Subdivision: Concept plan and design
Lots 37 and 47 Brixton Street, Kenwick

Homeswest

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
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Summary and recommendations

The Environmental Protection Authority has assessed a proposal by Homeswest to develop a 20ha site in Brixton Street, Kenwick. Under the proposal, 12ha would be developed for a mix of housing densities and open space, with the remainder being ceded to the Department of Conservation and Land Management for management as a conservation reserve.

Fill to a depth of 0.6m is proposed over that portion to be developed to improve foundation stability and drainage characteristics of the site. This would result in the loss of vegetation over that area.

The soils are predominantly clays associated with the Guildford Formation and perched ephemeral wetlands exist in the northern portion of the site. The vegetation on the site has several unique features including declared rare species associated with the wetlands, high species diversity and rare hybrids and co-occurrences. There are at least five complexes of vegetation on the site primarily related to the varying soil types and hydrological regimes.

The proposed conservation reserve would include the discrete wetlands and the species of rare flora represented on the site but it is likely that the conservation value of the whole 20ha site would be substantially reduced.

The preservation of genetic diversity is one of the three principle objectives of "living resource conservation" identified in the World Conservation Strategy (1980). This has been endorsed at the National (National Conservation Strategy for Australia - 1983) and State (State Conservation Strategy - 1987) level. The practical implementation of these global and local objectives will become increasingly important in the context of the "ecologically sustainable development" debate.

The Authority's conservation efforts in the metropolitan area are primarily based on the System 6 Report of 1983. Other areas perceived to be worthy of conservation are generally considered through the planning process at the State and Local level. The Brixton Street site is not part of System 6, because at the time of the System 6 Study its conservation values were not fully known.

Normally the Authority would not take a lead role in assessing the effects of developments on conservation values of land outside System 6 areas. Instead the Authority prefers to work pro-actively with the planning agencies. However, early indications were that the Brixton Street site was of such ecological significance that assessment under the Environmental Protection Act would be required. This decision has been strongly reinforced by specific technical advice from the Department of Conservation and Land Management, which describes the site as:

> "...one of the most outstanding nature conservation sites for reservation on the Swan Coastal Plain, and the most important unreserved conservation land in the Perth metropolitan area."

Thus, the level of assessment was set at Consultative Environmental Review (CER) with a public review period of 4 weeks commencing on 15 February 1991 and finishing on 15 March 1991.

Two appeals were received requesting a higher level of assessment but these were subsequently dismissed by the Hon Minister for the Environment.

During the public review period, 221 submissions were received by the Authority, nearly all opposing the proposal. In addition, the Minister for the Environment received over 200 items of correspondence during the environmental assessment of the proposal which were passed on to the Authority for consideration during its assessment.

One from the Department of Conservation and Land Management advises:

> "Management of the entire Brixton Street area as a nature conservation site would be difficult, but is considered achievable. CALM would have major problems

however in managing an 8ha reserve, bounded by urban and railway, which would probably be unsustainable in the long term."

Furthermore:

> "It is probable that the reduction from 20ha to 8ha would in itself render the area unsustainable as a wetland ecosystem in the long term. The further proposal to clear 12ha of the location, cover it with 60cm of fill and surround the wetland with high density housing would further impact on the long-term viability of the proposed 8ha conservation reserve."

From the issues raised in submissions, information in the CER and its own investigations, the Authority believes that the potential environmental impacts arising from this proposal are incompatible with the maintenance of the conservation values of the area. Thus the Authority believes the project is environmentally unacceptable and makes the following recommendations:

Recommendation 1

The Environmental Protection Authority has concluded that the proposed urban development on Lots 37 and 47 Brixton Street Kenwick is environmentally unacceptable and should not proceed.

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring detailed consideration as:

- **the significance and scarcity of the ecosystem types; and**
- **the floral diversity on the site.**

Given the site's high ecological value, the Environmental Protection Authority believes that it should be preserved in its entirety and protected from future development proposals, and thus the following recommendation is made:

Recommendation 2

The Environmental Protection Authority recommends that the Department of Conservation and Land Management and the National Parks and Nature Conservation Authority investigate the merits of acquiring the land for reservation as part of the conservation estate.

Whilst making these recommendations, it should be recognised that the Authority is <u>not</u> setting a precedent in terms of development on non-System 6 areas around the Brixton Street site, and any other proposals will be judged on their merits.

1. Urban conservation and the EPA

The Environmental Protection Authority's conservation efforts on the Swan Coastal Plain are based primarily on the 1983 System 6 study. This study identified 209 metropolitan and country areas of regional conservation significance and/or regional representation of biological and physical values on the Swan Coastal plain and made recommendations for their management.

The Authority believes the integrity of System 6 areas should not be further compromised and defends them strongly. Conversely, non System 6 areas are generally not given the same level of protection. The Authority has been criticised by some sectors of the community in the past for not intervening in some urban development/conservation conflicts in non-System 6 areas.

This does not necessarily mean that all areas outside System 6 are not environmentally significant, but rather that decisions on the use of these areas should be the primary responsibility of the planning process, both at the State and Local level.

2. Introduction

Lots 37 and 47 Brixton Street comprise a total area of approximately 20ha and are located approximately 10km south east of the Perth Central Business District (see Figure 1).

The site is owned by the State Housing Commission (Homeswest) which proposes to develop a portion of the land for medium density housing.

In 1987 the Department of Planning and Urban Development (formerly the State Planning Commission) released Policy DC 1.6 titled "Development Near Metropolitan Railway Stations" in line with recent moves towards urban consolidation in existing urban areas.

Urban consolidation has many advantages including:

- reduced costs for the provision of infrastructure;
- environmental benefits in terms of reduced transport energy consumption through reduced commuter travel distances; and
- a reduction in the areal growth rate of the Perth metropolitan area.

As the Kenwick Railway Station is located 400m due south of the subject site, the majority of the subject land fits into this category, and this fact has provided much of the impetus for development.

Development of the site was referred to the Environmental Protection Authority by a conservation group in 1990 due to concerns primarily related to the floristic value of the site. The location itself is not a System 6 "reserve" area (although area M69 owned by the University Western Australia is only 700m to the north east). Nevertheless the Environmental Protection Authority decided that the potential environmental impacts were sufficient to warrant formal assessment of the proposal under Part IV of the Environmental Protection Act 1986. The level of assessment was set at Consultative Environmental Review (CER), and two appeals requesting a higher level of assessment were dismissed by the Minister for the Environment.

3. Project description

The proponent, Homeswest, recognising the special values of the wetland areas, proposes to establish a conservation reserve of approximately 8ha and develop the remaining 12ha for medium density housing. The proposed conservation reserve, to be located in the northern corner of the site, would be handed over to the Department of Conservation and Land Management with the proponent contributing to management costs. Management of the proposed conservation reserve would include the following:

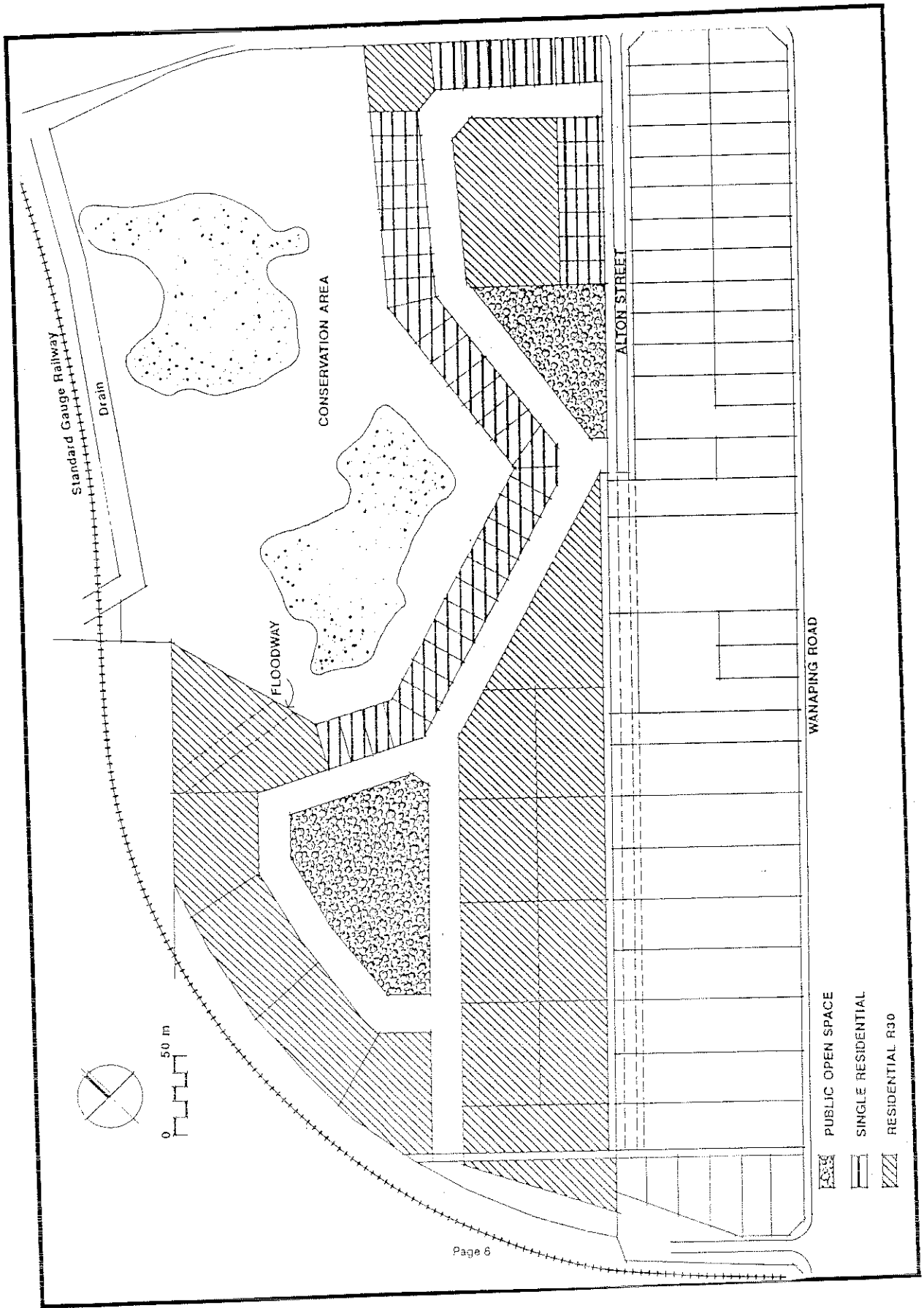

Figure 2: Site Plan (from Hames Sharley, CER)

- fencing of the reserve;
- construction of a drainage system that will isolate the reserve from the development area;
- preparation of a management plan with the Department of Conservation and Land Management; and
- control of access to the reserve.

It is proposed that block sizes in the 12ha to be developed would generally be in the range from 450 square metres to 650 square metres with the provision of a large number of group housing lots to bring the overall density to R30 (i.e. 30 dwelling units per hectare).

Development would include the provision of normal services such as sewerage, water supply, power, telephone, stormwater drainage disposal, gas, roads and street lighting. In addition, due to the ground condition and drainage problems, 0.6m of clean fill would be needed over the area to be developed.

In addition to the land given up for the conservation reserve, the usual requirement for 10% of the area to be given up for public open space would be incorporated in the development.

The proponents made several environmental commitments as part of the proposal and these are attached as Appendix 5.

4. Existing environment

4.1. Physical

The topography of lots 37 and 47 Brixton Street is generally flat with maximum height difference being only approximately 1m across the site.

In geological terms the area is on the Guildford Formation with soils consisting of sandy clay or clayey sands. Differences in soil types over the site are linked to small topographical variations, with the lower areas being more clayey. The clayey nature of much of the site and the related problems of foundation stability and stormwater drainage disposal are the predominant reasons for fill being needed as discussed in the project description.

Much of the site is "wet" to some extent in winter due to rain water becoming perched on the clay soils. There are relatively discrete wetlands (but still ephemeral, generally drying up by December) in the northern portion of the site and these are largely included in the proposed conservation reserve.

In March 1991, the Environmental Protection Authority published the Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 1991 for public comment. Regulations were published at the same time to ensure the wetlands in the Policy area were protected during the submission period. As a generality, any area which holds water at the beginning of summer (December 1) must not be filled, drained or polluted. Because of their emphemeral nature, none of the wet areas on the site are classified as wetlands under the Draft Policy.

Hydrological studies have been undertaken on the site and it has been established that there is little or no interaction between ground water and surface water on the subject land.

