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RESPONSES TO SUBMISSIONS
SUMMARISED BY THE DEP

POINT GREY ENVIRONMENTAL REVIEW
FEBRUARY, 1998

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Report No: MA7130
February, 1998

RESPONSE TO ISSUES RAISED IN PUBLIC SUBMISSIONS

SHIRE OF MURRAY TPS 4 AMENDMENT 104
TO REZONE FROM "RURAL" TO "SPECIAL DEVELOPMENT"
LOTS 75, 137-139, 293, 299, 322, 672, 727, 729, 738, 1132, 1133 & 1145
POINT GREY
SECTION 48 ENVIRONMENTAL REVIEW

INTRODUCTION

This document forms the proponent's (Shire of Murray) principal responses to submissions regarding the Section 48 Environmental Review for the proposed Point Grey Town Planning Scheme 4 Amendment 104.

The public submission period for the Environmental Review for the above amendment commenced on 17 October 1997 for a period of 60 days, ending on Tuesday 16 December 1997.

A total of 46 environmental submissions were received by the Shire of Murray and forwarded to the Department of Environmental Protection. These included 28 letters from individual members of the public.

The responses below are to the outstanding issues and comments which require further information from the proponent. The issues and comments were summarised in Department of Environmental Protection (DEP) correspondence to the proponent dated 23 January (Appendix A). For ease of reference, the following comments and responses are numbered in accordance with the DEP correspondence.

In summary, the principle issues were identified as:

Biophysical factors
1. Vegetation
2. Fauna
3. Wetlands
4. Estuarine vegetation and fauna habitat
5. Groundwater quantity

Pollution Management factors
6. Groundwater quality
7. Surface water quality: effluent disposal
8. Estuarine water quality

Social Surroundings factors
9. Mosquitoes

Other factors
10. Unresolved management issues
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13. Other alternatives
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1.0 VEGETATION

1.1 a) The project will result in increased pressure on the existing reserves within and adjacent to the development area from inflated public access and recreation, fire protection and other operational tasks within the reserves such as fox baiting. The responsible authority has not demonstrated that these impacts will be manageable (CALM).

The indirect environmental effects of development at Point Grey over the next 20 years must be considered in the context of growth which is expected in the Inner Peel Region over the next 50 to 60 years, and the increase in environmental management effort in the region which will be needed to protect the environment under the pressure of this growth.

The Inner Peel Region Structure Plan recognises the existence of 9,420ha of potential urban land around the Peel Harvey Estuarine system, which could accommodate around 254,340 people.

At full development, the Point Grey residents would comprise around 2.7% of the population potential recognised for the region.

Human pressure on conservation reserves will be an inevitable consequence of population growth, both local and regional, and this pressure will need to be managed so as to protect the values and beneficial uses of the reserves.

The Point Grey ODP is put forward as an acceptable land-use in the Inner Peel Region, in regard to protection of conservation reserves on exactly the same basis as is any other development proposal, including strategic plans such as the Inner Peel Region Structure Plan. The core proposition in this regard is that conservation reserves can be acceptably managed to protect recognised values from the pressures of human usage and general presence.

To argue this point to the contrary is to propose that conservation reserves cannot be acceptably managed, a proposition which would dismiss the validity of the entire process of "Conservation through Reserves" (eg: System 6), a management philosophy which

has been the cornerstone of the State Government's approach to conservation since the 1970's.

The fact that reserves can occur adjacent to development and that public access into reserves can be managed is demonstrated by the current practice of creating National and Regional Parks and gazetted conservation reserves within the Metropolitan area.

b) **The EPA's environmental review Instructions state that "Particular attention should be given to the interface between [conservation] areas adjacent to the development, management of human pressures, dieback and hydrological impacts (if any). Attention should also be given to criteria used which trigger implementation of specified management measures." The response to this is to defer the above issues to the development phase and no further detail is given (LMPS). Consequently, further discussion of the potential impacts of the proposed development, such as fire, rubbish dumping, threats to wildlife from domestic pets, weeds, degradation of the environment from off-road vehicles, management of human pressures, and dieback, on existing nature reserves adjacent to the amendment area is required.**

As a component of the environmental planning which has been undertaken for the project, all existing reserves, even those which have been created for the purpose of Recreation are provided with appropriate buffers in the form of vegetation retention or rural-residential development. 'Particular attention' ..... has therefore been 'given to the interface between (conservation) areas adjacent to the development..... ' through the careful placement of complimentary land uses on the Outline Development Plan as follows:

RESERVE NO	PURPOSE	VESTING AUTHORITY	ADJACENT LANDUSE (PROPOSED)
2707	Conservation of Flora & Fauna	National Parks and Conservation Authority	Rural-Residential lots
7502	Conservation of Flora & Fauna	National Parks and Conservation Authority	Conservation / Wood lot buffer
33039	Recreation	Shire of Murray	Large residential lots
27528	Recreation	Not Vested	Remnant vegetation / residential
11718	Recreation	Not Vested	Remnant vegetation / public open space
2738	Conservation of Flora & Fauna	National Parks and Conservation Authority	Rural-residential lots

The Environmental Review does not avoid environmental impact assessment by specifying that management plans for matters such as Foreshore and Conservation Reserves should be prepared prior to construction.

In contrast, the core points of impact assessment put forward in the Environmental Review are as follows:

- the ODP does not propose any direct physical impact (eg clearing, water table changes) to existing conservation reserves. In particular, and in response to the Instructions, a significant degree of environmental management and mitigation of potential environmental impact has occurred through the integrated planning design for the project which arranges land-uses within the site in relation to existing reserves so as to minimise indirect impacts;

- the Environmental Review accepts the principle that conservation reserves can be acceptably managed to mitigate the indirect effects of general population pressure;

- as per current protocol, the Environmental Review proposes a mechanism which provides statutory force to the requirement for the detailed elements of work (including but not limited to the issues raised above), infrastructure plans, implementation schedules and vesting details for management. These need to be agreed and approved by CALM, PIMA. WRC and the DEP during the design phase and before construction can commence, rather than during the development phase as stated.

The purpose of management plans such as are proposed for the Foreshores and Conservation area is not to demonstrate that reserve protection can be achieved, but to demonstrate that the administrative processes and active management measures required to ensure that reserve protection is achieved will be implemented. The core proposition is that the indirect effects of human pressure on conservation reserves can be managed, but active management must be implemented.

Environmental Recommendation Number 6.7 of the Environmental Review (TPS Provision Number 4) require the following specific details of a Foreshore and Conservation Reserve Management Plan:

Foreshore and Conservation Reserves Management (TPS Amendment No. 4)
Prior to construction, a Foreshore and Conservation Reserve Management Plan shall be prepared in stages for those areas affected, following consultation with the EPA, PIMA, CALM and the Shire of Murray. The Plan will address:

- (i) the interface between the development and adjacent areas;
- (ii) management of human pressures;
- (iii) dieback;
- (iv) hydrological impacts;
- (v) the tenure, detailed design and management of Private Conservation Reserves;
- (vi) the establishment and ongoing management of private conservation areas to provide links to public Reserves;
- (vii) the protection of areas of limestone outcrop that could provide habitat for the Carpet Python;
- (viii) the retention of the majority of remnant fringing vegetation and the provision of foreshore buffers and adequate setbacks from waterbird roosting areas;
- (ix) the design and siting of the proposed dredge spoil islands opposite the marina;
- (x) the design and construction of the access road to the site; and
- (xi) water management to reduce mosquito breeding habitat.

These specifications include the following:

- methods and design of foreshore protection (including weed management, fire management etc);
- the type and location of fencing to exclude feral animals, pedestrians or off road vehicles;
- landscape and rehabilitation design (identification of areas requiring re-vegetation and species choice) and implementation schedule;
- public access and information facilities;
- the location and form of pedestrian and cycle tracks,
- waterbird monitoring;
- mosquito management;
- vesting; and
- short and long term management responsibility.

An example Table of Contents for the Foreshore and Conservation Reserve Management Plan is provided as Appendix B.

1.2 a) The Foreshore Reserve Boundary is considered to be inconsistent in certain areas with remnant vegetation, landforms and soil characteristics. The alignment of the foreshore reserve boundary should be consistent with Water and Rivers Commission's (WRC) emerging State Foreshore Policy; existing Peel Inlet Management Authority (PIMA) policy; and Western Australian Planning Commission (WAPC) policy.

The method of delegating foreshore reserve boundaries was undertaken following detailed site work, a level of detail that could not be undertaken by the more regional plans.

In general, in terms of land use, the ODP is consistent with both the boundaries proposed by the existing Peel Inlet Management Program and the Inner Peel Structure Plan.

The Point Grey Outline Development Plan site has a direct water frontage of 15 kilometres. With the exception of the Marina site which proposes a break of less than one kilometre, the remaining area (over 93%) of water frontage is set aside for foreshore reserve within which significant areas of remnant vegetation are preserved and / or enhanced. Furthermore, the foreshore area should be viewed in the context of the overall Outline Development Plan which proposes a total green area (comprising conservation, foreshore, open space and existing government reserve) of 45% of the total land area at Point Grey.

It should be recognised that the ODP is a structure plan only for rezoning purposes, and that greater detail regarding land ownership and land use purpose will be required during subdivision application. It is proposed that those areas in private ownership which are adjacent to the foreshore reserve may be allocated to Public Open Space for the following land use purposes:

- location of the Dual Use Pathway which is proposed as an interface between conservation areas and development;
- buffer;
- general POS.

These matters will be addressed in detail within the Foreshore and Conservation Reserve Management Plan, to be agreed and approved by CALM, PIMA. WRC and the DEP before construction can commence.

b) The Outline Development Plan (ODP) and the environmental review states that the environmental values and preservation of existing remnant vegetation, due to the site's regional significance are to be upheld. It is considered that the ODP does identify and preserve much of the existing vegetation, however, several other important areas of foreshore are

proposed to be cleared for development (PIMA & WRC). The inclusion of a 1.5km road along the north eastern foreshore is totally unacceptable and the inclusion of larger buffer zones of at leat 100m should be a major consideration (MEAC).

Approximately 6ha or 2% of the remnant vegetation in good condition will be cleared to provide waterfront access to the Estuary, which will encourage and enhance the acknowledged high recreational opportunities and enjoyment of the estuary for both residents and visitors. This beneficial use will occur within designated and managed nodes, rather than over the entire foreshore reserve.

