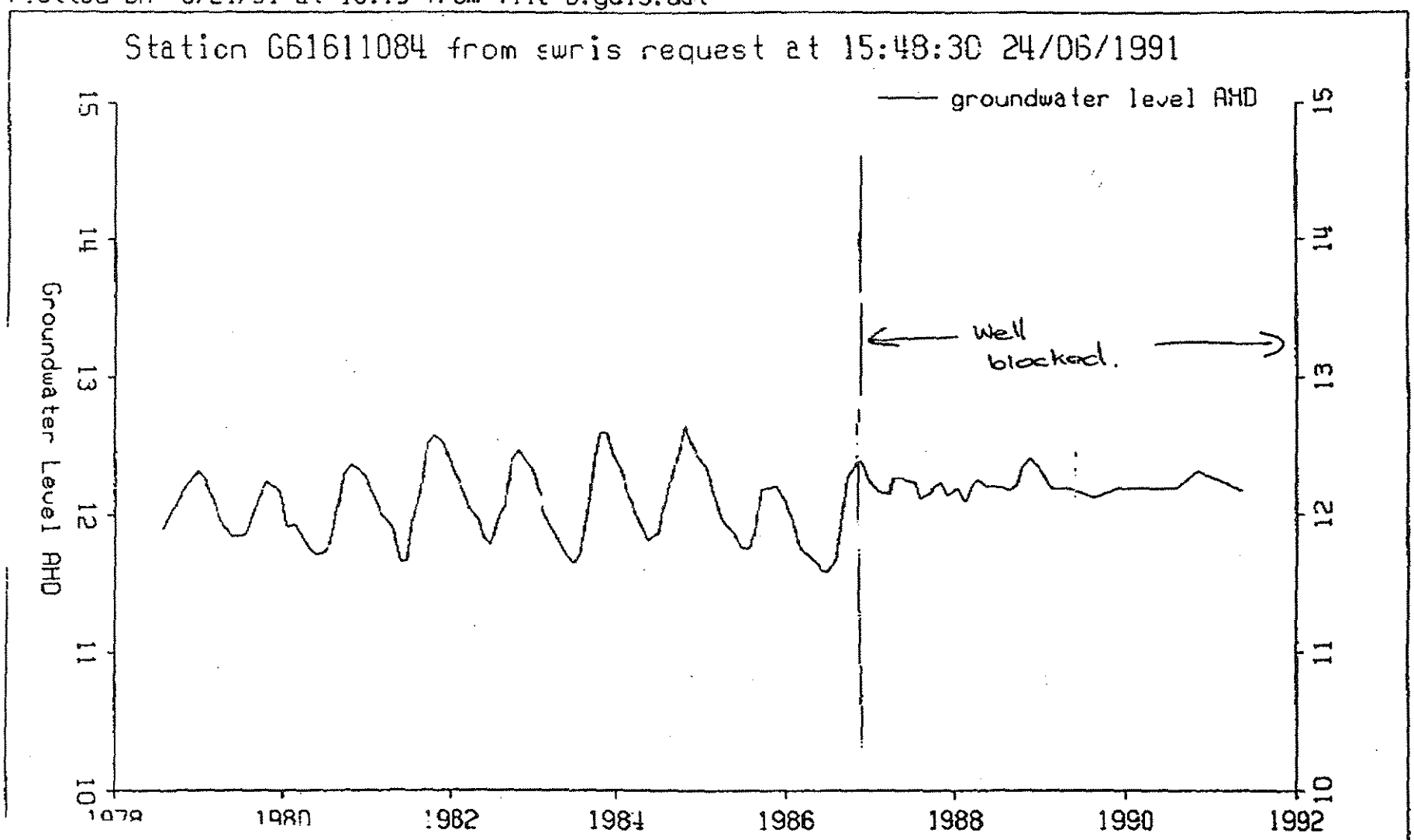
FIGURE 2

BOWMAN BISHAW GORHAM

Figure 3

Bore (A)