4.2. Biological

The value of the area for conservation rests primarily with its outstanding flora. There are at least five vegetation complexes on the site ranging from *Melaleuca laterita* shrubland in the claypan wetlands on the northern portion of the site to *Eucalyptus calophylla* (Marri) woodland on the "higher" better drained areas.

Two species of Declared Rare Flora under the Wildlife Conservation Act exist on the site and these are both closely linked to the deeper, more discrete wetlands that are largely contained in the proposed conservation reserve. These species are the Stalked Water Ribbon (*Aponogeton hexatepalus*) and the Aquatic Pennywort (*Hydrocotyle lemnoides*). In addition to the species of Declared Rare Flora, the site contains many other vegetation features that make it unusual, these include:

- 12 species of priority listed flora (priority listing for flora means that they are not Declared Rare Flora under the Wildlife Conservation Act but are sufficiently scarce to warrant further study and surveys);
- 258 indigenous species on 19ha;
- three newly discovered species not known on any other site;
- two species are known from only one other site, and another from just two other sites;
- two types of hybrid are not known from any other site, and several others are rare;
- exceptional diversity in some genera e.g. more species of *Tribonanthes* are found growing together at Brixton Street than at any other known site;
- the only known co-occurrence of *Calectasia cyanea* and *Calectasia grandiflora* ;
- 24 species of plants which are normally found on the Darling Scarp and Range are found at Brixton Street — for many this is the only known occurrence on the Swan Coastal Plain;
- 11 species are at the furthest extent of their geographical range;
- 11 of the Declared Rare Flora or priority species are found in the claypan/swampland in the northern section of the site. These species are dependant on the hydrology of the site, especially the existence of seasonal pools. Their tolerance to water quality changes and pollution is unknown; and
- five of the Declared Rare Flora or priority species are found in the shrublands adjacent to the seasonal pools, and most of their populations would be covered by landfill should the proposed development proceed.

Disturbance of the vegetation on lots 37 and 47 is generally limited to the fringes and along tracks in the interior. There have been 49 species of introduced flora identified in a total of 307 species on the site.

Detailed information on fauna of the site is not available. There can be little doubt that the proximity of the site to urban areas has resulted in impacts on fauna such as predation by introduced animals and loss of habitat. However it is likely that at least some fauna remains on the site such as invertebrates, reptiles, amphibians and avifauna, if not mammals.

4.3. Social

Preliminary investigations have indicated that there are no known Aboriginal sites on the land. However, if the development were to proceed, the proponent has given a commitment to undertake a detailed survey. The site has generally not been managed and recent human use of the site has been subjected to rubbish dumping and recreation such as trail bike riding. However, in the past few months some management of the site such as fencing and rubbish collection has been undertaken voluntarily by members of the community.

5. Submissions received

5.1. Public submissions

The CER prepared by the consultants for Homeswest was released for public comment for a period of 4 weeks from 15 February 1991 until 15 March 1991. In that time, 221 submissions were received by the Authority from different sectors of the community as represented in Table 1. This is an unusually large number of submissions for a project assessed at the CER level.

A large number of the submissions (180) were "standard" letters whereby photocopies or hand written copies of standard text are sent in as submissions. Standard letters obviously do not raise new issues after the first one of a type has been received, but they do give some indication as to the level of community concern over a particular issue.

Source of submission	Number of submissions
Individuals	204
Community Groups	11
Government Departments/Local Authorities	3
Industry	2
Political Parties	1

Table 1 - Submission source by group

In addition, during the course of the environmental assessment process, the Minister for the Environment received in excess of 200 pieces of correspondence, again predominantly standard letters.

There was a large amount of local interest in the project but submissions were also received from all over the Perth metropolitan area and a small number from rural areas.

The submissions reflected a wide range of community concern, and the Table 2 presents a breakdown of concerns by issue group. A more detailed breakdown can be found in Appendix 1. (Some related issues were raised several times in the one letter which is why the figure of 323 is possible under "Ecosystem Concerns" when there were only 221 submissions received).

Issue group	Number of times the issue was raised in submissions
Public Review Procedures	50
Alternatives	71
Ecosystem concerns	323
Specific fauna concerns	42
Specific flora concerns	151
Hydrology	58
Social issues	9
Future management	5
Other	5

Table 2 - Submissions by issue group

By far the most frequently raised issue in submissions was that of the importance of the site as a relatively intact and rare ecosystem. This includes the biological and physical interrelationships of soil types, climate, hydrology, and floral and faunal diversity. The significance of the flora on the site due to the diverse range of vegetation types and species that exist there was also raised in many submissions.

The complexity of the hydrology on the site was frequently commented on and its significance in terms of dependant ecosystems.

Many submissions queried the fact that the option of a land swap with the Department of Conservation and Land Management did not appear to have been considered. The Department of Conservation and Land Management themselves put in a detailed submission (see below).

From the submissions received, a list of questions/concerns was compiled and sent to the proponent. The proponent's response is given in Appendix 2.

The Authority has included consideration of the submissions received as part of the assessment process.

5.2. Department of Conservation and Land Management submission

The advice given by the Department of Conservation and Land Management is held in high regard, and thus it is felt a separate discussion of their submission is warranted. A copy of the full submission is attached as Appendix 3.

Early in their submission, the Department of Conservation and Land Management makes the following statement:

> "CALM has consistently advocated that the entire area at Brixton Street is one of the most outstanding nature conservation sites for reservation on the Swan Coastal Plain, and the most important unreserved conservation land in the Perth metropolitan area."

The Department of Conservation and Land Management was concerned with apparent inconsistencies and errors in the CER document ranging from information and facts not considered to unsubstantiated claims and assumptions. In addition, a considerable amount of new information not previously provided was submitted. Some specific points of their concern relate to:

- lack of consideration of the land exchange option;
- the lack of consideration of important facts in the CER, for example

  "- less than 3% of the Ridge Hill Shelf landform remains uncleared of native vegetation, and only a small percentage of the remnants consists of vegetation types seen at Brixton Street - the site is critically important as a representative of ecosystems that have been almost entirely cleared on the Swan Coastal Plain."

  "- the conservation value of the indigenous flora on a local and regional scale extends well beyond the three species of Declared Rare Flora that are the focus of the CER" (one of the three Declared Rare Flora species has been downgraded to a Priority species).

In addition, a significant amount of information on the botanical importance of the site was given relating to Declared Rare Flora, Priority species, rare co-occurrences and geographically restricted species (see Section 4.2).

The Department of Conservation and Land Management also expressed reservations about the viability of the proposed 8ha conservation reserve and the small buffer to the wetlands that would result.

In their submission on the CER, the Department advised:

> "Management of the entire Brixron Street area as a nature conservation site would be difficult, but is considered achievable. CALM would have major problems however in managing an 8ha reserve, bounded by urban and railway, which would probably be unsustainable in the long term."

Furthermore:

> "It is probable that the reduction from 20 ha to 8 ha would in itself render the area unsustainable as a wetland ecosystem in the long term. The further proposal to clear 12ha of the location, cover it with 60 cm of fill and surround the wetland with high density housing would further impact on the long-term viability of the proposed 8 ha conservation reserve."

6. Environmental impacts

Based on its own investigations, information in the CER and submissions received during the four week public review period, the Environmental Protection Authority identified the following major environmental issues.

6.1. Ecosystems

The majority of the Guildford Formation (the Department of Conservation and Land Management put the figure at 97%) has been cleared in the past for agricultural activities and thus the 20ha site at Brixton Street is significant as a relatively intact remnant. The combination of soil types, hydrology, topography and climate, have combined to result in a site of high biological (particularly floral) diversity.

The diversity of remnant fauna is not well known, but has probably suffered to some extent due to impacts arising from existing urban development in the vicinity (predation by introduced animals and loss of habitat). However, the flora on the site is in relatively good condition, and with active management, the faunal habitat value of the site could be considerably enhanced.

The proponents have tried to achieve a compromise between development and conservation by proposing to reserve almost half of the site to be managed as a conservation area. However, this would still result in a reduction of the biological diversity of the site and the loss of at least some of the ecosystems present. This would be either by direct development loss or longer term impacts on the conservation area (see 6.3. below).

6.2. Floral diversity

As discussed in Section 3, there is a diverse range of flora on the site with many unique features. The two species of Declared Rare Flora would be contained in wetlands in the proposed conservation area, and with appropriate management their immediate future could be assured even if development were to occur, but the floral significance of the site extends beyond these listed species. The extent of impact of the proposal on the flora other than the Declared Rare Flora of the site is related to a large degree to the proportion of the floral values that are located in the proposed conservation reserve. The Department of Conservation and Land Management was approached by the Authority for specific advice on this issue and their response is attached as Appendix 4.

The reply indicates that further intensive investigation of one area as opposed to the other ("conservation" against "development") would be needed to get definitive advice on the subject but that it is likely that the conservation values of the site would be significantly reduced by development of the 12ha proposed.

The preservation of genetic diversity is one of the three principle objectives of "living resource conservation" identified in the World Conservation Strategy (1980). This has been endorsed at the National (National Conservation Strategy for Australia - 1983) and State (State Conservation Strategy - 1987) level. The practical implementation of these global and local objectives will become increasingly important in the context of the "ecologically sustainable development" debate.

The key issue of the proposed reserve's ecological sustainability has a significant role in determining the environmental acceptability of the proposal as a whole.

6.3. Viability of the proposed conservation reserve

Even if it is assumed that the majority of the site's conservation values were contained in the proposed conservation reserve (which is not necessarily the case), it should be noted that the long term viability of an 8ha reserve immediately adjacent to medium density housing that is raised 0.6m above it is far from certain. The Department of Conservation and Land Management, as the State's foremost authority in conservation reserve management, have expressed reservations about the success of managing such a small area with medium density housing along approximately 50% of the boundary. For example, the following is taken from additional information supplied to the Authority by the Department of Conservation and Land Management (see Appendix 4):

> "It is probable that the reduction from 20ha to 8ha (Note - existing situation as opposed to development) would in itself render the area unsustainable as a wetland ecosystem in the long term. The further proposal to clear 12ha of the location, cover it with 60cm of fill and surround the wetland with high density housing would further impact on the long term viability of the proposed 8ha conservation reserve."

The buffer to the wetlands (which are the habitat of the declared rare flora) would only be approximately 30m which compares with approximately 100m (still a lot less than desirable) if the whole site is preserved. Potential impacts on the reserve would include human use, feral animal predation, weed invasion and changes to the hydrological regime (see 6.4.).

Whilst long term management of the whole 20ha as a reserve would still be difficult, the chance of success would be greater than for the 8ha reserve proposed. The Authority is not convinced that all the potential impacts affecting the viability of the reserve and the security of the declared rare flora species could be managed.

6.4. Impacts on hydrology

Maintenance of the current hydrological regime (specifically the ephemeral wetlands) of the proposed conservation area would be essential to the continuation of the Declared Rare Flora and other flora. Whilst this may be theoretically possible, the practicality has not been demonstrated and further intensive investigation would be required to determine the long term probability of success.

The wetlands have been assessed by members of the community using the Authority's Bulletin 374 and have attained either the "H" (High conservation) or "C" (Conservation) management categories. The management objectives for these categories are aimed at maintaining and enhancing the natural attributes of the wetlands. Management of the hydrology would need to take this into account.

6.5. Other impacts

There are other issues affecting the development and a brief discussion of these is given below.

6.5.1. Noise

The proposed development would be adjacent to a major freight rail link and the proposed extension to the Roe Freeway which could create unreasonable noise levels for the residents. However, this problem could be managed by appropriate building setbacks, bunding and building design.

6.5.2. Aboriginal sites

The CER has concluded that there are no identifiable Aboriginal sites on the subject land but have undertaken to do a full survey if the proposal were to receive environmental approval.

7. Conclusion

It is recognised that Homeswest is proposing to cede a conservation area far in excess of the regular 10% required for Public Open Space through the planning process and that the site has many attributes that make it ideal for urban consolidation.

However, after considering the Consultative Environmental Review prepared for Homeswest and the submissions from various sectors of the community and Government (primarily by the Department of Conservation and Land Management), the Authority believes the site is of such environmental significance that it would be unacceptable to allow development.

Thus the Environmental Protection Authority makes the following recommendations:

Recommendation 1

The Environmental Protection Authority has concluded that the proposed urban development on Lots 37 and 47 Brixton Street Kenwick is environmentally unacceptable and should not proceed.

In reaching this conclusion, the Environmental Protection Authority identified the main environmental factors requiring detailed consideration as:

- **the significance and scarcity of the ecosystem types; and**
- **the floral diversity on the site.**

Given the site's ecological value, the Environmental Protection Authority believes that it should be preserved in its entirety and protected from future development proposals, and thus the following recommendation is made:

Recommendation 2

The Environmental Protection Authority recommends that the Department of Conservation and Land Management and the National Parks and Nature Conservation Authority investigate the merits of acquiring the land for reservation as part of the conservation estate.