The only foreshore area proposed to be cleared is the marina, whilst limited public access is provided to the foreshore at the Sailing Club, Waterfront Tourist Village and Mealup Point Foreshore Village in accordance with Western Australian Planning Commission's policy requirements for public access to the foreshore. The amount of vegetation to be cleared to facilitate the proposed marina should also be reviewed in the context of the Level 5 Regional Boat Launching Facility recommended by the "Boating Facilities Study for the Peel Region" which in providing a range of regional facilities, would also result in substantial clearance of foreshore vegetation.

Current recreational use of the Point Grey foreshores is not confined to permanent residents of the immediate area: the eastern shores are a well known and popular crabbing area which we are advised are used by residents from Pinjarra and beyond, and small craft launched from other locations in the estuary are known to frequently land at Point Grey, particularly the western beach.

The proposal to develop nodal areas for recreation is therefore significant in light of the projected increase in population in the Inner Peel Region with around 250,000 people expected to settle around the Peel-Harvey Estuarine System by between 2041 or 2051. This increase in population will bring more human pressure to the reserves in the Point Grey area regardless of whether there is residential development on the peninsula itself.

The "inclusion of a 1.5km road along the north east foreshore "follows an existing track within Reserve No 33039 which is vested in the Shire of Murray for the purpose of Recreation and provides access for fishing and crabbing areas within the recreation reserve. At the request of the Shire of Murray, this access road is proposed to be upgraded. The owner of Point Grey has no jurisdiction over development within this

Reserve, however wishes to ensure that the management and eventual landuse of this Reserve is integrated with the conservation principles applied to this development.

It is reasonable to expect that unwanted human and vehicle entry to important conservation areas including the southern end of Robert Bay, and onshore reserves can be better prevented if there is a local population who can be expected to exert informal surveillance pressure on these areas.

1.3 **The Foreshore and Conservation Reserve Management Plan, as required by PIMA and WRC, should address issues such as vesting arrangements; the control of public access and pressures, especially to sensitive foreshore areas; and mosquito management (PIMA & WRC).**

It is accepted that a Foreshore and Conservation Management Plan is required. To this end Clause 4 of Amendment No 104 to the Shire of Murray Town Planning Scheme No 4 requires the preparation of the Plan prior to construction. As described in Section 1.1 above, the contents, proposed management, implementation schedules and vesting details require agreement and approval by CALM, PIMA, WRC and the DEP prior to construction.

1.4 a) **The proposed location of the marina is in a very valuable and sensitive area as it contains a significant strip of remnant vegetation. This remnant foreshore vegetation varies in width from 120 to 200 metres and is considered to have regional significance. Development should not lead to the loss of remnant vegetation on the proposal site as the vegetation in the area has already been largely degraded.**

The submission argues that the 6ha or 2% of the remnant vegetation in good condition which will be cleared for the marina and harbourside residential precinct should be retained because it has regional significance and has value because other vegetation in the area has been largely degraded. This is incorrect. Figure 2.5 of the Environmental Review shows that the majority of remnant vegetation on the site is in good condition (over 300ha). The vegetation which will be removed for the marina complex comprises Eucalypt/Banksia Woodland, Banksia Woodland and Spearwood Thicket, all of which

are represented within both the existing and proposed conservation and/or foreshore reserves. For example, Eucalypt/Banksia woodland occurs within existing conservation Reserve 27528 and within the additional 95ha of vegetation to be conserved as an east-west linkage across the site is in good to excellent condition (Goble Garret, 1996) . With the exception of a small strip of *Kunzea* thicket to be removed for the marina, all Spearwood Thicket will be retained in Foreshore and/or Conservation reserve. Only 4ha of parkland cleared and stock damaged Banksia woodland will be cleared for the harbourside precinct. All remaining Banksia woodland (approximately 70%) is in good condition and will be retained and managed within foreshore reserve at three other locations over the site. Banksia woodland also occurs prolifically on limestone areas between the ocean and the Harvey Estuary (Goble Garret, 1996).

The submission provides no information to support the claims that the vegetation is "very valuable", "sensitive" or has "regional significance", and is in contrast to the specialist botanical opinion. There is no regional document which indicates that this vegetation has special conservation significance.

b) The proposed location of the marina is not supported by WRC and PIMA as it is felt that the location has been chosen in terms of Best Planning Practices such as aesthetics and accessibility to the Dawesville Channel, rather than on environmental grounds. The development could easily be facilitated in an area that is already degraded (PIMA & WRC).

This comment does not acknowledge the high level of preliminary environmental baseline studies and constraints analysis which provided the blueprint for the planning overlay.

Preliminary constraints assessment was undertaken for the location of the marina with consideration of the following environmental factors:

- impact on waterbirds (distance from waterbird habitat);
- impact on samphire habitat;
- impact on seagrass habitat;
- prevailing wind and flushing opportunities to maintain water quality;
- impact on foreshore vegetation.

Following this assessment and based upon the above criteria, two optimal marina locations were selected, both on the western side of the development and furthermost away from significant waterbird habitat. Each location was considered to have a similar minimal level of environmental impact, however the southernmost location has greater environmental benefit for the following reasons:

- Seagrass loss is minimised by development in the southern part of the Point Grey beach. The *Halophila* seagrass in this area consisted of scattered small patches rather than large patches or a continuous meadow as it is further north or south.

- High water quality due its proximity to the Dawesville Channel will ensure efficient flushing and high water quality within the marina.

- The area to be dredged for the marina basin encompasses the narrowest strip of fringing vegetation on the western side of the project area. Erosion of the shoreline vegetation in the southern area of the proposed development indicates that this vegetation is already under threat from natural changes related to the Dawesville Channel.

- Public usage of the area is likely to increase as the marinising influence of the Dawesville Channel continues. This would increase disturbance of the existing bird populations which could be offset by creating intertidal habitat beyond the range of people and domestic animals.

- Large areas of dense seagrass and samphire were specifically avoided in selecting the current location for the marina.

Best Planning Practices were then applied to the two optimum sites and integrated with environmental considerations, with the proximity to the Dawesville Channel a combined benefit for the nominated location.

It should be noted that the Peel Inlet Management Plan (1992) recommended a dredged jetty in a similar area north of the nominated site.

It should also be noted that the marina's location reflects the recommendations of the Peel Inlet Management Programme (1992) prepared by the Waterway's Commission for the Peel Inlet Management Authority (PIMA).

Point Grey is nominated on Map 10 (p.91 – Peel Inlet Management Programme) with recommendations that include the creation of a foreshore reserve from vacant Crown land; the potential for dredging works to sustain boating facilities as part of proposals for residential development and the preparation and implementation of a Foreshore Management Programme.

The Outline Development Plan makes allowance for the requirements of the Peel Inlet Management Programme.

1.5 **Edge effects may have a negative impact on the existing reserves as a result of the proposed development. The subdivision design for the "Tourist", "Residential", and "Rural-Residential" zones as outlined in the environmental review and the ODP shows that a significant amount of private land holdings directly abut Public Foreshore and Conservation areas, without any physical demarcation between the reserves and private property. Past experience has shown that indiscriminate access tracks, the damaging of vegetation and the dumping of potentially noxious garden refuse in the reserve may occur without a physical barrier between reserves and residences. All boundaries of lots abutting the reserves should be demarcated by a physical barrier such as a road and appropriate fencing (PIMA & WRC).**

Firstly, it should be recalled that the remnant vegetation has been subject to significant "edge effects" since the site was cleared. Secondly, the ODP is a rezoning document and does not provide sufficient detail to show private landholdings adjacent to any proposed conservation and/or foreshore reserve. Rather, and only in certain areas, the ODP indicates proposed residential zoning adjacent to these reserves. As discussed in Section 1.2, it is proposed to generate POS in these locations which will provide a distinctive demarcation between the reserves and private property. This demarcation will include the construction of a Dual Use Pathway and appropriate fencing.

1.6 **The areas proposed for reservation should be defined to ensure that the integrity of the nature conservation values is retained over time. The responsible authority has not discussed buffers, security of tenure, management arrangements or the possibility of reforestation (CALM).**

The proposed nature reserves should be vested in either CALM, NPNCA, WRC etc or protected by a covenant so that their long term purpose does not change.

These details, including the finalised vesting authorities and arrangements for long-term management will be included within a Foreshore and Conservation Reserve Management Plan to be prepared prior to construction of any stage, which is a requirement of Amendment No 104 to Town Planning Scheme No 4. and subject to agreement and approval by CALM, PIMA, WRC and the DEP.

1.7 **There is not enough discussion of, or information provided, in reference to the retention of areas of remnant vegetation to determine if strategic nature conservation values will be maintained (CALM).**

The existing reserves, foreshore and remnant vegetation on the site and associated nature conservation values are currently unmanaged. The proposal will place 98% of the remnant vegetation within vested foreshore and/or conservation reserves and see the implementation of an agreed and approved management plan to protect the existing local and "strategic" nature conservation values.

1.8 a) **The impact of additional clearing for Carrabungup Road on the existing nature reserve is not adequately discussed (CALM). The realignment of Carrabungup Road and any other major access routes away from System 6 Area C50 to a more suitable location is advised (PIMA & WRC).**

The discussion of other potential access roads is very limited. No detail is given for the location of the southern access road, nor any reason why the link is required. This road has the potential to be extremely destructive, as it is likely to be routed close to Lakes Mealup and McLarty, and would split lengthwise the adjacent high quality bushland proposed for the Peel Regional Park. The failure of the ODP to consider the impacts of other access roads as part of the Scheme Amendment is a major deficiency (LMPS).

Several route options were assessed during the development of the ODP and were subject to both engineering and environmental constraints analysis.

The two route options studied follow existing road reserves (apart from some minor resumption to round a few corners) and will require only very minor additional clearance of vegetation. The Carrabungup alignment is already developed and would provide a lesser impact on the physical and natural environment than a re-alignment. The existing alignment also provides the most direct access to the existing recreation reserve (No 33039) which is heavily utilised by the local community for fishing and crabbing activities. Existing surface runoff characteristics can be maintained via edge drains along the access pavement and culverts under the roadway.

Routes other than the two selected will involve significant additional distance, significant land resumption, most likely greater disturbance to natural vegetation and natural drainage pathways, and a significantly increased cost. The only other access route to the site is via Lake Mealup Road, passing between Lakes Mealup and McLarty, representing an additional distance of over 4 kms and requiring considerable clearing of natural vegetation close to Ramsar Wetlands.