Plotted on 6/24/91 at 16:13 from file b:gd13.dat



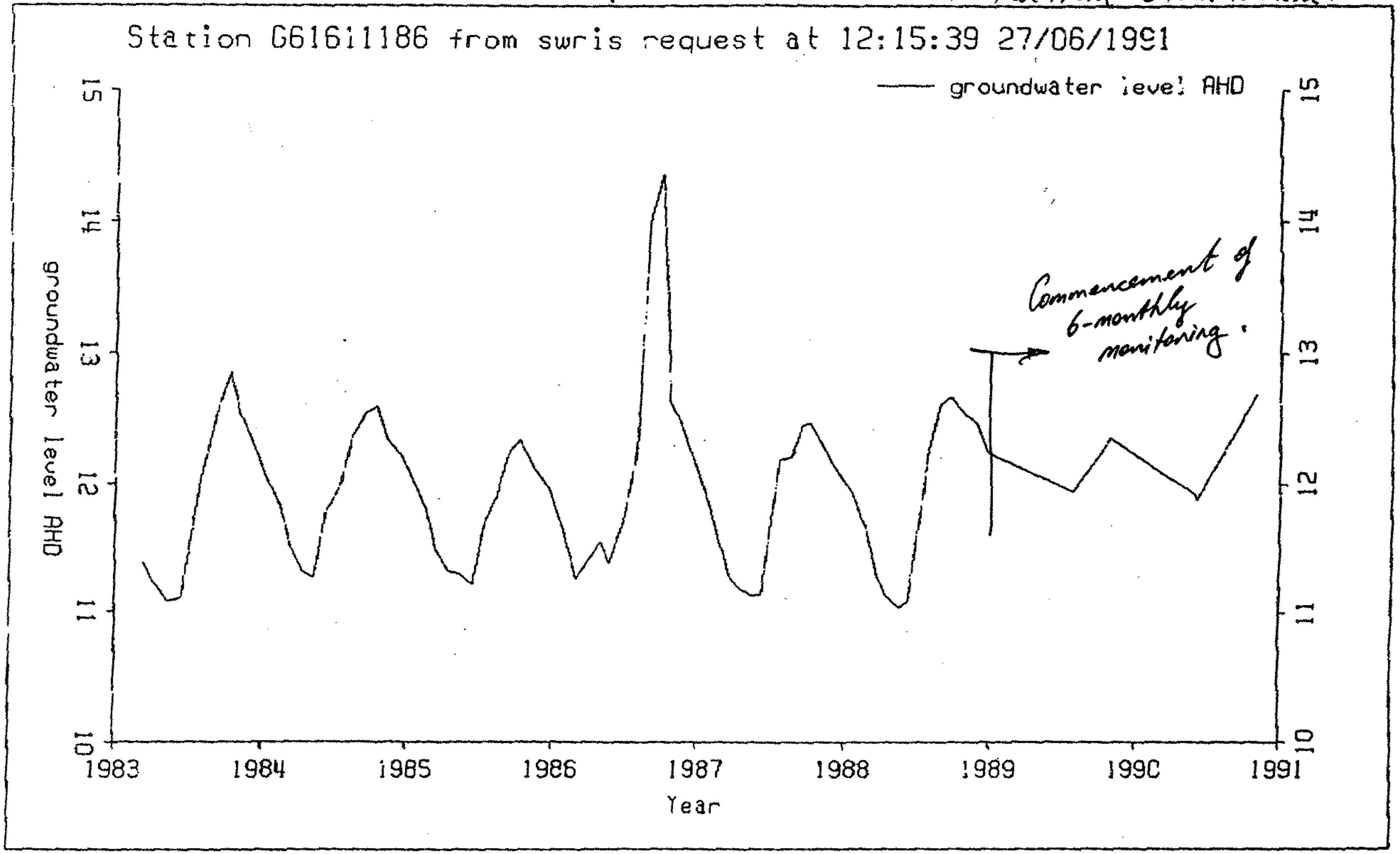
FIGURE

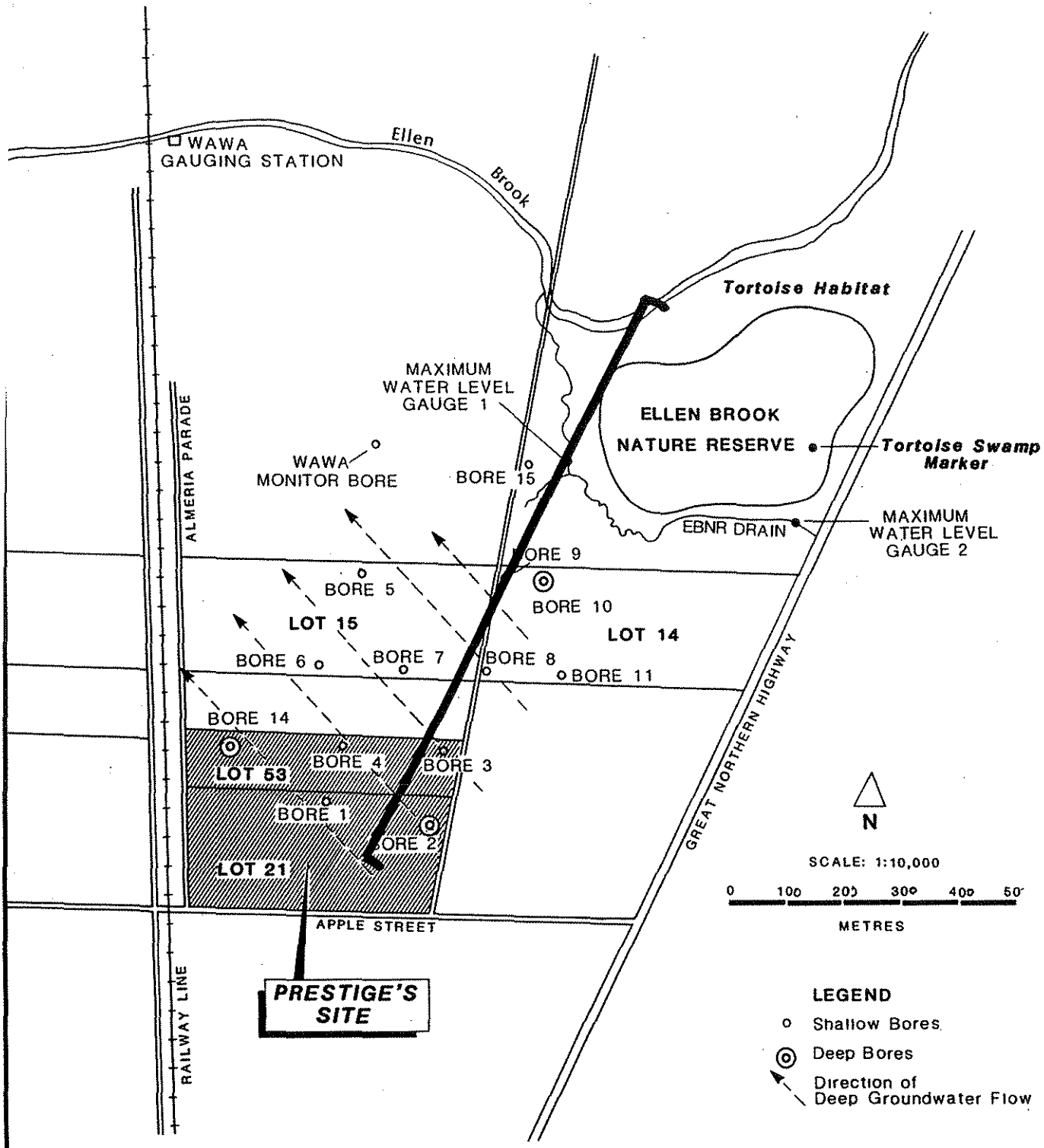
Well EE9

Total depth = 12 m

Slotted from 3.75m to 12m.

Plotted on 6/27/91 at 12:48 from file ee.pic





Cross-Section
(See Figure 6).