Whilst making these recommendations, it should be recognised that the Authority is <u>not</u> setting a precedent in terms of development on non-System 6 areas around the Brixton Street site, and any other proposals will be judged on their merits.

References

Environmental Protection Authority, 1990, "A guide to wetland management in Perth", Bulletin 374, Perth WA

G.J. Keighery and B.J. Keighery, 1991, "Floristics of Reserves and Bushland Areas of the Perth Region (System 6) Parts II-IV", Wildflower Society of Western Australia (Inc.), Perth WA

Hames Sharley Australia, 1991, "Consultative Environmental Review - Proposed Urban Development and Wetland Conservation on Lots 37 and 47, Brixton Street, Kenwick, City of Gosnells", Perth WA

Appendix 1

Summary of submissions

Appendix 1

ISSUE GROUPS	NUMBER OF SUBMISSIONS RAISING THE ISSUE
Public review procedures	
Level of environmental assessment inadequate	49
EPA guidelines inadequate and did not reflect conservation values of the site	1
Alternatives	
A land swap with CALM should be undertaken and the site made an "A" Class reserve for conservation	69
Moving the Kenwick railway station to remove development pressure	2
Ecosystem concerns	
The whole site is significant and should be reserved, not just the wetlands, and development would mean the loss of important bushland habitat	142
The site is described by CALM as being one of the most biologically important on the Swan Coastal Plain outside of reserves	62
Lack of attention in the CER to biodiversity of the site	49
This Guildford Formation claypan habitat is now extremely rare	30
Proposed conservation reserve will be too small and not ecologically sustainable	25
Adjacent areas are proposed for development making this site even more significant	7
Buffer zone adequacy	4
Failure of the CER to take a regional conservation perspective	2
The land is not presently "unused" but is habitat to many species of flora and fauna	1
The land was not included in System 6 because its conservation values were not known at the time	1
Specific fauna concerns	
The information on fauna in the CER is inadequate	22
The site is/must be important for waterbird feeding and breeding	13
CER does not mention that site may be suitable for reintroduction of the Western Swamp Tortoise	4
Full fauna survey needs to be undertaken	3

ISSUE GROUPS (Cont'd)	NUMBER OF SUBMISSIONS RAISING THE ISSUE
Specific flora concerns	
CER does not deal with the significance of the plant communities on the site	46
Statutory significance of DRF has not been recognised	42
There are many unique features of the vegetation on the site apart from the DRF (see Existing environment - Section 3)	31
The existence of seven vegetation complexes on the one site is very important/unusual botanically	18
Development will stop further study of the unique attributes of the site	10
The CER has not used the most up-to-date information on the flora of the site	3
Dieback is likely to be introduced during development	1
Hydrology	
The wetlands on the site are classified either "H" or "C" under EPA Bulletin 374 and thus development can't be justified	46
Long term studies are needed to understand the hydrology of the site properly	6
Over 85% of wetlands on the Swan Coastal Plain have been destroyed already	4
The development is inconsistent with the EPA's draft EPP on wetlands	1
Loss of wetland catchment due to roadworks in the area	1
Social issues	
The comments on crime can not be justified	2
No mention is made of the recent community volunteer work done on the site	2
CER opinion of the public meeting is inaccurate	2
Figure 6.2 in the CER is misleading as it only contains a small portion of the known Aboriginal sites in the Perth region	1
A comprehensive Aboriginal site survey is needed	1
Reference to Aboriginal sites is brief and jumps to conclusions	1
Future management	
Midge and mosquito problems will arise for future residents	2
Fencing of the site should be similar to Ellen Brook and funded by Homeswest	1

ISSUE GROUPS (Cont'd)	NUMBER OF SUBMISSIONS RAISING THE ISSUE
Recreation in the proposed conservation reserve should be specifically excluded	1
The management plan outline is very sparse	1
Other	
Urban consolidation is supported but not at the expense of conservation areas	3
Noise levels from the railway and proposed freeway will affect future residents	1
Assumptions made about energy conservation are not supported by data in the CER	1

Appendix 2

Proponents response to issues raised in submissions

CONCERNS/QUESTIONS TO BE ADDRESSED BY HOMESWEST - BRIXTON STREET CER SUBMISSIONS

The following is a list of concerns/questions that have been compiled from the submissions received from various individuals, organisations and Government Authorities. It would be appreciated if responses to the concerns/questions could be forwarded to the Authority as soon as possible. The items and Homeswest's response will be reproduced in the Authority's report to the Hon Minister for the Environment on the project.

The items in **bold** will be addressed by the EPA but Homeswest is free to provide comments on them.

1. ENVIRONMENTAL ASSESSMENT PROCESS

1.1. Given the significance of the site, the level of assessment should have been PER or ERMP.

EPA response - The level of assessment was determined at the CER level due to the significance of the site. This is a high level of assessment for an urban development project not directly affecting an area of identified conservation value (eg System 6 areas, National Parks). The PER and ERMP level of assessment are determined for more complex projects with a diverse range of environmental issues often of regional or state significance. Whilst the Brixton Street site is environmentally significant, the range and complexity of issues are limited. In view of the above, the Authority considered the four week public review period associated with the CER level was appropriate.

1.2. EPA guidelines inadequate and do not reflect the true conservation values of the flora on the site.

EPA response - the complexity of the guidelines is directly related to the level of assessment. In addition, it is not the objective of EPA guidelines to determine or reflect the conservation values of a particular site. The objective of the guidelines is to provide a preliminary list of what is required in the assessment document. The onus for thorough issue identification and impact management rests with the proponent.

2. ALTERNATIVES

2.1. The option of a land exchange with CALM has not been mentioned as an alternative whilst it is known that CALM are still interested in this course of action. This would enable the land to be managed by CALM as an "A" class conservation reserve.

2.2. Moving the Kenwick railway station to reduce development pressure would be a viable alternative and this has not been investigated in the CER.

3. ECOSYSTEM CONCERNS

3.1. The whole Brixton Street site is environmentally significant and should be preserved, not just the wetlands proposed for reservation.

3.2. The CER fails to take a regional conservation perspective.

3.3. Remnant habitat of this type associated with the Guildford Formation is now extremely rare and not well represented in reserves.

3.4. 8ha for conservation and 12ha for housing on a land form that has been 97% cleared is incongruous.

3.5. The CER failed to address the biodiversity of the site (primarily floral).

3.6. The 8ha proposed as a reserve is inadequate and will not be ecologically sustainable in the long term due to the pressure from surrounding urban development. This pressure will include changed hydrology and urban runoff, rubbish dumping, fires travelling into the proposed reserve, children and adults recreating in the reserve, weed invasion and domestic pets.

3.7. The 30m buffer proposed around the wetlands is inadequate and would not be sufficient to protect the wetland from the pressures listed in point 3.6.

3.8. The land is described by CALM as "one of the most outstanding nature conservation sites for reservation on the Swan Coastal Plain, and the most important unreserved conservation land in the Perth metropolitan area".

3.9. Similar adjacent areas may also be developed, making the Brixton Street site even more important.

3.10. Dieback is likely to be introduced with development.

4. SPECIFIC FAUNA CONCERNS

4.1. The section(s) in the CER dealing with fauna on the site are totally inadequate and a full fauna survey needs to be done including terrestrial and aquatic fauna.

4.2. No mention is made of the site's potential for reintroduction of the western Swamp Tortoise.

4.3. The site must be important for waterbird feeding and breeding.

5. SPECIFIC FLORA CONCERNS

5.1. The CER has not dealt at all with the significance of the plant communities. The existence of 7 distinct complexes on the one small site is extremely important botanically.

5.2. There is no attempt by the proponent to reconcile the difference between the 170 species mentioned on page 20/21 of the CER and the "over 300" species mentioned in the letter from the WA Wildflower Society (Inc.) in the CER as attachment 2.3.

5.3. There are many unique features of the flora on the site in addition to the 3 species of the Declared Rare Flora (DRF), and the CER has either not recognised these or has not given them any significance. These features include:

- 14 species of DRF or priority listed flora;
- 258 native species on 19ha;
- three newly discovered species not known on any other site;
- two species are known from only one other site, and another from just two other sites;
- two types of hybrid are not known from any other site, and several others are rare;
- exceptional diversity in some genera eg. more species of *Tribonanthes* are found growing together at Brixton Street than at any other known site;
- the only known co-occurrence of *Calectasia cyanea* and *Calectasia grandiflora* ;
- 24 species of plants which are normally found on the Darling Scarp and Range are found at Brixton Street - for many this is the only known occurrence on the Swan Coastal Plain;
- 11 species are at the furthest extent of their geographical range;
- 11 of the 14 DRF or priority species are found in the claypan/swampland in the northern section of the site. These species are dependant on the hydrology of the site, especially the occurrence of seasonal pools. Their tolerance to water quality perturbations and pollution is unknown; and
- 5 of the 14 DRF or priority species are found in the shrublands adjacent to the seasonal pools, and most of their populations would be covered by landfill should the proposed development proceed.

Why were these aspects not fully investigated?

5.4. The statutory significance of Declared Rare Flora has not been adequately recognised.

5.5. Development of the site will stop further study of the majority of these unique attributes.

5.6. The population of *Drosera occidentalis* has not been mapped and thus it is impossible to assess the impact of development.

6. HYDROLOGY

6.1. The hydrology of the site has not been adequately studied as the two reports by Australian Groundwater Consultants are not conclusive. Long term studies would be needed to understand the real situation.

6.2. The wetlands on the site are classified as either "H - High Conservation" or "C - Conservation" under the EPA's Bulletin 374 and thus development of the site can not be justified.

6.3. With 85% of wetlands on the Swan Coastal Plain destroyed or badly degraded already, development adjacent to this important one should not be countenanced.

6.4. If the development were to proceed, monitoring of drainage by the proponent to manage any impacts would essential.

6.5. The land is not presently "unused" but is habitat to many species of flora and fauna as well as being as being a study area for community groups.

6.6. The development is inconsistent with the EPA's Wetland Environmental Protection Policy.

7. SOCIAL ISSUES

7.1. The comments on crime are naive and can not be justified.

7.2. No mention is made of the recent work done by the "Friends of Brixton Street" and others to clean up the site.

7.3. Only 2 or 3 people at the public meeting were supportive of the development.

7.4. Figure 6.2 is misleading as it only contains a small portion of the known Aboriginal sites in the Perth metropolitan area.

8. FUTURE MANAGEMENT

8.1. Fencing of the site should be of similar standard to Ellen Brook and funded by Homeswest.

8.2. Recreation in the proposed conservation area should be specifically excluded.

8.3. The outline of the proposed management plan is very sparse.

9. OTHER

9.1. Assumptions are made about energy conservation through the reduction of vehicle use but are not supported by empirical data.

9.2. Urban development around the wetlands in the proposed conservation reserve will experience problems from mosquitoes and midge.

9.3. The concept of urban consolidation and higher density development adjacent to railway stations is supported, but should this be at the expense of an extremely significant conservation area?

9.4. The noise levels from the railway and the proposed Roe Highway would be unacceptable to future residents of the development.

CONCERNS/QUESTIONS TO BE ADDRESSED BY HOMESWEST
BRIXTON STREET CER SUBMISSIONS

The following are Homeswest's responses to the list of concerns/questions compiled by the EPA from submissions. The responses relate to the numbers of the concerns/questions on the attached list (attachment).

1. ENVIRONMENTAL ASSESSMENT PROCESS

1.1 Although this item is for the EPA to answer the proponent has the following response. The significance of the site has been established by the opponents of the development. There is no published authoritative document which clearly establishes the significance of the site. The "wetland" is not even recognised by the EPA in its recently published Environmental Protection (Swan Coastal Plain Wetlands) Policy 1991. It was originally considered that the development proposal could be dealt with informally.

1.2 This item is for the EPA to answer, however, the proponent has the following comments. The EPA guidelines are adequate for a CER. The alleged conservation value of the site has not been definitively established through published research or description.

2. ALTERNATIVES

2.1 The option of a land exchange with CALM has been examined in the past but avoids the strategic nature of this particular site as residentially zoned developable land in the centre of an urban corridor. For that reason it is beyond the terms of reference of the study which proposes to develop a portion of the land.

2.2 The concept of moving the Kenwick railway station is not feasible. The present position is excellent as it is fed by Kenwick Road, Wanaping Road and Royal Road. Furthermore, it is beyond the scope of the proponent to move railway stations and beyond the terms of reference of the CER to contemplate.