1.9 **The flora and fauna survey for the environmental review, undertaken on only 2 days in April, is not adequate to determine the diversity of species present. The large area of land involved in this proposal and the presence of ten different vegetation types suggests more time would have been required for an adequate plant census. The flora survey should have been conducted in spring to allow accurate identification of plants using floral structures and to observe species which would be dormant over summer and early autumn. Thus the survey must seriously underestimate the biodiversity of the site. A more detailed survey needs to be carried out before a decision on the proposal can be made (WSWA).**

As stated within the fauna report (Appendix D of the Environmental Review - "A Vertebrate Fauna Assessment of the Point Grey Area" (Ninox Wildlife Consulting 1996)), a comprehensive Environmental Review and Management Program was prepared for a proposed development on the Point Grey Peninsula in 1987 (Dames and Moore 1987). This review discussed the area in the context of Peel Estuary and detailed information on fauna was provided, mainly concentrating on aquatic species. The 1996 survey report updates this earlier information using records obtained by the author and other individuals over this period, and also provides a review of terrestrial fauna habitats.

The main purpose of this most recent survey was to provide an overview of the Project Area and its current conservation status.

Table 1 of the above report listed the fauna recorded during the two-day field assessment. Because the survey took place in autumn some species were not observed - primarily rare nomadic or migratory birds or terrestrial species which would require a trapping survey to establish their presence. To remedy this, Table 1 provided details on the bushbirds, mammals, frogs and reptiles which were expected to occur in the area based on known distributions patterns and habitat preferences. Similarly, Table 2 listed the waterbirds known or expected to utilise the Project Area.

Tables 1 and 2 were based and referenced on the extensive body of survey work undertaken on and near the Project Area by the authors of the fauna report and other individuals. Because these tables also listed a range of species which were remote possibilities for the Project Area, it is therefore highly unlikely that some species may not have been identified as stated in Submission 1.9.

Detailed knowledge of waterbird diversity at Robert Bay is not a requirement for recognising its significance as waterbird habitat and implementing management to minimise disturbance.

Likewise, detailed floristic information and a knowledge of the biodiversity of the site is not a requirement for the conservation and vesting of reserves or for the implementation of conservative management practices.

1.10 **The loss of habitat caused by the removal of 18ha of remnant bushland as well as the development of the sailing club and marina is by no means compensated by the planting of Tuart trees on the golf course or by the sitting of two offshore islands, both of these, besides taking a long period of time to become established, are going to be subject to human disturbance (MEAC).**

As previously stated in Section 1.2 the Outline Development Plan proposes 45% of the total land area at Point Grey for green space. This represents an area in excess of 560ha. Significant areas of remnant vegetation are preserved including a 100ha west-east sanctuary/conservation link, and an area in excess of 22ha and 64ha near Robert's Bay.

In total an area of 252ha of remnant vegetation is set aside as conservation reserve. The 18ha of remnant bushland referred to, which includes and is not additional to the area proposed for the development of the sailing club and marina and its removal should be viewed in the context of the 252ha which is to be preserved.

The loss of 18ha (6%) of remnant vegetation, which includes and is not additional to the development of the sailing club and marina complex and will result in minimal impact to the current conservation values of the site. In contrast, the establishment of an additional 260ha of vegetation on former parkland cleared farm land, regrowth of foreshore vegetation in the degraded Robert's Bay area, and the establishment of waterbird and estuarine intertidal habitat along the foreshore of the dredge spoil islands will result in positive nett increase in fauna habitat.

Landscape Management (TPS No. 10)
Prior to construction, a Landscape Plan shall be prepared in consultation with the EPA. The Plan will address:

(i) methods proposed to supplement existing vegetation and increase fauna habitat, particularly in areas of degraded remnant vegetation, in accordance with landscaping requirements, habitat replacement priorities and Planting Guidelines published by the Pinjarra Community Catchment Centre; and

(ii) planting of Tuart trees in strategic locations (focussing on the golf course) to enhance the site's landscape and increase the area of potential habitat for the Peregrine Falcon.

2.0 FAUNA

2.1 The environmental review does not provide adequate information or discussion on bird utilisation of the proposal area and potential impacts of the project on bird life during the construction and post-construction stages. (CALM).

To date, very little reliable data are available on the impact of resort and residential developments on waterbirds. Most of the available information is anecdotal, subjective or speculative - as opposed to the "hard" data gathered from systematic, long-term surveys.

It is inevitable that some impact will result from development adjacent to a wetland. A series of baseline waterbird surveys cannot identify potential impact. They do, however, more clearly identify sensitive areas and facilitate the production of impact reduction and conservation strategies within these areas. Robert Bay, identified in the fauna report, is such an area and has been discussed at length. Accordingly the planning design for the Point Grey project minimises development in this area.

It is only recently that surveys consisting of baseline sampling prior to development, followed by monitoring during and after construction have been included as commitments in proposals.

Part Mandurah Stage 2 – Nimox data in CALM –

Recent monitoring for waterbird disturbance (1997) has been conducted of a high usage waterbird habitat site where construction and dredging occurred directly adjacent (within 20-50m) during late spring and summer (the peak period for migratory wader activity). Construction occurred over three to four months behind visual screens.

The data showed that in virtually every sector where there was an initial, localised reduction in waterbird species richness and abundance that could have been attributed to nearby construction activity, this was generally followed by a marked rise in both richness and abundance once construction ceased near the sector or when waterbirds had apparently habituated to nearby disturbance. In some sectors of the study area, species richness and abundance remained consistently high despite nearby construction activity showed the following conclusions:

In comparison with earlier, similarly detailed waterbird surveys within the study area (Waterways Commission 1990), three main conclusions were reached:

1. There was no overall impact on the number of waterbird species using study area despite construction activity taking place. Month by month species richness was generally higher than the results from the earlier series of surveys.

2. Thirty-three species of waterbirds were recorded in the species area between 1998 and 1989, and 40 during the 1997 monitoring period, indicating that species richness had not been adversely affected.

3. Despite construction activity, waterbird numbers were consistently higher from December 1996 to February 1997 than those recorded for the same months during earlier surveys.

Mitigation of construction and post-construction impacts at Point Grey has occurred primarily through planning design to locate development nodes as far away as possible from significant waterbird habitat. Accordingly, construction at the Point Grey site will occur at a much greater distance from intertidal migratory wader habitat than the above construction works. The nearest construction works proposed to the major habitat at Robert's Bay will be the potential upgrading of the existing foreshore access road, while the construction of Sector 5 (Golfcourse Tourist Estate) will occur upland and at least 400 to 500 metres from the nearest intertidal zone.

Any short term impacts from these developments can easily managed by aiming for construction over the periods of lowest waterbird activity, when migratory waders are not present in the Estuary. The Construction Management Plan to be prepared as a commitment to this development, will be closely linked with the waterbird monitoring and management program (within the Foreshore and Conservation Reserve Management Plan) which will include a range of contingency actions should unexpected waterbird disturbance be observed.

Waterbirds (TPS Amendment No. 11)
Prior to construction, a Waterbird Monitoring Plan shall be prepared for important waterbird habitats adjacent to the site, in consultation with the EPA on advice from CALM and PIMA.

Construction Management (TPS Amendment No. 12)
Prior to construction, a Construction Management Plan shall be prepared in consultation with the EPA on advice from the Shire of Murray. The Plan will address:

(i) the minimisation of clearing and vegetation disturbance;
(ii) the protection of foreshore buffers;
(iii) the control and monitoring of dust, noise and smoke; and
(iv) the incorporation of environmental protection specifications in all construction-related contracts.

2.2 The intertidal flats in Robert Bay provide feeding and loafing habitat for the trans-equatorial migratory waterbirds. The area that directly abuts these intertidal flats is proposed for rural-residential development. No discussion of management of impacts on the waterbirds from pedestrians, domestic pets, off-road vehicles or boats is made in the environmental review (LMPS).

As discussed above, little reliable data are available on the impact of resort and residential developments on waterbirds, with the provision of foreshore screening, vermin-proof fencing and foreshore management to prevent intrusive human presence being relatively recent developments whose long-term effectiveness has not been monitored.

Waterbirds can be affected by various disturbances. The level to which they can adapt to these influences is entirely dependent upon (a) where the wetland is situated and distance from disturbance, (b) whether effective management and conservation strategies are in place and, (c) whether these strategies are realistically enforceable.

Locations such as Pelican Point and Milyu Nature Reserve are described in one submission as showing a marked reduction in the number of migratory wading birds over the past 15-20 years. It is extrapolated in the submission that a similar level of impact could be expected at Point Grey.

However, these metropolitan sites are poor examples since both are situated in areas of very high population density and are located adjacent to main highways or freeways. Nearby boat traffic is extremely high. Conservation and management strategies for these locations have been historically expedient in the face of continuing and inevitable disturbance and, in practice, are unenforceable within city recreational areas. Foreshore protection within the metropolitan area is therefore intrinsically nominal. There is free access to most points in these areas by humans, domestic pets and feral predators. Therefore it is hardly surprising that wading bird populations have been affected and adaptation to disturbance is low.

Contemporary development projects such as is proposed at Point Grey consistently include proactive conservation and management strategies to protect waterbirds during construction and post-construction to allow them to gradually adapt to disturbance. During the historical development of Pelican Point, and prior to the establishment of the Milyu Nature Reserve, this did not occur because it was not part of the development process at that time. Awareness of the sensitivity of wetlands and development impact upon them is a fairly recent phenomenon.

Contemporary developments typically include:

- Use of sight screens where appropriate to minimise visual impact during construction;
- Limiting intrusive human access to sensitive portions of the foreshore, enforced by fencing, consequently creating protected refuge areas;
- Control of vehicles by physical barriers;
- Public education to develop increased awareness of the sensitivity of an area;
- Adequate sign posting to define exercise areas for horses and dogs;
- Control of feral animals where practicable; and,
- Modification and improvement of conservation strategies based on monitoring.

While the major waterbird habitat area (Robert's Bay) should experience minimal disturbance, there will inevitably be some disturbance to waterbirds on the western shoreline. However, implementation of measures such as those indicated above will allow the process of adaptation and habituation by waterbirds to be greatly facilitated and future impact will be reduced. Long-term monitoring as proposed within the waterbird monitoring program will allow fine tuning of these strategies.