(*) Bores installed in March, 1989 and monitored until December, 1989 (The deep bores, #2 & #14, were monitored until March, 1990).

LOCATION OF MONITOR BORES

FIGURE 5

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 22 YEARS OF RECORDS

FIRST YEAR : 1965 LAST YEAR : 1987 NUMBER OF MISSING OBSERVATIONS (AS PERCENTAGE OF MAXIMUM POSSIBLE) : 43.79 %

STATION : 009067 MIDLAND (UPPER SWAN RESEARCH STN.) 31 45 S. 116 01 E 15.0 M ELEV

JANUARY 0900 HOURS LST

DIRN	CALM 7	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		1	1	1	*				3
NE		2	4	5	3	1	1	*	15
E		*	6	11	5	3	1	2	28
SE		1	5	5	1	*	*	*	12
S		2	5	4	1	*			12
SW		4	4	7	2	*			16
W		*	1	1	*	*			3
NW		1	2	1	*				4
ALL		11	26	35	12	5	2	2	

NO. OF OBS. 420

FEBRUARY 0900 HOURS LST

DIRN	CALM 6	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		1	2	1		*			4
NE		2	5	5	3	1	*		15
E		2	7	12	9	5	2	1	38
SE		1	2	5	1	*		*	10
S		3	4	4	*	*			11
SW		2	4	3	*	*			10
W		1	1	1	*				3
NW		1	1		*				2
ALL		13	24	32	13	7	2	1	

NO. OF OBS. 419

MARCH 0900 HOURS LST

DIRN	CALM 10	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		2	2	1	*	*			5
NE		2	5	7	3	1	*	*	19
E		2	6	7	6	4	2	3	29
SE		2	3	4	1	*		*	10
S		3	4	3	*				11
SW		1	5	3	*				9
W		1	1	1					3
NW		1	1	1	*				3
ALL		15	27	26	11	5	3	3	

NO. OF OBS. 423

APRIL 0900 HOURS LST

DIRN	CALM 18	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		6	3	1	*		*		10
NE		5	4	6	1	1	*	*	17
E		2	3	6	4	2	2	1	20
SE		2	2	2	1	*	*		7
S		4	3	2	*				9
SW		3	1	3	1				7
W		2	1	1					3
NW		2	4	1	1		*		8
ALL		24	20	21	9	3	3	2	

NO. OF OBS. 399

JANUARY 1500 HOURS LST

DIRN	CALM 6	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N			*						*
NE		1	2	1	*				4
E		2	4	4	1	1	*	*	12
SE		2	3	6	*				11
S		1	2	3	1	*			8
SW		2	6	23	13	4	1		49
W		1	2	4	1	*			8
NW		1	*	*	*	*			2
ALL		8	21	40	18	5	1	*	

NO. OF OBS. 358

FEBRUARY 1500 HOURS LST

DIRN	CALM 5	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		1	1	*	*				2
NE		1	2	1	*				4
E		2	5	6	4	1	*		18
SE		2	5	4	2	1	*		14
S		1	2	4	1				7
SW		1	8	17	10	2			39
W		1	3	3	*				8
NW		1	1	1	*				2
ALL		10	26	36	19	4	1		

NO. OF OBS. 353

MARCH 1500 HOURS LST

DIRN	CALM 5	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		1	1	*	*				2
NE		1	2	1	*		*		5
E		1	6	7	4		*		18
SE		2	5	4	2	*	*	*	13
S		1	3	4	1	*			8
SW		3	8	17	8	2	*		38
W		*	3	2	2	*			8
NW		*	*	*	1	*	*		2
ALL		9	29	35	18	3	1	*	

NO. OF OBS. 371

APRIL 1500 HOURS LST

DIRN	CALM 9	SPEED (KM/HR) 1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		3	1	1	*	*			5
NE		1	2	1	1	*			5
E		3	5	4	3		*		15
SE		2	2	2	1		*		8
S		1	3	3	1	*		*	8
SW		3	8	13	6	1		*	32
W		1	5	4	2				12
NW		1	2	2	1	1			6
ALL		15	28	29	14	2	1	*	