3. ECOSYSTEM CONCERNS

3.1 The conservation of the entire site was acknowledged as an alternative (P. 15) but was discarded because it was socially irresponsible for the reasons which were spelled out in Section 3 of the CER, namely:

- urban consolidation;
- improve usage of Perth-Armadale rail line;
- energy conservation;
- provision of affordable housing;
- assist in reduction of Greenhouse Gases; and,
- crime reduction.

3.2 The criticism that the CER fails to take a regional conservation perspective is not valid. Section 5 of the CER adopts a broad assessment of the physical environment of the general area of Kenwick. The proponents main responsibility is to address the conservation values of the site and not to provide a regional assessment.

3.3 The criticism that this remnant habitat is rare and not well representative in reserves is not correct. System 6 Reserve M69 (Kenwick Swamp) is located approximately one kilometre to the north-east of the proponents land. It consists of approximately 25 hectares of land owned by the University of Western Australia and used by the Botany Department for field trips and research.

3.4 The balance between development, 12 ha, and conservation, 8 ha, is not incongruous. The balance between development and conservation is made on the potential of the site for both uses. The alleged clearing of 97 percent of the landform in the past has nothing to do with this development proposal.

3.5 The criticism that the CER fails to address the biodiversity of the site is not true. Section 5.4 objectively sets out the known facts of the vegetation on the site. It refers to 170 species from the Keighery and Hopper report as well as attaching correspondence from the Wildflower Society which refers to a possible 300 species.

3.6 The criticism that the proposed 8 ha reserve is not sustainable is a negatively biased opinion. It is our contention that the proposed reserve, properly developed and managed, has a better chance of long term survival than it has at present.

The feared pressures of changed hydrology, urban runoff, rubbish dumping, fires travelling into the reserve, children and adults recreating in the reserve, weed invasion and domestic pets are all present at the moment.

3.7 The proposed 30 metre buffer is a well considered protection for the claypans given the topography and the good state of surrounding vegetation. This buffer was well researched and decided upon after lengthy consultation with senior wetlands officers at the EPA.

3.8 This statement, concerning the outstanding nature of the site, is clearly acknowledged in the CER. It is one of the motivations for the proponent to give up 8 ha of developable residentially zoned land for a conservation reserve.

3.9 Adjacent areas may be developed but they will be individually subject to similar processes and assessed on their merits. This can not be seriously taken as a reason for not conserving and developing the present site. Furthermore, the System 6 Reserve M69, situated approximately one kilometre to the north-east will not be developed.

3.10 The thought that dieback may be introduced with development is yet another unsubstantiated fear. There is as much or more possibility that dieback could be introduced to the site now than if it is conserved and managed.

4. SPECIFIC FAUNA CONCERNS

4.1 The criticism that the section on fauna is inadequate should be related back to 1.1 (the level of assessment). It was clearly established before the CER was commenced that a review of available literature was adequate. A full study of the fauna is therefore beyond the scope of the present study.

4.2 No mention is made of the possible introduction of the Western Swamp Tortoise because it has not been seriously considered on this site.

4.3 We do not agree that the site is important for waterbird feeding and breeding. Owing to the ephemeral nature of the claypans they are not considered to be a waterbird habitat. Waterbirds have not been observed on the site.

5. SPECIFIC FLORA CONCERNS

5.1 The CER has dealt with the significance of the plant communities. The best available data from CALM was utilised (Section 5.4). The conservation value of the site is clearly stated on Page 23.

5.2 To reconcile the difference between the 170 species referred to by CALM and over 300 species referred to by the Wildflower Society is beyond the scope of the study. The fact that neither of these organisations have considered the site important enough to undertake detailed botanical research only tends to lessen its importance.

5.3 The criticism that the CER has not recognised unique floral features is not valid. The best available data was used in the CER.

5.4 The statutory significance of the DRF is generally well understood. The presence of DRF on the site is clearly stated (Page 23). This criticism is therefore unfounded.

5.5 On the contrary, the conservation of the site will ensure that further study of the flora will be possible.

5.6 We know that Drosera occidentalis occurs in the viminaria heath, which has been mapped. It is acknowledged that examples of this species will be lost in the development area but will be conserved in the conservation area (Page 38, Section 8.2).

6. HYDROLOGY

6.1 This is a biased opinion. Two studies of the hydrology have been undertaken. They clearly establish the main hydrological characteristics of the site.

6.2 The classification of the wetlands as either H or C in terms of EPA Bulletin 374 supports the conservation of the claypans in the proposed 8 ha reserve.

6.3 This is an illogical statement. Just because wetlands have been modified or destroyed in the past, it does not follow that our proposal, which recommends a balance between conservation and development, should not be approved.

6.4 Monitoring of drainage is acceptable to the proponent as part of the future management of the reserve.

6.5 It is accepted that the land is presently the habitat of plant species. However, it is zoned for residential development and has been intended for such a purpose for many years.

6.6 The proposed development is not inconsistent with the EPA's Environmental Protection Policy (Swan Coastal Plain Wetlands) 1991. An inspection of the maps which accompany the policy, at the EPA, revealed that the Brixton Street property is not even identified as a wetland. This land is therefore not subject to the policy.

7. SOCIAL ISSUES

7.1 The comment on crime is totally justifiable. The matter was brought to our attention at the public meeting by a resident of Alton Street.

7.2 The work done by the "Friends of Brixton Street" was after the study was completed. Besides, the signs put up on the site by the "Friends of Brixton Street" are unsightly.

7.3 This is not true. The public meeting was loaded with environmentalists from as far away as Kalamunda. After the meeting a representative of the local ratepayers association told us that most of the attendees were strangers and that the local people were generally in favour of developing the site.

7.4 Figure 6.2 does not intend to show all the Aboriginal sites in the metropolitan area. It shows the major movement patterns, wetlands and some major sites.

8. FUTURE MANAGEMENT

8.1 The proponent has undertaken to contribute towards the fencing of the site. It is not clear what type of fencing is used at Ellen Brook.

8.2 Recreation is a broad concept covering a range of activities. Passive recreation such as walking along a bush path is considered to be compatible with the proposed conservation area and should be considered at the time of preparing a management plan.

8.3 The outline of the proposed management plan is merely a skeleton. This would obviously be broadened out and added to once the management plan is prepared.

9. OTHER

9.1 It is not considered necessary to supply any further statistical data than was put into Section 3.4. If the reader requires more detail he or she should reference the source, Newman 'et al', which provides more than adequate empirical detail.

9.2 The assumption that a mosquito or midge problem will be experienced is not certain, given the ephemeral nature of the claypans.

9.3 The person posing this question has not understood the proposal. The proposal is to conserve the claypan areas which contain the majority of rare or endangered plant species and to develop the balance of the land adjacent to the rail station.

9.4 The statement on noise is completely unsubstantiated. Discussions held with the Noise Abatement Officer of the EPA indicate that the level of rail traffic is not excessive and that building placement and design can be utilised to reduce noise.

Appendix 3

Submission from the

Department of Conservation and Land Management

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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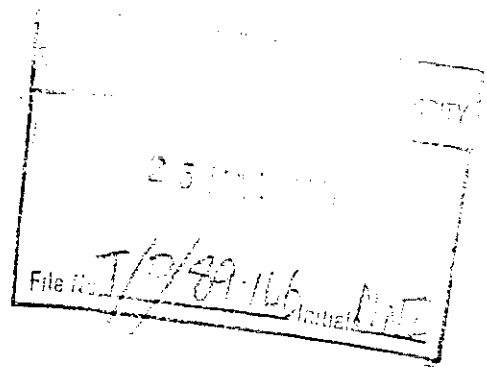
Your Ref:
Our Ref: 023850F3101 MW:DM 129
Enquiries: Mr M Waite
Phone: 367 0371

Director
Evaluation Division
Environmental Protection Authority
1 Mount Street
PERTH WA 6000



Attention: Mr N Winbush

SUBDIVISION : CONCEPT PLAN AND DESIGN - LOTS 37 AND 47 BRIXTON STREET, KENWICK - CER

Thank you for your letter of 15 February, regarding the above proposal. This Department has examined the CER document and offers the following comments.

For some years the Department of Conservation and Land Management (CALM) has been seeking to acquire this block from Homeswest, and had a clear understanding with them that a land-exchange would be arranged. However, earlier in 1989 the then SPC and Homeswest determined that blocks close to rapid transit stations should be given the highest priority for housing development. Lot 37 fits that criterion and Homeswest now wish to develop the block for housing.

CALM has consistently advocated that the entire area at Brixton Street is one of the most outstanding nature conservation sites for reservation on the Swan Coastal Plain, and the most important unreserved conservation land in the Perth metropolitan area. The only reason this land was not included in System 6, was because its conservation values were not fully known at that time.

A land exchange with Homeswest is seen as an equitable solution, enabling protection of the whole of Brixton Street site as a class A nature reserve vested in the NPNCA, while providing Homeswest with alternative land to develop for housing.

The CER gives no serious consideration to CALM's proposal, most noticeably on page 15 under the heading "4. Alternative Development Possibilities", where it is stated "The alternatives range from no development through the present proposal to full development". Development at another site is not entertained, yet this is a pivotal decision from the nature conservation perspective.

The CER also fails to meet the EPA's Guidelines in several important respects that collectively downplay the significance of the site in terms of its significance for nature conservation. It is clear that Hames Sharley Australia have done no original biological survey work in the preparation of the CER. Instead, they have gathered information from various sources, and interpreted the data provided with a range of unsubstantiated speculations that lead to a value judgement that development is environmentally acceptable.

Important facts that are not considered as such in the report include:

* less than 3% of the Ridge Hill Shelf landform remains uncleared of native vegetation, and only a small percentage of the remnants consists of vegetation types seen at Brixton Street - the site is critically important as a representative of ecosystems that have been almost entirely cleared on the Swan Coastal Plain ;

* ephemeral wetlands of the eastern Swan Coastal Plain are the least understood and most poorly conserved of any wetland complex in the Perth to Bunbury area;

* under the EPA's Bulletin 374 (A guide to identifying wetland management in the Perth metropolitan area), the Brixton Street site falls within the highest conservation class;

* the conservation value of the indigenous flora on a local and regional scale extends well beyond the three species of Declared Rare Flora (DRF) that are the focus of the CER.

There are a number of areas of the report which are unclear or in error. These include:

SECTION 2.1:

Brief mention of 7 other significant species. Thereafter reference is only to the '3 rare species' in the claypan.

SECTION 2.2:

Comment is made that the claypan is filled by direct rainfall - not overland flow. No mention is made of groundwater infill.

SECTION 5.4:

Reference is made to '170' species. Then the document states in Section 10.4 that the Wildflower Society talk about 300 odd species. There is no attempt to reconcile the difference to find out what the other species were or what importance they had, despite the consultants having access to preliminary data which formed the basis of the Keighrey Report (Attachment 2)..

Not until the last sentence of the summary is the term rare flora defined as declared rare flora - Wildlife Conservation Act. Thus the real significance of the rare flora is not adequately defined. No mention of Priority List species or what they are until briefly in Section 9 - the Conclusion.

SECTION 5.5:

No mention under the fauna section, of the potential of the site for Western Swamp Tortoise introduction - even if the comment was to discount this (ephemeral nature of habitat).

SECTION 8.2:

Although the 3 DRF are in the conservation area, the other species are spread out.

SECTION 10.4:

The contribution towards fencing of the area is not defined.

Important conservation features of the site include:

Brixton Street's botanicial diversity is remarkable - its 20ha supports 307 species of flowering plants, more than Bold Park (200ha, 226 species) and comparable with King's Park (400ha, 305 species) - the 258 species of native plants in 20ha represents 17% of the known flora of the Perth Flora Region in less than 0.005% of its area;

* three newly-discovered species not known from any other site occur on this site;

* two species are known from only one other site, and another from just two other sites;

* two types of hybrid are not known from any other site, and several others are rare;

* exceptional diversity in some genera eg. more species of *Tribonanthes* are found growing together at Brixton Street than at any other known site;

* 24 species of plants which are normally found on the Darling Scarp and Range are found at Brixton Street - for many this is the only known occurrence on the Swan Coastal Plain;

* 11 species are at the furthest extent of their geographical range;

* 11 of the 14 DRF or priority species are found in the claypan/swampland in the northern section of the site. These species are dependent on the hydrology of the site, especially the occurrence of seasonal pools. Their tolerance to water quality perturbations and pollution is unknown;

* 5 of the 14 DRF or priority species are found in the shrublands adjacent to the seasonal pools, and most of their populations would be covered by landfill should the proposed development proceed;

* when assessed at the plant community level, Brixton Street appears to have several that are floristically unique, although further survey of this is needed in the context of a regional study of extant plant communities of the Ridge Hill Shelf (the *Pericalymma* sedgeland claypan and *Melaleuca* low woodland would be destroyed by the proposed development, as well as substantial areas of *Viminaria* shrubland).