2.3 Concern was raised that the waterbird monitoring program is deferred to the post-approval stage. No specific actions were proposed in the environmental review to minimise impacts on waterbirds in the System 6 areas and other reserves due to the proposed increase in human population (LMPS).

The submission suggests that no actions have been undertaken to minimise impacts on waterbirds in the System 6 area. This is incorrect. A preliminary constraints analysis which identified locations of significant waterbird habitat resulted in significant redesign of preliminary plans. These included changes in the preferred locations of both the sailing club and the marina site.

As discussed above, a waterbird monitoring and management program will be integrated with proposed foreshore rehabilitation and construction management, as discussed in Section 2.2 above.

2.4 The fauna study of 20 hours without trapping is too brief to be called adequate. Research at the nearby Goodale Sanctuary south-east of Point Grey and at Lake Mealup suggests that the Point Grey Fauna list is far from complete. Inadequate management measures are proposed to protect the potential habitat for the carpet python (LMPS).

Comments which oppugn the need for a complete inventory of identified species in order to create and manage a conservation reserve are provided in Section 1.9.

The submission also make comment on the protection of the potential habitat for the Carpet Python. The conservation measures proposed include vesting of the area as secure nature conservation reserve, fencing for total exclusion of public access and preparation and implementation of a management plan to be agreed and approved by CALM.

3.0 WETLANDS

3.1 A large wetland complex exists along the eastern side of the development area, containing sumplands, damplands and a small estuarine wetland. Each wetland seems to have unique species composition and zonation of species. A full assessment of all wetlands on the development site should be undertaken and taken into consideration in the environmental review. Protection of all wetlands on-site and maintenance and restoration of adequate vegetation buffers around the wetlands should be incorporated into the ODP. Approval for a Wetlands Management Plan should be sought from PIMA and the WRC prior to the development proceeding to the next planning stage and before any works commence on site (PIMA & WRC).

The hydrology of the wetland areas on the site has been significantly modified by both the construction of Robert's Bay Drain and the filling and constructed alterations to the drainage line west of the drain, with remnant paperbark trees over the site indicating previous drainage lines. The wetland areas have been degraded due to the presence of cattle, and the vegetation is predominantly overstorey with little or no understorey. An assessment of the condition of each of the wetlands was undertaken (see Section 2.3.4.3 of the Environmental Review), with the eastern wetlands identified as category M - Multiple Use, as a result of the absence of their original vegetation.

Any notion that the wetlands "seem to have unique species composition and zonation of species" are likely to be derived from patterns of degradation rather than any significant botanical value.

It is proposed to retain all wetlands on site, removing cattle and protected from physical impact, with the current planning designed to form a considerable buffer from these wetland areas. The requirement for wetland protection will be incorporated within the Landscape Management Plans (TPS *(TPS Amendment No. 10)* and the Construction Management Plans *(TPS Amendment No. 11)*

Should the construction of a nutrient stripping wetland for the Robert's Bay Drain proceed, a Wetland Management Plan is required as part of the Scheme Amendment.

Constructed Wetland on Robert Bay Drain (TPS Amendment No. 16)
In the event that satisfactory arrangements can be reached in regard to funding, ownership and management, and subject to technical validation, a constructed wetland will be developed adjacent to the lower reaches of the Robert Bay Drain, under agreement with PIMA and the Shire of Murray for its ongoing management.

Robert Bay Wetland Management (TPS Amendment No. 17)
Prior to construction of the Robert Bay Wetland, a Wetland Management Plan shall be prepared in consultation with the EPA on advice from PIMA, the Shire of Murray and the Water Corporation. The Plan will address:

(i) maintenance of existing drainage functions of the drain;
(ii) minimisation of mosquito breeding areas;
(iii) maximisation of ecological and habitat functions of the wetland; and
(iv) ongoing monitoring of wetland water quality and ecological functions.

3.2 a) The development threatens significant wetlands, including Lake McLarty and Lake Mealup. These wetlands are RAMSAR listed wetlands (as is the Peel-Harvey estuary) and there is an international obligation by the Australian Government to ensure that RAMSAR wetlands are not damaged. The Point Grey development threatens the integrity of these wetlands and consequently if this proposal was approved, the Government would be in breach of the RAMSAR Convention (CCWA).

It is unclear from the submission how the Point Grey development threatens the Lake McLarty and Lake Mealup wetlands.

The Environmental Review (Section 4.7) discusses the potential impacts which may threaten the adjacent wetlands, with the most significant factors being the possible indirect impacts to water levels in wetlands with conservation value caused by groundwater drawdown, and a potential change in the quality of surface water and groundwater inputs to the wetlands.

These factors are recognised as setting the primary limits to the water supply potential from the aquifer.

Section 4.8.2 of the Environmental Review describes numerical modelling of groundwater abstraction to predict drawdown in both the superficial and Leederville aquifers. No abstraction will occur within the superficial aquifer, which supplies the groundwater source of the local wetlands. Further, and due to the discharge characteristics of the Leederville aquifer in this area, groundwater abstraction from this

formation is predicted to cause minimal impact on shallow water table levels or groundwater dependent vegetation and wetlands.

The accuracy of the model will be continually assessed by reactive monitoring within the required Water Supply Monitoring and Management Implementation *(TPS Amendment No. 9)*

The site is located downgradient of both surface and groundwater flow of Lake Mealup and Lake McLarty (Figure A5 Engineering Report 2 of the ODP). This, in combination with the very high phosphorus retention capacity of the Deep Spearwood Soils west of the wetlands will result in no nutrient transport to the lakes.

Water Supply Monitoring and Management Implementation (TPS Amendment No. 9)
For the duration of the water supply construction phase, annually for five years following completion of the last stage of construction and then at an interval determined by experience, the Water Supply Monitoring and Management Plan will be implemented in consultation with the EPA upon advice from the WRC.

Phosphorus Leaching Monitoring and Modelling Implementation (TPS Amendment No. 5)
Throughout the construction of the sewage treatment plant, annually for five years thereafter, and then at an interval to be determined by experience, monitoring of sewage treatment and treated effluent disposal facilities will be undertaken to confirm phosphorus storage performance in the soil profile. Follow-up phosphorus leaching modelling will be carried out to confirm that phosphorus objectives for the Peel-Harvey Estuary can be met for the foreseeable future. The monitoring and remodelling program will be detailed in the NIMP, and will be carried out in consultation with the EPA upon advice from the WRC.

b) The environmental review does not deal at all with the potential impacts of the development on Lake Mealup and Lake McLarty as required by the EPA's Environmental Review Instructions. In particular, the assumption that the expected drawdown of the Leederville aquifer will not significantly impact shallow water table levels or groundwater-dependent vegetation and wetlands is not explained (LMPS).

Please refer to Sections 3.1a above and Sections 5.1, 5.2 and 5.3 which detail the groundwater hydrology and predicted impacts of drawdown.

3.3 Intensive development such as is proposed at Point Grey would adversely affect nearby RAMSAR wetlands which are on the Register of the National Estate (WANC).

Please refer to Section 3.2a.

3.4 The basis for the proposed buffer widths is not described and they are inadequate (LMPS).

No information is provided to support the submission that the buffer widths are inadequate.

The wetlands will be protected from the current physical impact by removing cattle and protected from physical impact. The ODP provides for a considerable buffer around these wetland areas which will also be planted as part of the Landscape Management Plans (TPS *(TPS Amendment No. 10)* .

4.0 ESTUARINE VEGETATION AND FAUNA HABITAT

4.1 The development of the marina and sailing club will necessitate dredging. The very shallow water in this part of the inlet is a known bird roosting and foraging area and it attracts many water birds including migratory wading birds that are protected by international agreements such as CAMBA and JAMBA. The impacts of the proposed marina, sailing club, dredging activities and the increase in aquatic and other associated activities on the waterbirds and other associated fauna has not been adequately discussed.

It should be noted that the location of the Sailing Club reflects the recommendations of the Peel Inlet Management Programme (1992) which provides for this facility on the eastern side of Point Grey.

Based on the constraints analysis undertaken for the site, the recommended location was placed further to the west and away from the shallow flats on the eastern side of the small point, in an area which is not considered to be a significant waterbird habitat area.

Plans for the sailing club emphasise siting with minimal impact to existing fringing vegetation and shallow estuarine habitats. The depth requirements for the sailing dinghies themselves (hobbie cats or centreboard monohulls) require less than 0.5m water depth, however could be prohibited within a "Waterbird Conservation Zone". This zone is not within the powers of the landowner or the Shire of Murray to create, however will be recommended within the Foreshore and Conservation Reserve Management Plan, which will be closely linked with the waterbird monitoring and management program to include a range of contingency actions should unexpected waterbird disturbance be observed.

As stated in Sections 1.1 and 4.3, the planned increase in population growth will see increasing pressures on the estuarine environment, with or without the Point Grey development. At present the recreational usage of the area is largely uncontrolled and, in the absence of signage and education, is likely to increase as the area becomes marinised and more attractive to recreational crabbers and fishers. Public education and signage will provide more protection for this area than is currently provided. As with the marina

area, it is proposed to mark accessible areas to show where boats can travel without causing deleterious impacts.

Please also refer to Sections 4.2 and 4.6b.

4.2 **The area of the shoreline and estuary bed that are proposed to be dredged for the construction of the marina are considered to be highly sensitive and valuable in terms of sandy beach accretion and the emergence of seagrass beds along these shorelines. The seagrass beds are considered valuable in terms of providing habitat and feeding grounds for the low order marine and estuarine creatures which inhabit the Peel-Harvey estuary, especially since the opening of the Dawesville Channel and the increased movement and exchange of marine water from the ocean to the estuary (PIMA & WRC). The proposal to use signage to protect seagrasses from boating is totally inadequate (LMPS).**

Sandy beaches are likely to develop in the area as the finer sediment particles are winnowed away by the clean oceanic water from the Dawesville Channel. Examination of aerial photographs does not show any evidence of significant accretion in the area between 1994 and 1997.

The seagrass meadows in the area to be dredged are small patches of *Halophila ovalis*; a dynamic, rapidly growing species which is likely to spread along the northern part of the western coast of Point Grey.

Development of seagrass meadows along the shallow subtidal areas of the artificial habitat islands will mitigate the loss of the embryonic seagrass meadows in the proposed dredge area. The creation of seagrass meadows on the eastern side of the habitat islands may lead to the development of the most stable seagrass communities in the area, because disturbance due to storm action will be largely alleviated and the shallow subtidal will receive high quality water and little human interference.