NO. OF OBS. 330

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M.I.S.S. 16/ 4/91

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 22 YEARS OF RECORDS

FIRST YEAR : 1965 LAST YEAR : 1987 NUMBER OF MISSING OBSERVATIONS (AS PERCENTAGE OF MAXIMUM POSSIBLE) : 43.79 %

STATION : 009067 MIDLAND (UPPER SWAN RESEARCH STN.) 31 45 S, 116 01 E 15.0 M ELEV

SEPTEMBER 0900 HOURS LST

CALM: 18

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	7	5	3	*	*			15
NE	7	5	6	2	*	*	*	19
E	1	3	3	2	3	1	1	13
SE	1	2	1	*	*	*	*	5
S	2	3	1	*	*			7
SW	3	2	2	1	1	*		8
W	1	1	4	*	1	*		6
NW	1	4	2	1	*	*		9
ALL	23	24	20	6	6	2	1	

NO. OF OBS. 398

OCTOBER 0900 HOURS LST

CALM: 11

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	2	2					6
NE	5	2	4	1	*	1	*	13
E	1	3	7	2	3	2	1	20
SE	2	4	2	1		*	*	10
S	3	6	2	1		*	*	12
SW	2	3	4	2	1			12
W	1	2	3	1	1			8
NW	2	4	2		*			8
ALL	17	26	26	10	5	2	2	

NO. OF OBS. 401

NOVEMBER 0900 HOURS LST

CALM: 9

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	2	1	*	*			5
NE	1	5	4	1	1		*	13
E	1	4	6	3	4	1	1	21
SE	2	4	3	*	*			10
S	4	7	2	*	*			13
SW	2	7	5	3	*	*	*	19
W	*	2	2	*	*		*	5
NW	1	2	2	*	1	*		5
ALL	13	33	25	10	7	1	2	

NO. OF OBS. 407

DECEMBER 0900 HOURS LST

CALM: 9

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	*	2	*	*			4
NE	2	3	6	2	1	*	*	14
E	2	6	9	6	2	1	1	26
SE	2	3	2	1	1			9
S	2	4	3	1	*			10
SW	3	4	7	2	*			15
W	1	1	2	1	*			5
NW	2	3	1	1	*			7
ALL	14	24	34	13	4	1	1	

NO. OF OBS. 381

SEPTEMBER 1500 HOURS LST

CALM: 8

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	2	1	1	1	*			4
NE	2	2	2	*	*			7
E	2	2	2	*	*	*		7
SE	2	2	2	*		*		6
S	4	5	3	*				12
SW	3	7	11	4	2	1		27
W	1	4	7	3	2	*		17
NW	1	2	5	3	2			12
ALL	16	24	33	12	6	1		

NO. OF OBS. 361

OCTOBER 1500 HOURS LST

CALM: 6

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	1	*	*					1
NE	1	1	1	*		*		4
E	2	3	3	1	*	1		10
SE	2	1	2	1	*			6
S	1	4	4	*	*			10
SW	2	9	20	9	1	1		41
W	1	4	5	4	1	*		14
NW	1	1	3	2	1	*		8
ALL	12	23	38	16	3	2		

NO. OF OBS. 352

NOVEMBER 1500 HOURS LST

CALM: 5

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N	*	1	*					1
NE		1	1	*				2
E	1	3	3	2	*	*	*	10
SE	1	2	2	*			*	7
S	1	3	4	2	*	*	*	9
SW	2	5	24	14	4	*	1	50
W	1	2	5	2	1	1		11
NW	*	2	2	*	*	*		5
ALL	5	18	42	21	6	1	1	

NO. OF OBS. 361

DECEMBER 1500 HOURS LST

CALM: 6

DIRN	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 & UP	ALL
N		*	*					*
NE	1	1	1	*				3
E	1	3	3	1	*	*		9
SE	*	3	3	*	*	*		7
S	2	2	3	2	*			9
SW	3	5	25	14	7			53
W	1	3	5	1	*			10
NW		*	1	*				2
ALL	9	18	41	19	8	*		