* the site has never been the subject of a fauna survey, and Museum records are insufficient to make a reasonable assessment of fauna conservation values. Moreover, fauna includes invertebrates as well as vertebrates (which the CER ignores) - it is probable that the main significance of Brixton Street for fauna conservation will lie in the terrestrial and aquatic invertebrates occurring on the site, as well as for sedentary small vertebrates;

* the CER's assertion that "it is considered that the impact of development will be limited to the elimination of snake habitats" under its discussion of the impact on fauna (Section 8.3, page 38) is so biologically naive as to call into question the professionalism of the consultants - even cursory visits to the site have shown that a range of fauna inhabits the site, including birds, frogs, reptiles and numerous invertebrates; far more habitats than those of just snakes would be destroyed by the proposed development.

On the basis of these and other data, Brixton Street is clearly an outstanding area for nature conservation, of such importance that a CER seems most inappropriate as an adequate level of environmental review.

Two conflicting assessments of the hydrology of the area are presented in the CER. The consultants place great weight on the report that contends that surface runoff is not important. This assessment appears to be based on one transect. In Section 5.6, the first paragraph refers to surface runoff water from the Brixton Street area subcatchment. It is not clear whether this is from roads or lands ie. it appears to be in conflict with the statement in Section 2.2 of no overland flow into the claypans.

There is some conflict in the hydrological reports as to whether there is significant overland inflow or not. The later report says no, in contrast to the first, but then the comment is made that a track acts as a barrier to surface water movement. Even if surface inflows are not necessary to maintain the wetland, they may become quite significant in terms of pollution and introduction of weeds, both of which could render the wetland ineffective for flora conservation. Comment is made in Section 8.1 that peak overflow infills will occur. The groundwater situation is not discussed. There appears to be potential for a reduced groundwater table (as a consequence of drainage) resulting in more rapid percolation of water from the wetlands, and hence more rapid drying.

Relevant experts (eg. from WAWA) may need to be consulted to independently assess the available hydrological data.

The CER makes unsubstantiated claims concerning the benefits of the proposal. For example, on page 14, it is stated "We believe that this proposal provides the best possibility for the preservation and conservation of the rare plant species". No supporting data for this belief are provided. It is pertinent to note that:

* one of the species of DRF, *Drosera occidentalis*, has not as yet been accurately mapped on the site; hence the impact of the proposed development cannot be accurately assessed;

* Populations of the other two species of DRF, as well as nine other taxa of high conservation significance, occur in the seasonal ponds, but their requirements regarding water quality and tolerance of urban pollution are unknown; ecological first-principles suggest, however, that the provision of as large a catchment buffer as possible will maximise conservation of the wetland ecosystem. In this context, it is difficult to understand how the placement of high density urban housing within 30m of the edge of the seasonal wetlands at Brixton Street could be perceived as the "best possibility" for the conservation of rare plants inhabiting the wetlands. On the contrary such a development would greatly increase the risk of pollution of the wetlands by overland flow during heavy rainfall events.

* assumptions about the conservation of energy and the reduction in Greenhouse Gas emission through the reduction of vehicle fuel usage are not supported by empirical data.

CONCLUSIONS:

In summary, the consultants' argument for a "balanced approach" involving the establishment of an 8ha nature reserve and a 12ha urban housing development on one of the last viable remnants of a landform that has been 97% cleared seems incongruous. The CER fails to take a regional conservation perspective, and downplays the nature conservation significance of the site to a narrow focus on three species of Declared Rare Flora. The ecological sustainability of the proposed 8ha nature reserve remains doubtful in any case with no data available on the tolerance of the wetland ecosystem and species to urban pollution. Management of the entire Brixton Street area as a nature conservation site would be difficult, but is considered achievable. CALM would have major problems however in managing an 8ha reserve, bounded by urban and railway, which would probably be unsustainable in the long term.

In view of the paucity of Ridge Hill Shelf wetland plant communities in conservation reserves, and the outstanding biodiversity and possibly unique communities found at Brixton Street, CALM's offer of a land exchange to Homeswest remains the recommended course of action to ensure a viable and valuable nature conservation reserve is established, involving the whole site.

Syd Shea
EXECUTIVE DIRECTOR

March 13, 1991

ATTACHMENTS:

1 Letter to Manager, Wildlife Branch, from Dr Ken Atkins (Senior Biologist, Flora).

2 "Floristics of Reserves and Bushland Areas of System Six Region II, Brixton Street Wetlands, Kenwick". A private report prepared by G J Keighrey 1991.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Form CLM 808

To: Manager
Wildlife Branch

Your Ref:
Our Ref: 025295F3103
Enquiries: Dr Atkins
Phone: 367 0425

Subject: **LOT 37 BRIXTON STREET, KENWICK - RARE FLORA**

Attached are a plan of the Brixton Street subdivision and a report by Keighery and Hopper (Appendix 1). The 19 ha site contains 309 species of flowering plants. The following is a summary of the known information on the rare, threatened and poorly known flora, and flora of scientific interest, of the site. Three species of Declared Rare Flora, and 11 species of Priority Flora are recorded at the site.

DECLARED RARE FLORA

Aponogeton hexatepalus

Found in all pools at the site.

The species occurs in temporary swamps between Perth and Nannup. Numbers of plants will vary between years (and seasons), and individual plants may be difficult to distinguish, so estimates of plant numbers are subject to interpretation. Total number of plants recorded is 15225, from 20 populations. The Brixton Street populations are a northern disjunction, with other populations being concentrated in the Bunbury - Collie - Capel area (4625 plants), and a southern disjuncture at Nannup (number unknown). In 1983 10000 plants were recorded at the Homeswest site, Brixton Street. In 1989 this population was recorded as having 'over 200 plants'. 600 were also recorded at another site on private property on the other side of Wanaping Road.

The Nannup poulation is the only one known from CALM land (State forest). All other populations are on private property, MRD road reserve, Westrail reserve, Shire reserve and road reserve.

The Brixton Street populations therefore represent a three-fold increase in the distribution range of the species. The Homeswest population represents 66% of the known plants.

This species is regarded as threatened due to its dependence on seasonally wet swamps, which are threatened on the Swan Coastal Plain as a consequence of clearing, fertilizer runoff, and landfill.

Hydrocotyle lemnoides

Six populations are known, with 12000 plants being a conservative estimate as, again it is difficult to count plants, and numbers will vary with seasons. Two of the populations are on nature reserves (Ellen Brook and Dobaderry), and one on State forest (Julimar). These represent several thousand plants. The Brixton street population has a recorded population of 10000 in 1986, and 'over 500' in 1989, with another population being also recorded from the area on the other side of Wanaping Road. The sixth population is on private property near Julimar and has no population size estimated. The distribution range for the species is 100km.

The Brixton Street populations represents the southern end of the range of the species on the Swan Coastal Plain, with the Dobaderry Nature Reserve population being an outlier on the scarp. This population represents the main number of recorded plants (80%), although this is really a false value due to the gross approximations used in assessing plant numbers. The population is however very significant.

Drosera occidentalis

214 plants found in the *Viminaria juncea* scrub adjacent to the swampland. Further surveys under suitable seasonal conditions are likely to find more plants (a population of at least 300 is estimated). The plants are extremely small and detection requires detailed ground searching. An area of likely habitat has been determined on the southeast side of the swamp close to Alton St., but no *Drosera* have been located to date.

The species is found in 17 populations from Gingin to Lane Poole Reserve, in three main nodes: Gingin - Bullsbrook, south metropolitan, and Pinjarra - Lane Poole.

While the number of plants recorded is high (46000), the plants are extremely small and most of the earlier populations were in threatened sites. Approximately half of the recorded plants are on private development land. The discovery of extensive populations (10500 plants) in the Lane Poole Reserve may result in the removal of this species from the DRF list.

PRIORITY SPECIES (refer Appendix 2 for definitions)

Calandrinia aff. *composita*

Priority 1 species. Presumed to be a new species, only known from the Brixton Road site. The species *Calandrinia composita* is listed in Briggs and Leigh's publication on Rare or Threatened Australian Plants as presumed extinct.

Eleocharis sp. (GK 5180)

Priority 1 species. Only known from the Brixton Road site.

Eryngium sp.1 (G Keighery 8757)

Priority 1 species. Also known from a degraded rail reserve north of Serpentine, and on an adjacent area at Brixton Road.

Eryngium sp.2 (G Keighery 5390)

Priority 1 species. Presently only known from Brixton Road. Previously only known from a collection at Midland in 1905, and presumed extinct until found at Brixton Road.

Hydatella dioica

Priority 2 species. Only known elsewhere from Upper Swan in a nature reserve in reasonably large number. The species may be rare but it is very small and therefore possibly overlooked

Schoenus andrewsii

Priority 2 species. Known from several Metropolitan area sites, largely from old collections, and from Carnamah and the Kalbarri National Park. Eight plants have been recorded at the Brixton Street site in the *Viminaria* scrub.

Schoenus capillifolius

Priority 2 species. Known also from a nature reserve and railway reserve (Upper Swan to Waterloo).

Helipterum pyrethrum

Priority 3 species. Found at 9 sites, two of which are nature reserves.

Stylidium utricularioides

Priority 3 species. This species is found in small populations from Gnangara to Pinjarra on the coastal plain, and on the adjacent scarp. Several thousand plants have been recorded at the Brixton Street site. Most of the known sites are threatened by development. Two populations appear to occur in State forest, and one on the University of WA reserve at Cannington

Synaphea acutiloba

Priority 3 species. Found at Ellis Brook, Red Hill and Kalamunda National Park on the Scarp, not found elsewhere on the Swan Coastal Plain.

Villarsia submersa

Priority 3 species. Found at many sites from Denmark to Kenwick, in seasonal pools. The species is often found with the DRF *Aponogeton hexatepalus* and *Hydrocotyle lemnoides*. Although it has a wide distribution, the habitat for this species is threatened. Twenty to 40 plants have been recorded at the Brixton Street site.

UNUSUAL DISTRIBUTION

Anigozanthos bicolor

A record by Dr Hopper of *Anigozanthos bicolor* is the only one for the Swan Coastal Plain. This species is common throughout the wandoo woodlands marginal to the jarrah forest and also occurs at the foot of the Darling Scarp from Bullsbrook north to Moguмber.

Anigozanthos manglesii and *A. viridis* are also present, with this being the only known area where these three species co-exist.

Tribonanthes brachypetala

Usually found on the scarp, this is the only area on the Swan Coastal Plain where this species is known to occur.

Other Scarp Flora

The high water table and clayey soils support 24 species of flora normally associated with the lateritic or granitic soils of the northern jarrah forest and Darling Scarp. These include *Lomandra micrantha*, *Hakea erinacea*, *Grevillea bipinnatifida*, *Diuris longifolia* (early flowering race), *Stirlingia tenuifolia* and *Synaphea acutiloba*.

Range Limits

Several species (*Anarthria laevis, Baumea acuta, Caladenia ferruginea, C. longicauda* ssp. nov., *Eryngium* sp 2, *Petrophile longifolia, Schoenus bifidus, Thelymitra villosa, Tricoryne humilis* and *Villarsia submersa*) are at the northern limits of their known range, and *Schoenus andrewsii* at the southern limit.

Calectasia species

The site is the sole known co-occurrence of the Star of Bethlehem lilies, *Calectasia cyanea* and *C. grandiflora*. It is also the only known extant population of *Calectasia grandiflora* on the Swan Coastal Plain, and the discovery of this population was instrumental in the reinstatement of this species. This population is thus of importance in assessing taxonomic status of these species.

RARE HYBRIDS

Anigozanthos bicolor x *A. viridis*

This naturally occurring hybrid is plentiful at the site. Such hybrids are only known from one other location near Collie. Also recorded are *Anigozanthos bicolor* x *A. manglesii*, and *Anigozanthos manglesii* x *A. viridis* hybrids.

Tribonanthes brachypetala x *T. australis* and *T. australis* x *T. uniflora*

These two types of hybrid are known nowhere else.

DISTRIBUTION

Most of the rare flora is found in, or associated with the swamplands and ephemeral pools in the central-northern section. Species from the swampland include *Aponogeton hexatepalus, Hydrocotyle lemnoides, Eryngium* sp.1., *Eryngium* sp.2., *Eleocharis* sp.(GK 5180), *Schoenus capillifolius, Helipterum pyrethrum, Hydatella dioica, Villarsia submersa* and *Tribonanthes variabilis* x *T. australis*. Species from the woodland/swamp edges include *Tribonanthes brachypetala, Tribonanthes brachypetala* x *T. australis, Anigozanthos bicolor, Anigozanthos bicolor* x *A. manglesii* and *Anigozanthos viridis* x *A. manglesii* and the orchid species found at the edge of their range. *Drosera occidentalis, Schoenus andrewsii, Synaphea acutiloba* and most of the other Darling Scarp species are found in the *Viminaria* scrub that surrounds the swamps. *Stylidium utricularioides* and *Calandrinia* aff. *composita* are found in the swamp and *Viminaria* scrub.