Public education and signage will provide more protection for the foreshore and nearshore seagrass than is currently provided. The navigation channels will be clearly marked to show where boats can travel without causing deleterious impacts on the seagrass and to avoid the inconvenience to those on board of running aground. Signage

and interpretation are tools effectively used by management and conservation agencies like PIMA and CALM for managing human use and reducing potential impacts in sensitive environments. At present, recreational usage of the area is totally uncontrolled and, in the absence of signage and education, is likely to increase as the area becomes marinised and more attractive to recreational crabbers and fishers.

4.3 The Austin Bay Nature Reserve is the only area in the Peel-Harvey estuary that remains without intensive development. The proposal for such a large development in close proximity to the reserve and to the shoreline of the estuary is likely to have detrimental impacts on the natural estuarine vegetation of the area.

It is unclear how the development at Point Grey will impact Austin Bay Nature Reserve other than the indirect impacts of population growth and increased public access. As discussed in Section 1.1, the indirect environmental effects of development at Point Grey over the next 20 years must be considered in the context of growth which is expected in the Inner Peel Region over the next 50 to 60 years. The Inner Peel Region Structure Plan proposes an increase in population by 254,340 people, of which the Point Grey residents would comprise around 2.7% of the population potential recognised for the region. .

This level of population pressure and increase in boat ownership and estuary use will impact Austin Bay with or without development at Point Grey and will require an increase in environmental management effort in the region which will be needed to protect the environment under the pressure of this growth.

Recommendations for both CALM and PIMA to prepare management plans for the Point Grey foreshore and reserves were made in 1992 within the Peel Inlet Management Plan, however have not been prepared or implemented.

The Point Grey ODP is an environmentally sensitive development which will incorporate considerable conservation land, will resolve reserve vesting, contribute to the rehabilitation and revegetation of currently degraded foreshore areas, and will result in the preparation and implementation of management plans to a greater level than that able to be adopted by government resources alone.

4.4 The habitat of the proposed constructed dredge spoil islands is too high for optimal value to ground nesting species such as pelicans and fairy terns. In addition, the proposed jetty for public access to these islands totally negates their value as waterbird habitat (LMPS).

It is not proposed to replicate habitat for ground nesting species such as the pelican or the fairy tern. The most significant habitat for migratory waterbirds is the feeding habitat provided by intertidal flats which will be replicated along the foreshore of each island.

The configuration, slopes and height of the dredge spoil islands can be significantly varied during the detailed design phase in order to meet the final fine-tuned requirements for spoil disposal, marina shelter and waterbird habitat.

The need for a jetty for public access to the island will be assessed further in the Foreshore and Conservation Reserve Management Plan.

4.5 There is no detail given to expected changes to the waters and seabed associated with the marina and sailing club developments (DOT).

Water quality within the proposed marina is expected to be high due to the high degree of flushing by oceanic water entering the estuary through the Dawesville Channel and due to minimal inputs from terrestrial sources. The marinisation of the area has removed much of the fine sediments that originally characterised the western coast of Point Grey. Some re-accumulation of fine particles is expected within the marina basin. The Water and Sediment Quality Monitoring Program (WSQMP) will monitor the status of these fine sediments to ensure that contaminants are not being concentrated in the marina.

The water and sediment quality within the area of the sailing club is expected to improve slowly due to the ongoing marinisation of Robert's Bay.

4.6 a) There are indications that the marine works have not been planned properly. The Harvey estuary has a maximum natural depth of 1.6m and this limits the general size of sailing vessels to 10m. The environmental review claims that the marina should be able to be utilised by 15m yachts, however, for this to occur, a channel would need to be dredged wholly across the estuary and into the throat of the Dawesville channel itself.

The marina has been conceptually designed to accommodate a maximum vessel being a 15m motor cruiser, which has a design draft of 1.5m (refer Engineering Report No. 6). Sailing yachts with drafts up to 1.5m (ie. vessels to approximately 10m length) can access and moor in the marina, however larger yachts would need to be penned at either the proposed Port Bouvard marina or Mandurah Ocean Marina where appropriate water depths will be available.

The proposed depth in the navigation channel between the Dawesville Cut and the marina has been set at -2.5m CD, which represents a minimum 1.0m keel clearance below the design vessel to take into account appropriate factors for wave action, squat, channel bed conditions, etc.

b) The environmental review also mentions a small channel that may be dredged to allow access to the sailing club. As the low water mark is approximately 100m offshore and the presumed power boat depth some 250m offshore, this "minor channel" is likely to involve some 3 000 sq.m of surface and 2 000 cu.m of spoil (DOT). Further clarification is necessary of depth requirements for both sail and powered craft and consequent dredging needs or proposals.

The depth requirements at the proposed dinghy sailing club would be approximately 0.5m below low water to allow navigation by outboard powered rescue craft. The sailing dinghies themselves (hobbie cats or centreboard monohulls) require less water depth, but a clean sand bottom to walk boats to and from the launching beach is required, as discussed in the Environmental Review.

Taking into account a mean low low water level of 0.4m above chart datum, the rescue boat channel from the launching ramp need only extend to approximately 50m offshore of the LWM, a total distance of 150m. It is considered that approximately 2000m^2

surface area would need to be deepened with a total volume of approximately 750m^3 of spoil removed, which is not considered to constitute an unacceptable impact.

4.7 **The environmental review quotes "old" predictive data in regard to estuary water levels. The extreme event reviews of 1997 should be utilised for the rare event planning leading to the design water levels in section 2.2.3 of the environmental review (DOT).**

Minimum development levels noted in the Environmental Review and ODP have been determined from estimated extreme water levels in the Peel and Harvey estuaries based on available information in 1996. Finalisation of these minimum development levels will sensibly be made after review of the latest information, study results etc. immediately prior to the relevant development approval. Minor adjustment of the minimum development levels in the light of updated information will have no effect on planning, engineering or environmental aspects of the proposed development.

4.8 **The section in the environmental review regarding shoreline stability (section 2.2.7) quotes a long-term photo record to substantiate a claim for stability. This is quite invalid for Point Grey, which now experiences a significantly changed regime at the post-Dawesville water levels. There is a need for close study of the post 1994 record for indicators of possible natural change. It is reasonable to presume some significant local variation of sandy shore reaches (DOT).**

It is agreed that some re-arrangement of the western shoreline in response to the modified current regimes in the area was predicted as a result of opening the channel. However, the adjustments were predicted to be primarily localised and minor in extent and, relative to the area of the proposed development site, insignificant.

Examination of the shoreline subsequent to the opening of the Dawesville Channel in photographs from 1994, 1996 and 1997 in fact has indicated that apart from evidence of minor erosion in some areas of the west shoreline since the channel opening, there has been little change in the shorelines. This effect should have stabilised by now and there is no evidence of significant accretion in the area of the proposed marina.

The final location of the edge of development adjacent to the shoreline will be subject to study of the latest shoreline trends closer to the time of detailed planning.

Stabilisation of shoreline position and shape can be undertaken at low cost utilising natural stone armoured headland/s if an area of likely future variation of significance is identified after near shore development is established.

4.9 Seabed sediments should be monitored within harbours and swimming areas as heavy metals such as zinc tend to build up near boats and urban drainage outlets (DOT).

Seabed sediments will be monitored in a Water and Sediment Quality Monitoring Program (WSQMP) to be designed to meet the requirement of the DEP, WRC, PIMA, EPA, DOT and Shire of Murray. The monitoring program will include pre-construction monitoring to collect a baseline dataset against which to assess possible changes due to the marina development.

5.0 GROUNDWATER QUANTITY

5.1 The impact of drawdown of the Leederville aquifer on the nature reserves (from the Murray River mouth to the Harvey River mouth) and important wetlands for migratory birds requires further discussion and investigation (CALM). As waterbird usage of wetlands is a good indicator of their integrity, the responsible authority should be required to fund comprehensive surveys of waterbird usage of the Waroona mound wetlands to monitor the effects of drawdown as suggested by the Royal Australian Ornithological Union when the previous development proposal for this land was submitted (PPS).

The wetlands are maintained by the unconfined groundwater system in the Superficial formations. The confined Leederville aquifer and the unconfined Superficial aquifer are not in direct hydraulic connection in the area between the Murray River mouth and the Harvey River mouth. Therefore, it is considered that drawdown in the Leederville aquifer will have no significant impact on the nature reserves and wetlands.

5.2 Potable water for the development is proposed to be supplied through the abstraction of groundwater. The impact of increased bore-water use on the bores and land of neighbouring land users has not been addressed (AgWA).

There are no other users of the Leederville aquifer in the surrounding area. All existing bores and wells abstract from the unconfined Superficial aquifer which will not be impacted.

5.3 The information presented in the environmental review is inadequate to sufficiently characterise the hydrology of the area to justify claims that the development will not have unacceptable environmental effects. There is a lack of site-specific detail upon which to base and verify the modelling (LMPS).

There is a sufficient level of hydrogeological information available for the current planning process. The site specific information upon which interpretation and modelling

are based include lithological logs from two (2) test production bores on the project site, results of controlled test pumping of the bores and specific aquifer hydraulic parameters from analysis of the test pumping data.

5.4 No information is provided to support the claim that lowering the Leederville aquifer will not affect the superficial aquifer (LMPS).

Information to support the view of limited hydraulic connection between the confined Leederville aquifer and unconfined Superficial aquifer include the following:

- At least three significant low permeability shale (clay) layers between the zone of abstraction at +140m below ground level and the Superficial aquifer.
- Differences in water quality between the two aquifers.
- The drawdowns presented in Figure A23 of Engineering Report 2 in the ODP are for the confined Leederville aquifer and will not be transferred to the Superficial aquifer due to the lack of hydraulic connection.

5.5 The stratigraphic/hydrologic framework of the site is not established (LMPS).

As stated in the response to Item 5.3, there is sufficient site specific information to develop an understanding of the site stratigraphic/hydrologic regime. The geological section presented in Figure A3 of Engineering Report 2 in the ODP incorporates all this information as well as available information for bores in the surrounding region. The site specific stratigraphic information for Bore PGPB1 is included in Figures B1 and B2. Please refer to Figures 1 and 2 of this document.