NO. OF OBS. 320

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M.I.S.S. 16/ 4/91

BUREAU OF METEOROLOGY - SURFACE WIND ANALYSIS

PERCENTAGE OCCURRENCE OF SPEED VERSUS DIRECTION BASED ON 22 YEARS OF RECORDS

FIRST YEAR : 1965 LAST YEAR : 1987 NUMBER OF MISSING OBSERVATIONS (AS PERCENTAGE OF MAXIMUM POSSIBLE) : 43.79 %

STATION : 009067 MIDLAND (UPPER SWAN RESEARCH STN.) 31 45 S, 116 01 E 15.0 M ELEV

MAY 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		9	6	2	1	*			18
NE		10	9	8	2	1	*		30
E		2	3	3	2	1	1	1	12
SE		1	1	*	*				2
S		2	1	*	*				5
SW		1	2	1	*			*	4
W		2		1	1	*		*	4
NW		4	2	*		*			6
ALL	21	29	24	16	7	2	1	1	

NO. OF OBS. 470

JUNE 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		9	7	5	1	*			22
NE		11	10	6	3	*		*	30
E		2	2	3	1	*	*	*	8
SE		1	*	*					2
S		2	1	*					3
SW		1	1	1	*				3
W		*	1	*	*				3
NW		2	1	1	*		*		5
ALL	25	28	23	16	6	*	1	1	

NO. OF OBS. 409

JULY 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		13	7	3	1	1	*		24
NE		12	6	6	1	*	*		25
E		1	1	2	1	2		1	8
SE		1	*	*	*				2
S		1	1	1					3
SW		1	2	1	*	*	*		4
W		1	*	1	*		*		2
NW		3	2	2	1	*	*		8
ALL	23	32	20	15	4	3	1	1	

NO. OF OBS. 472

AUGUST 0900 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		9	4	3	1				17
NE		*	7	5	2	1	*		24
E		2	2	3	2	1	1	*	11
SE		1	1	1	*				3
S		3	2	1	*				5
SW		1	2	2	1	*	*		6
W		1	1	1	1	1	*		4
NW		2	2	1	1	*			6
ALL	24	27	20	17	8	3	1	*	

NO. OF OBS. 466

MAY 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		3	1	1	*	*	*		6
NE		3	4	3	*		*		10
E		2	5	3	2				12
SE		2	2	1	*				5
S		3	4	2	1		*		11
SW		4	5	5	2	1	*		17
W		1	6	4	1	1	*		14
NW		3	2	4	2	1			12
ALL	13	21	31	23	8	2	1		

NO. OF OBS. 394

JUNE 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		4	3	3	1	*	*		11
NE		4	5	3	*	*			14
E		2	5	4	*	*			11
SE		1	2	1					4
S		2	1	3	*				7
SW		2	4	4	1	1			13
W		3	4	3	2	*			12
NW		3	3	5	2	*	*	*	13
ALL	16	21	27	27	7	3	*	*	

NO. OF OBS. 348

JULY 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		7	5	3	1	*			15
NE		4	2	2	1				9
E		2	3	3	1	1			9
SE		1	1	*		*			2
S		3	3	1	*				6
SW		2	6	5	1	*		*	15
W		2	4	4	1	*	*		12
NW		3	5	3	2	1	*	*	14
ALL	18	24	27	21	6	2	1	1	

NO. OF OBS. 415

AUGUST 1500 HOURS LST

DIRN	CALM	1 TO 5	6 TO 10	11 TO 20	21 TO 30	31 TO 40	41 TO 50	51 TO UP	ALL
	SPEED (KM/HR)								
N		3	2	2	*	*			8
NE		2	3	2	*	*			8
E		2	3	3	1	1			11
SE		2	1	1	*				4
S		3	3	2	*	*	*		9
SW		2	6	10	2	2	*	*	23
W		1	3	5	2	1	*	*	13
NW		2	2	4	1	1	*		11
ALL	14	18	25	29	8	5	1	*	