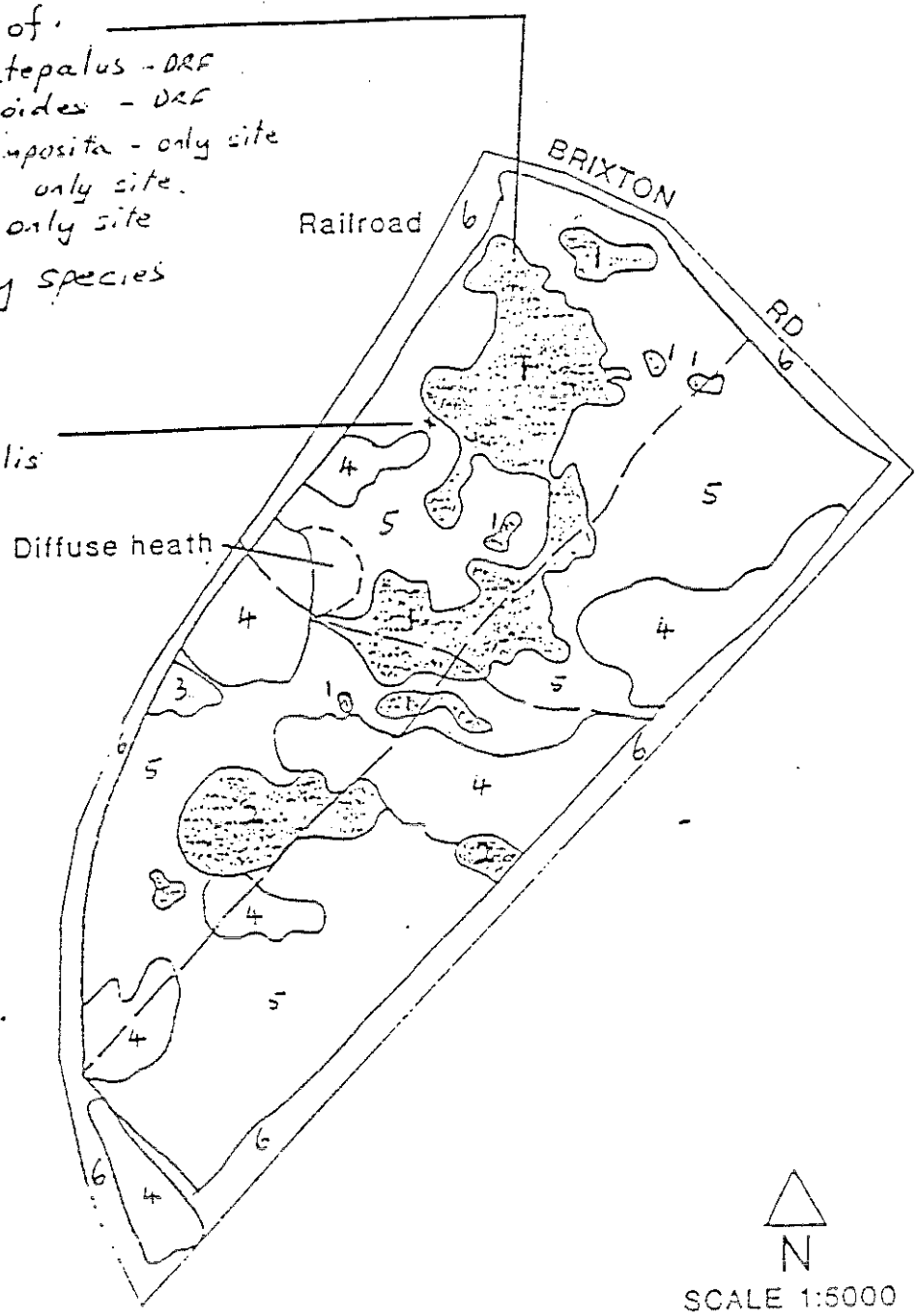
The conclusion is that the area has two values. The first is that it has scientific interest with the disjunct populations of many species not normally associated with the Swan Coastal Plain. The second is the potential conservation value due to the presence of a range of rare and threatened species. These species are mainly in the swamp area, which is a habitat under threat throughout its range. The main conservation reserves for this habitat type are the Short-necked Tortoise reserves at Upper Swan.

K J Atkins
SENIOR BIOLOGIST (FLORA)

27 November, 1990

Claypan Location of:
Aponogeton hexatepalus - DRF
Hydrocotyle lemnoides - DRF
Calandrinia aff composita - only site
Eleocharis sp. - only site.
Eryngium sp.2 - only site
6 other priority species

Location of DRF
Drosera occidentalis



LEGEND

1 Mel.laterita or open clay (Swampland and Pools)

2 Pericalymma sedgeland claypan

3 Melaleuca low woodland

4 Marri

5 Viminaria

6 Disturbed

Floristics of Reserves and Bushland Areas of System Six Region II Brixton Street Wetlands, Kenwick

G J Keighrey, 1991

Contents

Introduction

The remnant detailed in this paper comprises lots 37 and 47, Brixton Street, Kenwick. The site is approximately 19 hectares in extent, and is a flat winter wet plain between Yule and Bickley Brooks, on Guildford formation clays.

The clays contain natural depressions which fill from rainfall, though, the surrounding water table is high (Australian Groundwater Consultants, 1989). These ephemeral wetlands are now rare on the Swan Coastal Plain, and few have had their floristics detailed.

This paper is the second in a series detailing the floristics of bushland remnants of the System Six region (Keighery, 1991a). Aspects of the biology of the uncommon sedge, *Schoenus capillifolius* present at this site have been documented elsewhere (Keighery, 1991b).

These ephemeral claypans are a unique feature of the northern half of the Swan Coastal Plain, and as far as we are aware this is the first complete floristic study of this geomorphic unit.

Results

Vegetation - Structure

The site contains seven vegetation complexes, two of which *Melaleuca rhaphiophylla* low woodland and low heath) are of very limited extent. Maps of the vegetation structure are given in Australian Groundwater Consultants (1989) and Hames and Sharley (1991).

The *Melaleuca* woodland lines the edge of an ephemeral creek on the south-western quarter of the site.

The "dry" claypans of the southern side of the area are covered by a low heath of *Astartea/Pericalymma* (site description in Table 1,A). The drier claypans of the north-eastern side of the area are covered by a *Kunzea recurva* open heath (Table 1,C).

The winter wet pools themselves usually are covered by a low open *Melaleuca laterita* shrubland (Table 1,D) except for the deepest pool which is covered by an *Amphibromus neesii* grassland (Table 1,B). The central pool of this area contains water up to early December, and in this, the only populations of *Myriophyllum crispatum, Eleocharis* sp. (GK 5180), *Villarsia submersa* and *Ottelia ovalifolia* present in this area occur.

Higher in the landscape, where drainage is improved, and the soils are shallow loams and clays over ironstone, the vegetation is a *Viminaria* shrubland (Table 1,E). This vegetation covers most of the block under study.

On the highest ground, where the drainage is best and the soils deepest, a Marri (*Eucalyptus calophylla*) woodland is found (Table 1,F).

Disturbed vegetation (where much of the original cover has been removed) occurs on the western and southern margins of the site. This area is where the majority of the weed records are found (Table 2). One particular site on the S.W. boundary near a large drain contains numerous exotics generally not recorded elsewhere (Table 3). This suite of weeds are apparently the result of dumped garden refuse, and should be removed.

The vegetation types recorded at Lot 37 are characteristic of the heavy soils of the eastern side of the Swan Coastal Plain. The conservation status of ephemeral wetlands on the plain are very poor, and as far as we are aware only J.R. and B. Martyn Reserve has *Kunzea* heath, *Melaleuca lateritia* shrubland and *Viminaria* shrubland present within its boundary.

Species

Three hundred and seven species of vascular plant were recorded from the site. This total being composed of 5 ferns, 157 species of monocotyledons and 150 species of dicotyledons. 49 species were naturalized aliens. The occurrence of these species in the vegetation types recorded at the site are given in Table 2.

Significant species of flora include three declared rare under the provisions of the Conservation and Land Management Act. 10 species are on the priority list of the Dept. of Conservation and Land Management.

The area also contains 24 species of plants which are normally associated with the heavier soils of the Darling Scarp and range (Table 4).

The following species (*Eleocharis* sp. (GK 5180), *Schoenus capillifolius, Hydatella dioica, Aponogeton hexatepalus, Eryngium* sp (GK 8757), *Calandrinia ?composita, Stylidium utricularioides, Helipterum pyrethrum* and *Trichocline* sp. (GK 6382)) recorded at Brixton Street, appear to be confined to the Swan Coastal Plain.

Certain species are at the margins of their ranges; eg: northern limit (*Baumea acuta, Schoenus bifidus, Anarthria laevis, Tricoryne humilis, Caladenia ferruginea, Petrophile media, Eryngium* sp II (GK 5390) and *Villarsia submersa*) or southern limit (*Schoenus andrewsii* and *Conostylis festucacea*).

Several other species were recollected at Brixton Street many decades after their previous records for the metropolitan region. These species are:

Dichopogon preissii; previous collection 1903
Calandrinia composita; previous collection 1905
Eryngium sp. II; previous collection 1905.

The area are also contains a series of taxonomically significant populations, some of which do not match current taxonomic placement or which will (or have) delimite closely related species. These taxa are:

a) *Eleocharis* sp. (GK 5180) is here found growing with *E. acuta*. This species is not recognized as distinct in the Flora of the Perth Region, and appears confined to the Swan Coastal Plain.

b) *Calectasia cyanea/C. grandiflora* are found co-occurring at this site, which is the only area where this has been recorded, and is near the presumed type locality of *C. grandiflora*. The discovery of this population was instrumental in the reinstatement of *C. grandiflora* as a distinct species. This is the only known extant population of *C. grandiflora* on the Swan Coastal Plain.

c) *Wurmbea dioica* ssp. *alba* at Brixton Street grows submerged in the claypans, flowering in early spring while the claypans are still full of water. These plants are hermaphrodite or andromonoecious, not dioecious and have pure white flowers. The strikingly different habitat

and associated floral differences suggest that this population is genetically different and requires taxonomic re-assessment.

d) *Tribonanthes ?uniflora* (GK 6259). Currently this taxon is placed under *T. australis* or *T. longipetala*, however, both of these species occur on site, and hybrids between *T. australis* and *T. ?uniflora* (voucher: GK 6260) have been recorded. The status and distribution of *Tribonanthes uniflora* requires further study.

Brixton Street with four species and two hybrid *Tribonanthes* recorded is the richest site ever recorded for this genus.

e) *Velleia trinervis*: swamp form (GK 10429). This is a glabrous plant with very pale orange and purple flowers. Examination of collections of this widespread species suggest that there are several distinct subspecies, and that the coastal claypan populations are one of these. Further studies are needed on this species.

Discussion

The vascular flora of this small area is exceedingly diverse, 258 species of native plants in an area of 19 hectares (representing 17% of the known flora of the Perth Region in less than 0.005% of the area). As detailed in the species section of this report a significant proportion of this flora is either rare, geographically restricted, taxonomically or geographically significant. This reflects the rarity of the habitat, which has been almost entirely cleared on the Swan Coastal Plain.

The data presented here suggests that the ephemeral wetlands of the eastern Swan Coastal Plain are the least understood and most poorly conserved of any wetland complex of the Perth to Bunbury area. Most have been cleared for agriculture or drained for housing yet have attracted far less concern for their preservation than the "drowned" wetlands supporting few species of common waterfowl. Further detailed vegetation studies are urgently needed on such wetlands to increase awareness of this vanishing part of our wildlife heritage.

Acknowledgements

Raelene Hick and Jan Rayner have prepared versions of this paper from a preliminary report to Homeswest through to this, hopefully, final paper on this site. To the Western Australian Wildflower Society for publishing this paper to ensure its availability to interested parties. To the many people who have assisted in helping and promoting the conservation of Perth's wetland heritage.