POLLUTION MANAGEMENT FACTORS

6.0 GROUNDWATER QUALITY

6.1 The aquifer from which drinking water is proposed to be abstracted is unconfined and as such is vulnerable to contamination. A modelling exercise was undertaken to determine the estimated length of time before phosphorus would leach through the soil and reach the drinking water aquifer, however this exercise was not performed for nitrogen. An estimate of time before the aquifer begins to become contaminated with nitrates is needed so preventative and protection measures, such as proclaiming a water reserve around the production bores, installation of monitoring bores and an initial risk assessment of pollutants entering the water source, can be considered. (PIMA & WRC).

Potable water will not be withdrawn from the superficial unconfined aquifer.

Testing of potable water reported in the Environmental Review and Scheme Amendment document indicated that potable water exists in the confined Upper Leederville aquifer at around 140 m below and is separated by impermeable clays. The bore log for PGB1 provided in the Amendment Scheme text on Figure B1 of Engineering Report 2 shows that 30 m of clay lies above the potable water zone.

In addition, hydraulic heads in the Leederville indicate upward heads which will act against downward flow from the superficial aquifer.

6.2 Both the potable and irrigation water descriptions do not account for the potential salinisation of groundwater as consumption increases. Salt intrusion could prove to be a significant problem and the "salt factor" should be incorporated into the calculations of available supply, particularly as ground water is the proposed source of potable water (AgWA).

Salinisation of the groundwater is also possible if 'salty' water from the proposed artificial wetland at Robert Bay is utilised for irrigation of the golf course and landscape vegetation. This possibility needs to be clarified and taken into consideration when a decision on potable water supply is made (PIMA & WRC).

The Environmental Review indicates on page 60, that reverse osmosis desalination equipment will be deployed in the event that salinity levels increase in the potable water supply.

Groundwater supply projections have accommodated the potential for increasing salinity.

Earlier comments note that the potable water is confined and will not be influenced by superficial aquifer water quality factors.

6.3 **If the Water Corporation is not able to provide potable water for the development, the water quality must be to standards specified in the National Health and Medical Research Council and ARMCANZ document "Australian Drinking Water Guidelines (1996)", and monitoring of the water quality should be done at the cost of developers (HDWA).**

If the Water Corporation do not supply, operate and maintain the potable water supply for Point Grey development, a separate supplier will be utilised to supply, operate and maintain the complete potable water supply system. In accordance with current Office for Water Regulation (OWR) requirements, the supplier/operator will be licensed and monitored by the OWR to ensure that satisfactory standards are maintained, including conformance with NHMRC "Australian Drinking Water Guidelines". The water operators costs will be recovered via water rates charged to the development's residents.

6.4 **The developer has not identified and confirmed an alternative supply of potable water as required by "Council Special Provisions Relating to Specified Land", paragraph 7 item f(i). This provision states if a reticulated water supply cannot be provided by the Water Corporation, paragraph 9 item (iii) requires the developer to "identify an appropriate contingency option for water supply".**

The Water Corporation has advised that it may be able to supply mains water to the site in the future.

In terms of alternatives Upper Leederville groundwater is the preferred source based on the options which have been reviewed to date.

These include:

- mains supply across Harvey Estuary in a submarine pipeline.
- desalination of estuary water.

The developer is in conformance with the requirements of "Council Special Provisions relating to Specified Land", as, in the event that a reticulated potable water supply system is not provided by Water Corporation, an appropriate contingency option of ground water supply is offered.

The provisions referred to relate to Water Supply Management – Clause 9 of Amendment No 104 to Town Planning Scheme No 4. The provision requires that 'prior to construction a Water Supply Management and Monitoring Plan shall be prepared', which is required to address amongst other things "..... the identification of appropriate contingency options for water supply". The developer is required to prepare the Management Plan and the Amendment dictates the appropriate time.

6.5 **The inclusion of a golf course within the development increases the potential for pollution of the estuary from fertilisers, herbicides and pesticides. The proposed application rate of phosphorus on the golf course of 20 kg/ha/annum exceeds the amount set by the Peel-Harvey SPP No. 2 which equates to 15 kg/ha/annum (PIMA & WRC).**

Detailed review of phosphorus and nitrogen export was requested by the DEP. This work is presented in Appendices A and B of this response document. The findings of work presented confirm that export of phosphorus, nitrogen and pesticides from the golf course land use will not cause be environmentally significant

7.0 SURFACE WATER QUALITY: EFFLUENT DISPOSAL

7.1 The provision of a sewer by the Water Corporation is recommended, given the scale of the proposed development (HDWA).

The Environmental Review confirms that land areas to be developed at conventional residential densities will be serviced with reticulated sewerage. Other low density residential areas, including special residential and special rural will be serviced with on-site effluent disposal systems in accordance with Statement of Planning Policy No.2.

The Water Corporation has previously indicated an interest in removing the Point Grey development sewage via pump station/rising main and gravity sewer, for treatment at the future Tims Thicket Wastewater Treatment Plant. Preliminary cost analysis indicates that the proposed on-site system will be more cost effective than the Water Corporation off-site system and has the additional benefits of recycled water utilisation. The scale of the proposed on-site system is significant but entirely appropriate and attractive for private sector operation under OWR licence. The private sector is responsible for the successful operation of significantly larger wastewater systems than the on-site system proposed (for example in Adelaide, Melbourne and Sydney).

7.2 **"Biological Nutrient Removal" (BNR) is cited as an option for sewage treatment, however no explanation or reference is given. This should be clarified to ensure ecological standards are truly considered in the sewage treatment operations. Research into sewage treatment technology may have progressed significantly, however insufficient attention is given to the type of technology to be implemented by the developers (AgWA).**

The calculations for the proposal were based on the lower extremity of effluent concentrations expected from a BNR plant, and no Water Corporation BNR plant in Western Australia is achieving this level on a continuous basis. Consequently the estimated nutrient loads to the estuary as stated in the environmental review may be lower than what are actually achievable. Further calculations of estimated nutrient loads to the estuary should be performed using a range of expected BNR effluent concentrations (PIMA & WRC). An average of near 10 mg/L for the most advanced plants (such as Rottnest and Pemberton) is a more typical final effluent concentration value from BNR plants (LMPS).

Experience with BNR plants has shown that effluent concentrations, hence loads, vary significantly over the day and week due to different levels of human activity. This is important in the operation of a BNR plant where cycle times must be carefully controlled to ensure that the biological nutrient removal processes are optimised. As the development at Point Grey proposes to include tourist facilities, the loadings would be more variable than expected from a purely residential development. The variability of the nutrient output from the BNR plant should also be taken into consideration when calculating the expected nutrient output of the development (LMPS).

Operating results from the Rottnest and Pemberton plants should not necessarily be interpreted as evidence that package plants are not capable of achieving significantly improved results with a moderate increase in expenditure on regular attendance of an experienced operator and suitable monitoring.

The Newman Sewage Treatment Plant, for example, provides hard evidence of consistent performance to the 5 ppm total Nitrogen standard. Results from Newman

Sewage Treatment plant indicate that a consistent total nitrogen of <5 mg/l is possible over time.

The plant has a variable population 3,500 - 6,000 and an average flow around 1,200 m^3/day, with treated effluent <5 BOD, <5 suspended solids, <5 total nitrogen.

The plant was operated from 1981 - 1990 by BHP Iron Ore and 1990 - 1995 by the Water Corporation.

Shire of East Pilbara has operated the plant from 1996 onwards. It requires no special operating attendance. Daily operator attendance is 2 hours as there are manually cleaned screens.

The plant is an Orbal system, ie a variant of an oxidation ditch. Such plants are capable of sustaining quite large swings in population and are capable of maintaining <5 TKN (Total Nitrogen) with little nutrient impact despite a change in BOD loading over time.

There has been no need to use nitrogen monitors and the plant has no remote telemetry at present.

In the event that there is an equipment malfunction there is 5 days storage to contain raw sewage whilst essential works are carried out.

The treated effluent from the plant enters a treated effluent storage pond and is reticulated within the town's open spaces.

Another example of < 5 total Nitrogen performance is the Caloundra Wastewater Treatment Plant (population approximately 10,000) which, together with many other package plants in the southern coastal Queensland area, is reportedly successfully and consistently operating in an environmentally sensitive area.

Such plants and other suitably designed package plants are more than capable of achieving the environmental standards required for the development.

7.3 **The loading from sullage waste from the marina has not been examined in the assessment of water water treatment and effluent disposal considerations. In addition, sullage may contain salt, which is undesirable from an effluent reuse point of view, and chemicals such as glutaraldehyde which are biocidal to the microorganisms in the BNR plant. the impact of sullage on the BNR plant should be further investigated (LMPS).**

No consideration has been given to marina sullage in the sewage treatment plant design however given adequate dilution there is an expectancy that the sewage treatment plant will be able to cope without problem.

7.4 **The proposed disposal of effluent by way of irrigation of woodlots within the bore water extraction areas for potable water supply is not acceptable as there is potential for contamination of the water source (HDWA).**

It must be noted that abstraction of potable water will utilise the upper Leederville aquifer, whilst treated effluent disposal will be to the superficial aquifer.

In regard to the relationship between these operations and the risk of potable water contamination, Groundwater Consultants to the project Rust have advised as follows:

(i) Effluent disposal to the superficial aquifer will not impact on the underlying confined Leederville aquifer due to the presence of confining beds. The intake area for the Leederville is some distance (20km) to the east of the site.

(ii) Potable water abstraction will be from the underlying Upper Leederville formation as described in hydrogeological reports for the project.

(iii) Hydraulic loads in the Upper Leederville area higher than those in the superficial aquifers, resulting in upward discharge towards the superficial. However, beneath the project site a thick sequence of confining clays prevents water transmission between these aquifer sections.

(iv) There is no conflict between the artesian bore location and effluent disposal as both involve different aquifer systems and are separated by confining materials.

The attached diagrams at Figures 1 and 2 have been extracted from the Planning Amendment document and demonstrate the location of effluent disposal zone, confining clay layer and potable water abstraction zone.

7.5 **The modelling of the woodlot assumes uniformity of the soil profile and does not mention variations which may cause much quicker phosphorus saturation or transport of phosphorous through the profile. Such "preferred channels of flow" may significantly effect the model output (CALM). No geotechnical information has been provided on the suitability of the effluent disposal areas (LMPS).**

The environmental review also gives no indication of the woodlot's capacity to absorb the volume of effluent proposed to be applied to the area without surface runoff or tree failure and does not consider rainfall during winter (LMPS).