NO. OF OBS. 416

* OCCURRED BUT LESS THAN 0.5 PERCENT

PRODUCED BY M.I.S.S. 16/ 4/91

Appendix 3

Clarification of proposal and drainage modifications, March, 1992

PRESTIGE BRICK

6 March, 1992

The Chairman
Environmental Protection Authority
9th Floor Westralia Square
38 Mounts Bay Road
PERTH WA 6000

ATTENTION: Mr Shane Sadlier

Dear Sir

Re: Clay Excavation
Lots 23 and 51 Almeria Parade, Upper Swan

After our discussion on site on 26 February 1992, I would like to clarify and summarise the more important issues.

1. The first area is to be mined in approximately two to three years (1994 - 1995) and will be situated in the eastern quarter of Lots 23 and 51 (formerly Stage 4 of our earlier proposal).

   The permanent access road off Apple Street will be positioned 30 metres from the boundary of Lots 22 and 23. This access is as far from the Upper Swan townsite residences as possible and still a safe distance from the entrance to the heavy haulage assembly area.

   This will minimise the impact on the local residents.

2. Bunding will be formed on the Eastern, Western and Southern side of the first area prior to excavation. This will lessen any noise and dust affects, as well as act as a visual screen.

   The bunds formed in each quadrant will catch and divert all water into the dams so formed and, therefore, no silt laden water occurring as a result of the excavation process will enter the road drainage system or the Ellen Brook Nature Reserve over the life of the excavation.

54383

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Prestige Brick Pty. Ltd.
A.C.N. 009 266 273
Military Road, Midland, Western Australia
Telephone: Administration (09) 250 2111 • Sales (09) 274 5333
Administration Fax: (09) 274 1585 • Sales Fax: (09) 250 1170
P.O. Box 1245 Midland, Western Australia, 6056

Bunds formed on the boundary with Lots 22 and 23 and along Almeria Parade and Apple Street will remain for the entire life of the excavation.

3. Original test drilling was carried out in a dry summer and showed a total depth of 12 metres before encountering water. Further information and experience since this time indicates the water table to be just below 8 metres in summer. We therefore wish to state that we will not excavate below the water table.

4. The end use has now been reassessed and we will follow the more aesthetically pleasing and practical recommendations given to us to have small amenity lakes left in each quadrant mined. These may be joined later to form one long natural lake on the Northern side of Lot 51.

5. If the dams eventually fill and overflow in the longer term, it will enter the Almeria Parade drain and this quantity of water will be insignificant in comparison to the volumes currently entering the drainage system.

   Each dam, in each quadrant, will have a capacity of approximately 25,000 cubic metres and each season of operation the water in the dam will be used for dust suppression on haulage roads. This usage, together with evaporation and seepage loss, will almost empty the dam each season.

6. Clean runoff will be deflected by the bunds into the drainage system on Almeria Parade and Apple Street, however, this clean runoff will be significantly less than before the excavation.

7. Prestige Brick will commit to share, on an equitable basis with Bristile and Midland Brick Company, the costs of diverting or modifying the existing drainage system outside Lots 23 and 51 leading to the Ellen Brook Reserve from the excavation areas, provided that it is an agreed and pre-arranged specification and is solely for the purpose of protecting the CALM Reserve at Ellen Brook.

Yours faithfully

Brian Nolan

BRIAN NOLAN
Production Manager
for Prestige Brick Pty Ltd

bn:033

Appendix 4

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NOTE: These reports are available either in the libraries of the Environmental Protection Authority or the Department of Conservation and Land Management.

Appendix 5

List of those who made written submissions

Department of Planning and Urban Development

Department of Conservation and Land Management

Water Authority of Western Australia

Shire of Swan

Geological Survey of Western Australia

Department of Aboriginal Sites of the Western Australian Museum

Zoology Department of the University of Western Australia

Sanwa Vines Pty Ltd

Conservation Council of Western Australia Inc.

Fringe Dwellers of the Swan Valley Inc.