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Table 1

Vegetation Site Descriptions

A *Astartea fasicularis/Pericalymma elliptica* heath

Stratum 1: Shrubs 1-1.5 m, CC = 30
Astartea fasicularis, Pericalymma elliptica

Stratum 2: Sedges, 40-60 cm, CC = 20
Leptocarpus canus

Stratum 3: Herbs, CC = 5
Goodenia filiformis var. *filiformis, Stylidium roseo-alatum, Goodenia filiformis* var. *minutiflora, *Cyperus tenellus*

B *Amphibromus* grassy flats
At the edges of these pools, a band of sedges occur:

Stratum 1: Sedges 30-70 cm, CC = 60
Leptocarpus canus, Dichopogon preissii, Pimelea imbricata var. *gracillima, Schoenolaena juncea*

Stratum 2: Aquatics: *Aponogeton hexatepalus*

In the centre:

Stratum 1: Grasses, 60-90 cm, CC = 60
Amphibromus neesii

Stratum 2: Herbs, CC = 30
Aponogeton hexatepalus, Wurmbea dioica ssp. nov., *Isolepis cernuua, *Cyperus tenellus, *Lythrum hyssopifolium*

C "Dry" claypans - *Kunzea* heath

Stratum 1: Shrubs, 50 cm-1.5 m, CC = 50
Kunzea recurva, Vimminaria juncea (rare)

Stratum 2: Shrubs 20-40, CC = 10
Xanthorrhoea brunonis

Stratum 3: Shrubs, 10-30, CC =
Scaevola lanceolata, Dampiera linearis, Conospermum huegelii, Daviesia physodes, Grevillea bipinnatifida

Stratum 4: Sedges and perennial herbs, CC = 10
Conostylis festucacea, Amphipogon turbinatus, Borya scirpioidea, Cyathochaeta clandestina

Stratum 4: Herbs, CC = 5
Stylidium calcaratum, Stylidium roseo-alatum, Stylidium utricularioides, Philydrella drummondii, Philydrella pygmaea

D *Melaleuca laterita* shrubland

Stratum 1: Shrubs 1.5-2.5 m, CC = 20
Melaleuca laterita

Stratum 2: Shrubs, 30-60 cm, CC = 20
Pimelea imbricata var. *gracillima*

Stratum 3: Sedges, 40-60 cm, CC = 20
Leptocarpus co-angustatus

Stratum 4: Herbs
Aponogeton hexatepalus, Wurmbea dioica, Hydrocotyle lemnoides

E *Viminaria* shrubland
Stratum 1: Shrubs 3-5 m, CC = 20
Viminaria juncea

Stratum 2: Shrubs 70 cm-1.2 m, CC = 60
Hypocalymma angustifolium, Verticordia serrata, Allocasuarina humilis, Xanthorrhoea brunonis, Hibbertia hypericoides, Acacia lasiocarpha

Stratum 3: Sedges
Mesomelaena tetragona, Leptocarpus co-angustatus

F Marri (*Eucalyptus calophylla*) woodland

Stratum 1: Trees, 10-15 m, CC = 30
Eucalyptus calophylla

Stratum 2: Shrubs, 1-2 m, CC = 1
Viminaria juncea

Stratum 3: Shrubs 30 cm-80 cm, CC = 20
Hibbertia hypericoides, Nemcia capitata, Xanthorrhoea ?preissii, Opercularia vaginata

Stratum 4: Shrubs 5 cm - 20 cm, CC = 20
Xanthosia huegelii, Stylidium brunonianum, Senecio minimus, Dampiera linearis, Gompholobium marginatum, Kennedia prostrata, Triplerococcus brunonis, Drosera erytherorniza, Drosera macrantha, D. stolonifera

Stratum 5: Sedges and Perennial Herbs
Tetraria octandra, Burchardia umbellata, Anigozanthus manglesii, Lepidosperma angustatum, Thysanotus triandrus, Cyathochaeta avenacea

Stratum 6: Herbs
Drosera glanduligera

Table 2

BRIXTON STREET FLORA

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
FERNS						
SELAGINELLACEAE						
Selaginella gracillima		x		x		
OPHIOGLOSSACEAE						
Ophioglossum lusitanicum ssp. coriaceum				x		
LYCOPODIACEAE						
Phyllogiossum drummondii	x	x		x	x	
Pilularia novae-hollandiae	x					
ISOETACEAE						
Isoetes drummondii	x					
JUNCAGINACEAE						
Triglochin minutissima		x				
T. calcitrapa		x	x			
T. procera	x					
T. stowardii	x	x			x	
T. sp. aff. calcitrapa (GK 10430)					x	
POACEAE						
Agrostis aemula	x	x	x			
A. preissii	x					
*Aira cupiana		x	x			x
Amphibromus neesii	x					
Amphipogon amphipogonoides		x	x			

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
A. turbinatus			x			
*Avena fatua						x
*Briza maxima		x	x			x
*B. minor		x	x			
*Cynodon dactylon	x					x
Danthonia cf. caespitosa (GK 9666)	x					
*Ehrharta calycina			x			x
*E. longiflora		x	x			x
*Eragrostis elongata						x
*E. curvula						x
*Paspalum dilatatum	x					x
*Plagiochloa uniolae			x			x
*Lagurus ovatus						x
*Lolium temulentum	x					
Neurachne alopecuroidea		x	x			
Stipa compressa			x			
S. semibarbata						
S. trichophylla			x			
*Vulpia myorus	x	x				x
HYDROCHARITACEAE						
Lepilaena australis	x					
Ottelia ovalifolia	x					
APONOGETONACEAE						
Aponogeton hexatepalus	x					
CYPERACEAE						
Baumea acuta	x	x				
B. juncea		x				
B. preissii	x	x				
Chorizanda enodis	x	x		x		
Cyathochaeta avenacea		x	x	x	x	

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
*Cyperus tenellus		x	x	x		x
Eleocharis acuta	x					
Eleocharis sp. (GK 5180)	x					
Isolepis marginatus	x		x			
I. oldfieldiana	x					
I. stellata	x	x				
I. sp. (GK 6458)	x					
Lepidosperma angustatum			x	x		
L. leptostachyum		x				
L. longitudinale			x			
Mesomelaena tetragona		x	x		x	
Schoenus andrewsii		x				
S. asperocarpus		x				
S. benthamiana		x	x			
S. bifidus		x			x	
[B]S. capillifolius	x					
S. elegans		x				
S. grandiflorus			x			
S. odontocarpus	x					
S. sp. (GK 5185)		x			x	
S. sp. (GK 10906)						
Tetraria octandra		x	x			
RESIONACEAE						
Anarthria laevis		x				
Leptocarpus canus	x	x		x		
L. co-angustatus		x		x		
Lepyrodia muirii	x			x		
Loxocarya fasiculata		x	x			
CENTROLEPIDACEAE						
Aphelia cyperoides		x	x			
Brizula drummondii	x					
B. muelleri		x				

TAXON	VEGETATION TYPE CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'I
Centrolepis aristata		x	x		x	
C. glabra	x	x	x	x		
C. hummillima	x	x		x		
C. polygyna	x					
HYDATELLACEAE						
[B]Hydatella dioica	x					
Trithuria bibracteata	x	x				
T. submersa	x					
PHILYDRELLACEAE						
Philydrella drummondii	x	x			x	
P. pygmaea	x	x			x	
JUNCACEAE						
Juncus bufonius			x		x	
*J. capitatus						x
J. holoschoenus					x	
DASYPOGONACEAE						
[D]Acanthocarpus cannaliculatus		x			x	
[E]Calectasia cyanea					x	
[CE]C. grandiflora		x			x	
Kingia australis		x			x	
L. caespitosa			x			
[D]L. micrantha					x	
L. odora			x		x	
XANTHORRHOEACEAE						
Xanthorrnoea brunonis		x			x	
X. ?preissii			x			

TAXON	VEGETATION TYPE					DIST'C
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	
PHORMIACEAE						
[D]Agrostocrinum scabrum (glabrous form)		x			x	
Dianella revoluta var. divaricata			x			
ANTHERIACACEAE						
Borya scirpioidea		x	x			
Borya sphaerocephala		x	x			
Caesia occidentalis			x			
Chaemascilla corymbosa		x	x			
Dichopogon capillipes			x			
Dichopogon preissii	x			x		
Laxmannia sessiliflora		x	x			
L. squarrosa			x			
Sowerbaea laxiflora		x	x		x	
Thysanotus arbuscular		x				
T. manglesii		x	x			
T. patersonii		x				
T. sparteus		x	x			
T. thyrsoideus		x	x			
T. triandrus		x	x		x	
Tricoryne elatior			x			
[C]T. humilis		x				
COLCHICACEAE						
Burchardia multiflora		x	x		x	
B. umbellata			x			
[E]Wurmbaea dioica ssp. alba	x					
HAEMODORACEAE						
[D]Anigozanthos bicolor		x	x			
A. viridis	x	x			x	
A. manglesii			x			

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
A. bicolor x manglesii					x	
A. bicolor x viridis					x	
Conostylis aculeata ssp. aculeata			x			
C. festucacea					x	
C. setigera		x	x		x	
Haemodorum laxum		x	x			
H. panniculatum			x			
H. sparsiflorum		x	x		x	
H. simplex		x			x	
H. spicatum			x			
[D]Tribonanthes brachypetala (GK 6249)		x	x	x	x	
T. australis (GK 6248)		x	x		x	
T. australis x T. brachypetala (GK 6249)		x	x			
[E]T. sp. (uniflora) (GK 6259)	x					
[E]T. uniflora x australis (GK 6260)		x				
T. longipetala (GK 6262)		x	x		x	
HYPOXIDFACEAE						
Hypoxis occidentalis		x				
IRIDACEAE						
*Babiana stricta						x
*Chasmanthe floribunda						x
*Freesia leichtlinii						x
*Hesperantha falcata		x				x
*Hexaglottis lewisae						x
Patersonia occidentalis		x	x			
[D]P. juncea		x				
*Sparaxis bulbifera						x
*Romulea rosea		x	x			x

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
*Watsonia bulbillifera		x				x
*W. marginata		x				
ORCHIDACEAE						
Caladenia deformis		x				
C. flava					x	
C. longicauda		x	x			
C C. ferruginea		x	x			
C. pectinata		x	x			
C. huegelii		x	x			
DE Diuris longifolia (early fl'ing race)		x	x			
D. emarginata	x	x				
Eriochilus dilatatus		x	x			
Lyperanthus serratus			x			
Microtis unifolia		x				
Prasophylum drummondii	x	x				
Thelymitra crinita		x	x			
T. antennifera		x				
T. flexuosa		x			x	
T. villosa		x			x	
PROTEACEAE						
Conospermum huegelii		x				
Dryandra nivea		x	x		x	
D Grevillea bipinnatifida		x	x			
C Hakea ?auriculata (GK 8014)		x				
H. candolleana		x				
D H. erinacea		x				
H. incrassata		x	x			
H. lissocarpha		x	x			
H. prostrata			x			
H. sulcata		x		x		
H. trifurcata			x			

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'
H. varia				x		
D Isopogon asper					x	
D I. dubius		x				
C Petrophile media var. juncifolia		x	x			
D P. seminuda				x		
Stirlingia simplex		x				
D Synaphea acutiloba		x				
S. petiolaris		x	x			
LORANTHACEAE						
Nuytsia floribunda			x			
AMARANTHACEAE						
Ptilotus drummondii			x			
D P. declinatus		x				
D P. manglesii			x			
P. stirlingii		x				
PORTULACCACEAE						
E Calandrinia composita	x	x				
CARYOPHYLLACEAE						
*Silene gallica var. gallica			x			x
LAURACEAE						
Cassytha glabella					x	
DROSERACEAE						
Drosera bulbigena		x			x	
D. erythrorhiza			x			
D. gigantea	x	x				
D. glanduligera		x	x		x	

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
D. macrantha			x			
D. heterophylla		x				
D. menziesii ssp. menziesii	x	x				
D. occidentalis		x				
D. stolonifera ssp. stolonifera			x			
D. tubaestylus		x	x			
CRASSULACEAE						
Crassula colorata			x			
C. natans	x					
MIMOSACEAE						
Acacia lasiocarpha		x			x	
A. pulchella		x	x		x	
A. saligna			x			
FABACEAE						
Daviesia physodes			x			
Dillwynia aff. cinerascens		x	x			
Eutaxia virgata	x	x		x		
Gompholobium aristatum			x			
G. marginatum		x	x			
Kennedia prostrata			x			
Nemeia capitatum		x	x			
*Ornithopus compressus	x					x
Sphaerolobium linophyllum		x				
*Trifolium angustifolium						x
*T. dubium			x			x
*T. cernuum						x
*T. arvense						x
*Vicia sativa ssp. nigra			x			x
Viminaria juncea		x	x		x	