The modelling of phosphorus movement beneath the woodlot does not assume a uniform soil profile.

(i) Soil profile testing at 60 sites was carried out and demonstrated a high degree of lateral uniformity of soil profile characteristics throughout the proposed woodlot area,

(ii) test of variation of phosphorus sorption (PRI) with depth in the soil profile indicated increasing PRD with depth, whereas the model utilises phosphorus adsorption coeffiecients typical of the upper lower PRI soils,

(iii) in the application of model coefficients, the lowest reported values were utilised in each case for the model, thus the model actually assumes that the whole of the woodlot area is formed of the "preferred channels" referred to.

Therefore, it is likely that phosphorus retention in the woodlot area will actually be significantly greater than indicated by the modelling presented in the Environmental Review.

In Appendix C of this document, additional phosphorus transport modelling is presented which accounts for the effect that higher than expected P concentrations in treated

effluent may have, as well as documenting modelled phosphorus storage when average and maximum soil sorption coefficients are applied.

This additional modelling demonstrates that phosphorus retention in the woodlot soil profile is likely to be significantly better than presented in the Environmental Review.

Appendix E of the Environmental Review provides appropriate geotechnical information describing the irrigation suitability of soils in the woodlot area. It should be pointed out that irrigation of Spearwood Sand profiles is absolutely routine in the Western Australian Horticultural Industry. The infiltration characteristics of Spearwood sand are very well understood.

A copy of advice from CALM confirming the suitability of the proposed area for the establishment of a commercial woodlot based on irrigation of treated effluent to plantations of Eucalyptus globulus is attached at Figure 3.

Table 6 on page 15 of Appendix E of the Environmental Review shows the incorporation of winter rainfall in to the phosphorus and water transport modelling.

The total recharge rate (rainfall plus irrigation) used in the model is 3.11mm.day. Spearwood sand has much greater capacity to absorb recharge than 3.11mm/day and therefore there no realistic likelihood of surface runoff.

7.6 The disposal of saline reject water from the reverse osmosis plant has not been considered in enough detail, as no indication of size and location of the proposed "soakage pit" is provided.

The water supply engineering report provided in the Planning Amendment document indicates that at full development, the RO plant would produce around 705m3/day of reject water with a salinity of around 3,500mg/L.

The reject water will have very low suspended solids levels due to filtration of the feedstock water to prevent blinding of the RO membranes, therefore the reject water will be highly suited to disposal by infiltration.

The site presents vast areas where sandy soil profiles suitable for RO reject water disposal prevail. The total area of the soakage pits at full development is likely to be in the order of several hundred square meters.

Recognising that the RO reject water will consist of potable standard groundwater enriched only in TDS content to around 3,500, there are many available areas for location of the soakage pits.

Natural groundwater quality at the surface of the superficial aquifer varies up to around 4,000mg.L at the estuarine fringes, whilst estuary water varies in salinity between 15,000 to 40,000 mg/L.

Identification of a site for soakage pits where permeable sandy soil profiles underlain by groundwater of similar salinity to the RO reject water (3,500mg/L) will be readily achievable.

7.7 **The nutrient risk of effluent disposal in the rural-residential development on Bassendean sand to the east of Point Grey requires further consideration as these sands are generally unsuited to on-site effluent disposal (AgWA). The suggested lot size in the rural-residential subdivision is 1250m^2 and it is unlikely that this size lot could support long term on-site disposal of treated wastewater from any on-site treatment unit required by the Health Department. It is recommended that this development be included in the sewerage scheme (WC).**

The ODP shows that the proposed lot size in the area mapped as Bassendean Sand east of Point Grey is 2ha, not 1250m2 as stated in the submission.

Long term on-site disposal of effluent can be achieved on 2ha lots using either conventional septic tank leach drain systems, or approved alternative systems including aerated treatment units or modified leach drain systems.

There is no justification for connection of this area to sewer in this regard, and at 2ha, sewering would expose the project to unnecessary costs with negligible environmental/public health benefit.

7.8 On-site effluent disposal systems on lots over 4,000m^2 should be aerobic treatment units in accordance with SPP No. 2 (PIMA & WRC).

On site effluent disposal on lots not sewered will be carried out in accordance with SPP No. 2.

It should be noted that there is a common confusion in the use of the term aerated treatment unit.

The Health Department of WA uses the term " Alternative Treatment Units" which is abbreviated to "ATU", to describe on-site effluent disposal systems with superior performance which were introduced as a requirement for areas mapped as "constrained" in amendments to the Government Sewerage Policy implemented in the early 1990's.

Alternative treatment units (ATUs) include both aerobic treatment units (also abbreviated to ATU) eg Biocycle Clearwater Aquarius systems, as well as modified leach drain systems eg Ecomax.

The correct term as drawn from SPP No2 is in fact "alternative treatment units", including both aerobic treatment units and modified leach drains systems.

7.9 The buffer for the waste water treatment plant should be located within the scheme area, not overlapping on adjacent properties, unless outright purchase of the affected area is contemplated (WC).

Impingement of the 70 DU odour contour on neighbouring properties is limited to an approximate 200m by 400m area at the south western extent of the adjacent Water Corporation reserve. This comprises an area of seasonally inundated lowland which is separated from the remainder of the reserve by the bed of the Robert Bay Drain, which is perennially inundated. The reduction of the current beneficial uses of this part reserve will be minimal, and there will be no effective reduction of potential alternative land uses for this area.

Fig. 4.9 of the Environmental Review indicates that the 7 odour unit contour extends approximately 300 metres South from the odour source within the Wastewater treatment

plant site, and therefore falls within the Point Grey development site. The only direction that the 7 odour unit contour extends outside of the development site is to the east, where the contour harmlessly extends up to 250 metres inside the Robert Bay Drain Reserve.

As the 7 odour unit contour is normally accepted by Water Corporation as the odour buffer limit for residential development it is considered that the wastewater treatment plant site is well located.

8.0 ESTUARINE WATER QUALITY

8.1 Concerns were raised about the accuracy of the estimates of potential nutrient contributions to the estuary as outlined in the environmental review. Contributions from various sources, including tourist/short stay accommodation, were included in the modelling of phosphorus (P) export, however, they were not included in the estimate of nitrogen (N) export.

This submission is incorrect.

The contribution of tourist/short stay accommodation was in fact included in the estimate of nitrogen export.

At page 107 of the Environmental Review, the N export calculations allow for nitrogen application from 3,000 residential lots.

Careful review of the ODP will show that there are in fact only 1500 residential lots proposed with the remaining 1500 lots falling into the tourist /short term residential category.

In fact, recognising that the N export calculations assume that tourist/short term residential lots will apply the same amount of nitrogen as permanent residential lots introduces a level of conservatism to the model.

The N export calculations have additional conservatism built in as follows:

- The calculations assume that both the golf course irrigation and treated effluent woodlot will contribute nitrogen to the site, when it is likely at full development, when there is sufficient volume of treated effluent available, that treated effluent will be used for golf course irrigation.

- The calculations assume that between 4% and 10% of the nitrogen applied to the woodlot will be exported in groundwater flow : in contrast, the nitrogen uptake of eucalyptus plantations is 50 to 90kg/ha/annum (CALM, VEPA), which equates to 2.7 tonnes/annum at full development (at final treated effluent of 5mg/L total N) : this compares to around 3.2 to 5.8 tonnes per annum of N uptake potential by the

65ha woodlot at full development: this indicates that N export from the woodlot will be much less than 4% to 10%.

Appendix D of this document reviews and refines the analysis of potential nitrogen export from the site following development which was given in the Environmental Review. The refined estimates set out in Appendix D may be summarised as follows:

- maximum potential N export estimate 1853kg/annum
- minimum potential N export estimate 443kg/annum

These refined figures are lower than the conservative estimates presented in the Environmental Review (1700kg/annum to 4300kg/annum) and demonstrate that the conclusions made in the Environmental Review are conservative and realistic.

Recognising that the Southern Metropolitan Waters Study found that between 450 and 900 tonnes N/annum were estimated to discharge from the Peel Harvey inlet to the adjacent ocean waters, it is reasonable to conclude that the export of nitrogen from Point Grey to southern metropolitan waters will not be environmentally significant, and would represent between 0.04% and 0.4% of estimated current outflow.

Appendix D further notes that the removal of current Lupins cropping land use which will occur as part of the development process will cause a reduction in nitrogen leaching potential which may in fact fully offset additional nitrogen applications to the site from the new land uses.

8.2 **The proposed 312ha identified as 'Reserve/Conservation' was not included in the P-retention modelling exercise as it is assumed no P will be applied to this land. However, forested areas have been proven to contribute significant amounts of P through natural processes and this land is part of the development. Consequently, this aspect should be factored into the modelling exercise (PIMA & WRC).**

The only important mechanism of phosphorus export from the Point Grey land to the adjacent estuarine water bodies is by soil profile leaching and unconfined groundwater flow from the underlying superficial aquifer to the estuary water column.

There is no significant surface water flow from the site as the surface soils are sandy and do not yield any significant runoff even under extreme rainfall intensity.

This may be confirmed by examining the aerial photograph of the site provided in the Environmental Review, which shows in particular that the conservation reserve area has no surface drainages, either seasonal or perennial.

Recognising that rainfall recharge to the superficial aquifer is the dominant hydrological process for the site, it follows that the quality of groundwater recharge and also the quality of groundwater in the superficial aquifer flowing to the estuary, which needs to be examined in regard to current and future phosphorus export.

It is noted earlier that the Spearwood Sands which dominate the site and underlie the site in general and specifically the proposed conservation reserve areas, very good phosphorus retention capabilities.

It is therefore reasonable to expect that:

- phosphorus produced by persistent vegetation will be confined to the uppermost part of the soil profile, and that

- underlying groundwater in the superficial aquifer beneath the conservation reserve areas and indeed the whole site will have very low natural phosphorus concentrations.

This is in fact the case, and research for the project has shown that soil profile phosphorus levels are very low except for the uppermost few centimetres, even in areas such as around historical stock watering areas, where stock manure would concentrate and reach high total loading over 40 to 50 years of farming, phosphorus was at very low levels except for the top few centimetres.

Phosphorus is very strongly adsorbed by iron and aluminium sesquioxides, which is the class of soil minerals which occurs in Spearwood sand and imparts the yellow colour.