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST
OXALIDACEAE						
*Oxalis polyphylla						x
*O. pres-caprae						x
*O. purpurea						x
RUTACEAE						
Eriostemon spicatus		x			x	
Boronia cymosa			x			
POLYGALACEAE						
Comesperma ciliatum		x				
EUPHORBIACEAE						
Monotaxis grandiflora		x	x			
STACKHOUSIACEAE						
Stackhousia pubescens			x			
Tripterococcus brunonis		x	x		x	
DILLENIACEAE						
Hibbertia aurea			x			
H. hypericoides			x			
THYMELAEACEAE						
Pimelea imbricata var. gracillima	x					
LYTHRACEAE						
*Lythrum nyssopifolia				x		x
MYRTACEAE						
Astartea fasicularis	x			x	x	
Baeckea camphorosmae		x	x			
Calytrix aurea	x			x	x	

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST
Eucalyptus calophylla			x			
Hypocalymma angustifolium		x		x	x	
H. robustum			x			
Kunzea micrantha				x		
K. aff. recura (GK 6830)	x	x				
Melaleuca raphiophylla		x				
Pericalymma elliptica		x				
Verticordia acerosa		x				
V. densiflora		x				
[D]V. huegelii var. huegelii		x				
V. pennigera		x				
HALORAGACEAE						
Gonocarpus pithyoides			x			
G. nodulosus		x				
Myriophyllum crispatum	x					
APIACEAE						
[B]Eryngium sp. I (GK 8757)	x					
[DC]E. sp. II (GK 5390)	x					
Homalosciadium homalocarpum		x	x			
Hydrocotyle callicarpa		x				
H. diantha	x	x				
[A]H. lemnoides	x					
Schoenolaena juncea	x	x				
Xanthosia huegelii		x	x			
EPACRIDACEAE						
[D]Andersonia aristata				x		
Astroloma pallidum		x	x			
PRIMULACEAE						
*Anagallis arvensis			x			x
*A. minor	x					

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
GENTIANACEAE						
*Centaurium erythraea						x
*Cicendia filiformis	x	x				
CUSCUTACEAE						
Cuscuta australis	x					
MENYANTHACEAE						
Villarsia capitata	x	x				
C V. submersa	x					
LAMIACEAE						
*Stachys arvensis						x
SOLANACEAE						
*Solanum nigrum			x			x
SCROPHULARIACEAE						
Glossostigma drummondii	x					
Grattiola peruviana	x					
*Parentuciella viscosa	x	x				x
LENTIBULARIACEAE						
Polypomphlyx multifida	x	x			x	
P. tenella		x			x	
Utricularia menziesii	x			x		
U. violacea	x					
RUBIACEAE						
Opercularia vaginata		x	x			
CAMPANULACEAE						
Wahlenbergia gracilenta		x	x			

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'D
*W. capensis			x			x
LOBELIACEAE						
Isotoma hypocratiformis			x			
Isotoma pusilla	x					
I. scapigera	x					
*Monopsis debilis	x	x				
GOODENIACEAE						
Anthotium junciforme	x	x				
Dampiera linearis		x	x			
Goodenia caerulea	x	x	x			
G. filiformis var. filiformis		x				
G. filiformis var. minutiflora	x	x				
[E]Vellea aff. trinervis (GK 10429)		x		x		
Scaevola lanceolata	x		x			
STYLIDIACEAE						
Levenhookia pusilla		x				
Stylidium brunonianum		x	x			
S. bulbiferum		x				
[E]S. calcaratum (rose form)	x	x				
[D]S. cannaliculatum		x				
S. carnosum			x			
S. dichotomum		x				
S. divaricatum		x				
S. ecorne	x					
S. innundatum	x	x				
S. perpusillum	x					
S. petiolare	x	X				
S. pulchellum	x	x				

TAXON	VEGETATION TYPE					
	CLAY	VIMIN	MARRI	WET HEATH	DRY HEATH	DIST'C
[D]S. roseo-alatum	x	x				
[B]S. utricularioides	x	x				
ASTERACEAE						
*Arctotheca calendula						x
Centipedia minima		x				
*Conyza canadensis						x
Craspedia pleiocephala			x			
*Hyalospermum cotula		x	x			
[B]H. pyrethrum	x					
*Hypochaeris glabra	x	x	x			x
Ixiolaena viscosa			x			
Myriocephalus isoetes	x					
M. helichrysioides	x					
Podolepis canescens		x				
P. gracilis			x			
Senecio sp. (?gilbertii: GK 6665)			x			
S. minimus		x				
Siloxerus humifusus		x				
*Sonchus oleraceus						x
[CE]Trichocline sp (GK 6382)		x				

Key: * = naturalized species

A = Declared Rare Species

B = Species confined to Swan Coastal Plain

C = Geographically significant population

D = Heavy soil species

E = Taxonomically significant population

Table 3

Species of Disturbed area on S.W. Boundary

Trees: *Melia azederach, Robinia pseudaccacia, Brachychiton populeneum.*

Shrubs: *Riccinus communis, Osteospermum ecklonis.*

Herbs: Dicotyledons: *Oxalis purpurea, Oxalis polyphylla, Aster subulatus, Anagallis arvensis, Linum trigynum, Sonchus oleraceus, Arctotheca calendula, Trifolium angustifolium, Trifolium campestre, Meliotus indica, Stachys arvensis, Sonchus oleraceus.*

Herbs: Monocotyledons: *Cynodon dactylon, Ehrharta calycina, Rhyncheletrum repens, Plagiochloa uniolae, Lolium perenne, Pennisetum clandestinum.*

Table 4

Heavy Soil Species, rarely recorded on Coastal Plain

MONOCOTYLEDONS

Cyperaceae

Schoenus andrewsii

Dasypogonaceae

Lomandra micrantha
Agrostocrinum scabrum

Haemodoraceae

Anigozanthos bicolor
Tribonanthes brachypetala

Anthericaceae

Thysanotus arbuscular
Tricoryne humilis

Iridaceae

Patersonia juncea

Orchidaceae

Diuris cf. *longifolia*

DICOTYLEDONS

Proteaceae

Grevillea bipinnatifida
Hakea ?auriculata
Hakea erinacea
Isopogon asper
Isopogon dubius
Petrophile seminuda
Synaphaea acutiloba

Amaranthaceae

Ptilotus manglesii
Ptilotus stirlingii

Droseraceae

Drosera heterophylla

Myrtaceae

Verticordia huegelii

Epacridaceae

Andersonia aristata

Stylidiaceae

Stylidium cannaliculatum
Stylidium ecorne
Stylidium roseo-alatum

Appendix 4

Additional information from the

Department of Conservation and Land Management

Executive Director
DEPARTMENT OF CONSERVATION
AND LAND MANAGEMENT

Your ref
Our ref: TP89.146
Enquiries: Mr N Wimbush

HOMESWEST DEVELOPMENT ON LOTS 37 AND 47 BRIXTON STREET, KENWICK (BRIXTON STREET WETLANDS)

I refer to your submission dated 13 March 1991 on the above project which is currently being assessed by the Environmental Protection Authority at the Consultative Environmental Review level.

As discussed in your submission, CALM obviously have very real concerns about development of any of this particular site for medium density housing by Homeswest. The Authority has debated the matter and would like some additional points clarified before making final recommendations to the Minister for the Environment. These are:

1. Can data on species numbers in the 8ha area be provided? What proportion of the site's conservation values (primarily floristic diversity) are located in the 8ha area to be given up by Homeswest? i.e. Does the proposed reserve encompass a good representation of the site's vegetation including Declared Rare Flora and Priority species?

2. Could you please comment on the predicted long term viability of the proposed 8ha conservation reserve as opposed to the predicted viability of conserving the whole 20ha site.

Environmental
Protection Authority

1 Mount Street Perth
Western Australia 6000
Telephone (09) 222 7000
Facsimile (09) 322 1598

The next meetings of the EPA will be on Thursday 30 May and Thursday 13 June 1991.

Thanking you in anticipation of your assistance.

Frank Batini
A/DIRECTOR
EVALUATION DIVISION

27 May 1991

BRIX270591NWI

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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Your Ref:
Our Ref:
Enquiries:
Phone:

Mr Barry Carbon
Chairman
Environmental Protection Authority
1 Mount Street
PERTH WA 6000

Dear Mr Carbon

I refer to Mr Batini's memo of 27 May 1991 regarding the proposed Homeswest development of Lots 37 and 47 Brixton Street, Kenwick and provide the following information in respect of the specific questions asked:

1. It is not possible to analyse the flora data to specifically say what is, and what is not, in the proposed "conservation" area. The data available is however presented by five vegetation types. One type (clay) is restricted to the proposed "conservation" area and two (wet and dry heath) are restricted to the "development" area. The *Viminaria* and marri vegetation types occur in both areas and species in these types have been regarded as potentially occurring in both areas. This assumption is very inaccurate due to the larger proportion of these vegetation types in the "development" area, and the probable specific habitats in which species would occur that are found at the interzones between these vegetation types and the other site-specific habitats. This could be interpreted by analysing whether the species also occurred in only one or other of the clay or heath communities, but such a complex analysis of the flora data would not be valid.

   Further field investigations, specifically comparing the "conservation" area to the "development" area would be required to provide a definitive assessment of the flora values of these areas.

The results of the flora assessment are presented in the following table.

	"Conservation Area" only (clay community)	Could be in both areas (*Viminaria*/ Marri)	"Development Area" only (heath communities)
Rare or priority species	9	5	0
Species of taxonomic or geographic significance	2	34	6
Total Species	39	216	15

Note that while it may appear that a great proportion of the flora of the area would be retained in the "conservation" zone, these over simplified results are potentially very misleading.

As stated above, the main occurrence of the *Viminaria* and Marri communities is outside of the conservation zone, and hence a large proportion of the 39 species of interest in this area possibly occur outside that zone. It is felt therefore that the loss of this area has the potential to reduce the flora diversity and conservation value of the Brixton Street location by a significant degree.

It should also be stressed that the wetlands are not the only area of conservation value. The proposed conservation area does not include the areas of *Pericalymma* sedgeland claypan, nor the small (and only) area of *Melaleuca/Kunzea* Heath. It also only contains small areas of the Marri Woodland and *Viminaria* shrubland which are important for the occurrence of many Darling Scarp species and other species not normally associated with this area of the Swan Coastal Plains.

2. Crucial to the sustainability of the Brixton Street Wetland, is the minimisation of the impact of surrounding development. Because the total area is only 20 ha and has no protective buffer between it and existing urban pressures, management and protection of the conservation values would already be difficult.

While the 8 ha proposed conservation area incorporates the wetland claypans it must be stressed that a wetland environment is dependent on the hydrological balance of the area. The protection of any area of remnant vegetation is strongly related to the size of the remnant and the distance from internal core areas to external influences. The potential for weed, fertiliser, herbicide, rubbish incursion are all increased with reduced area. The 20 ha area of the Brixton Street location provides only a 100 m buffer to the Alton Street housing area. This is a minimal size for a buffer to the wetlands area.

It is probable that the reduction from 20 ha to 8 ha would in itself render the area unsustainable as a wetland ecosystem in the long term. The further proposal to clear 12 ha of the location, cover it with 60 cm of fill and surround the wetland with high density housing would further impact on the long-term viability of the proposed 8 ha conservation reserve.

Yours sincerely

Syd Shea
EXECUTIVE DIRECTOR

5 June 1991

Appendix 5

Proponent's commitments

10. LIST OF COMMITMENTS

The following commitments have been made by the Proponent.

10.1 The employment of an ethnographer/archeologist to undertake a detailed survey of the site to the satisfaction of the Aboriginal Sites Department of the W.A. Museum.

10.2 Subdivision and amalgamation of Lots 37 and 47 to create a single lot to cover the proposed conservation area.

10.3 Transfer of ownership of the conservation lot to the Department of Conservation and Land Management.

10.4 Contributing towards fencing the proposed conservation reserve in order to limit access and prevent damage or incursion of machines during the construction phase.

10.5 In conjunction with CALM, to prepare a management plan for the reserve along the lines of the outline provided in Attachment.

10.6 The rehabilitation of the proposed conservation reserve area to return it to a pristine state ie. remove roads, remove car bodies, remove squatter rubbish and remove alien plants growing from rubbish tips.

10.7 To provide access to the site at a yet to be finalised location.

10.8 To assist with signs and other educational information to ensure the public is made aware of the significance of the site.

10.9 To generally assist in establishing the reserve as proposed in the management plan.

10.10 To provide a floodway to remove floodwater from the site in a manner acceptable to the City of Gosnells and the Water Authority of Western Australia and the EPA.

10.11 To control dust during development to the satisfaction of the City of Gosnells.

10.12 To position the buildings, adjacent to the railway line, so as to screen noise to the satisfaction of the EPA.