The process of phosphorus breakthrough is therefore as a sharp front in soils of even texture, such as occurs at Point Grey.

The phosphorus modelling calculates how long it will take before additional phosphorus applied at the surface as a result of new land uses will have travelled through the top 7m of the soil profile. (The model makes the conservative assumption that exit from this upper 7m is equivalent to export to the estuary whereas in fact land elevations are as large as 35m in many parts of the site, and it would take up to 100 extra years to flow laterally in groundwater and reach the estuary).

The amount of phosphorus leaching to the aquifer beneath the conservation woodlot areas (and eventually reaching the estuary in groundwater flow will remain unchanged during the modelling period.

8.3 **The WRC cannot assess the validity of the calculations for the final P export figure as they have not been included in the environmental review. The value of 70 kg/annum is one third of the amount of export of P from the current land-use and equal to what a relatively pristine, forested catchment would contribute. Given that P is harder to immobilise that N and that the final export figure of P is equivalent to what a relatively pristine, forested catchment would export, it does not seem likely that a change in land-use from pastoral to urban could result in such a large reduction in P export. This discrepancy needs to be investigated further (PIMA & WRC).**

The figure of 70kg/annum of phosphorus export is the figure estimated for the amount of phosphorus which is currently exported from the site to the adjacent estuary by groundwater outflow.

The figure is calculated as follows:

- the land area is 1159ha = 1.159×10^7 m^2;
- rainfall is 960mm of which 12% becomes recharge to the superficial aquifer;
- recharge volume is therefore = 1.33×10^6 m^3/annum;
- the estimate assumes that all recharge flows to the estuary and this is the only source of groundwater export from the site;

- it is assumed that average groundwater quality in the superficial aquifer is 0.05mg/L, which is an appropriate regional estimate of average P concentration, based on information presented by Davidson 1995;

- the total annual P export quantity is therefore derived by assuming that groundwater outflow equals recharge and multiplying the average phosphorus concentration by the recharge volume, ie 1.33 x 10^6 m^3/annum x 0.05mg/L = 66kg, which rounds out to 70kg/annum.

For comparison, the annual export allocation made under the EPP is calculated as 1159 ha x 0.37 kg/ha/annum = 434 kg/annum.

These calculations indicate that **pro rata**, the site exports much less phosphorus than the catchment target, and that the phosphorus sorption capacity of the Spearwood sands will maintain this performance under the influence of proposed new land uses, for a very considerable period of time, in the order of several hundred to several thousand years.

Finally this comment is incorrect in its consideration that P is much harder to immobilise than N. The opposite is in fact generally the case.

8.4 **The environmental review states that N export from the development area to the Peel-Harvey estuary are to be 4.2 tonnes/annum, which equates to approximately 1% of the total N export from the estuary to the ocean. One of the overall objectives of the Peel-Harvey EPP is to reduce nutrient inputs to the estuary. The Point Grey proposal is considered to be contrary to that objective as the development proposes a significant and unacceptable amount of N export to the estuary (PIMA & WRC).**

The Peel Harvey Estuarine System (Catchment Management) EPP does not provide for any specific limitation to nitrogen loadings to the estuary waters nor is any catchment target identified.

The possible nitrogen export quantity presented in the Environmental Review is in fact a worst case estimate as there are several factors which have not been accounted for in the model:

- nitrogen export from the eucalyptus woodlot irrigated with treated effluent is assumed to be 4 to 10% of the application rate, whereas the 2.7tonnes/annum total application in treated effluent compares to 50 to 90kgN/ha/annum plantation uptake rate over 65ha = 3.2 to 5.8 tonnes/annum total N uptake potential;

- the N export calculation does not account for the probable re-use of treated effluent for golf course fertilisation, and the model includes extra N application for golf course maintenance.

If these factors area taken into account, the total N application estimate would fall from 42 tonnes/annum to 25 tonnes/annum, and the export estimate at between 4% and 10% would fall to between 1 and 2.5 tonnes per annum at full development in 25 to 30 years time.

These may be shown to be very small if not negligible quantities when compared to the 450 to 900 tonnes/annum estimate of total export from the Peel-Harvey System to southern metropolitan waters.

As noted in earlier discussion in regard to phosphorus transmission to the estuary, the model does not account for the period of time required for residual nitrogen in recharge to:

- drain downwards through the soil profile and reach the unconfined aquifer;

- flow in the aquifer outwards from the site to the estuary and discharge to the estuary water column : calculations indicate that recharge in the centre of the site is likely to take around 100 years to reach the estuary shores.

The modelling of N exports is therefore shown to be very conservative and the Environmental Review's conclusion that N export due to the change of landuse would not be an important environmental factor is validated.

8.5 Modelling of predicted nutrient outputs from the development does not account for the possible use of treated effluent for irrigation of the golf course. Further calculation of predicted nutrient output should be made for the above circumstance to provide a more accurate representation of likely outcomes (PIMA & WRC).

As noted in earlier responses, the modelling presented in the Environmental Review accounts for a worst case scenario in regard to nutrient application to the site.

As such the model assumes that at full development all effluent generated will be disposed to the woodlot, and a separate source of irrigation water and additional nutrients would be applied to golf course irrigation.

In practice it is likely that when sufficient population is available to generate sufficient treated effluent to irrigate the golf course then treated effluent would be diverted to the golf course and used to replace irrigation water and nutrient applications previously drawn from separate sources.

In this instance the total nutrient applications to the site would decrease compared to the figures used for P and N modelling.

For phosphorus, the golf course would apply around 15 to 20 kg/ha/annum over the approximate 40ha of fairways, which equates to around 600 to 800 kg/annum. Irrigation with treated effluent would replace around 511 kg of phosphorus/annum which would formerly have been applied using chemical fertiliser or equivalent.

For nitrogen the reduction in the total inventory of application to the site would be 2,555kg/annum when golf course irrigation uses treated effluent for disposal.

8.6 **The increased stormwater runoff resulting form the conversion of agricultural land to a relatively large percentage of hard stand areas, as well as irrigated areas such as golf courses, lawns and gardens has the potential to both increase and hasten the flow of nutrient to the Peel-Harvey estuary. Consequently, a stormwater system should be designed to cater for stormwater discharge from a 1 in 10 year storm event and to capture at least the first 25mm of any rainfall event. Consideration should also be made of the potential for heavy metal contamination from urban areas through stormwater runoff (PIMA & WRC).**

Figure 2.1 in the Environmental Review shows that the site is principally comprised of Spearwood sand profiles which are permeable and well drained. Consequently, it will be possible to fully dispose stormwater generated from new developments by soil infiltration.

Halpern Glick Maunsell have advised that the hydraulic loading characteristics of the site indicate that a total of around 7ha of infiltration structures will be required to achieve full infiltration of stormwater generated from the proposed development. There is ample land available within the site to accommodate the requirement for stormwater infiltration structures.

The design philosophy for stormwater will be to retain all stormwater flows on site and to have zero direct discharge to the adjacent estuary from all new structures.

The marina precinct will be constructed at low reduced level and will incorporate structures to drain stormwater back inland for disposal to ground. Stormwater from the immediate periphery of the marina that cannot be disposed by soakage will be passed through triple interceptor traps sized to accommodate 1:10 year storms, the first 25mm of flow or other realistic performance criterion, as determined in conjunction with WRC/PIMA.

Research by Appleyard (1983) found that concentrations of trace metals in groundwater collected below urban stormwater infiltration basins located in Spearwood sands were all low, below drinking water criteria set by the NH& MRC (1987) due to adsorption by the soil profile. This research indicates that export of trace metals from the site in groundwater under the influence of urban stormwater disposal is unlikely.

1. Appleyard (1993), Environmental Geology 21:227-336,

8.7 The proposed marina development may increase the risk of nutrient, heavy metal or hydrocarbon contamination of the waters of the Peel-Harvey estuary. The proposal should satisfy water quality objectives to standards set out in ANZECC water quality guidelines. This should be demonstrated through continued monitoring and a comparison of baseline data prior to any site works with water samples throughout the life of the marina (PIMA & WRC).

The Environmental Review made several recommendations for Environmental Management (6.4, 6.5, 6.13,6.14, 6.24, 6.25) which accommodate monitoring of water quality and other physical attributes before during and after construction. These recommendations have been carried into the TPS Amendment 104 Special Provisions at Provision 8 –Marina Management. Water Quality Criteria applicable to the Point Grey Marina incorporating Secondary Contact (inside marina) and Aquatic Ecosystems (outside marina) beneficial uses are set out in Table 4.1 of the Environmental Review and will be the recognised target water quality parameters for the marina.

The WSQMP will monitor contaminant concentrations in sediments and waters in the marina and at control sites. This will enable detection of possible sources of contamination to the estuary from the marina. The WSQMP will use ANSEZZ and DEP water and sediment quality guidelines to set criteria against which to assess possible exceedence of baseline concentrations in the area. The WSQMP will be ongoing.

8.8 There is no consideration of the effects caused by the constructed islands on the hydrology of the area (MEAC) or algal bloom frequency (LMPS).

The hydrological effects of the proposed habitat islands are expected to calm the waters within the proposed marina by reducing the fetch of the south-west seabreezes in summer and the north-westerly winds in winter. It is anticipated that there will be localised, small-scale changes in the currents around the habitat islands, but no significant effect on the broad-scale circulation patterns in the Harvey Estuary.

- The area surrounding the islands will be well flushed by oceanic water and excessive accumulation of nutrients, which could lead to algal blooms, is not anticipated. Once seagrasses have become established around the habitat islands, they will help to stabilise the sediments and reduce nutrient release from sediments by reducing resuspension events.

- The higher salinity of the water in the vicinity of Point Grey is expected to reduce the frequency of phytoplankton blooms in the area.

It is assumed that the comment refers to hydrodynamic effects of the constructed islands rather than "hydrology". The effect of the constructed islands on the existing flood tide current from the Dawesville channel will be to deflect the current to the south close to the Point Grey Shoreline similar to the existing situation. The main effect will therefore be to protect the area of shoreline that is currently showing signs of erosion in adjusting to the new tidal current conditions.

With careful design, the southern island shape and position can potentially be utilised to assist the deeper penetration of the flood current to the South, and thereby enhance Harvey Estuary circulation. The islands should not have any influence on the ebb tide current which primarily returns on the west side of Harvey Estuary.

SOCIAL SURROUNDINGS FACTORS

9.0 MOSQUITOES

9.1 The exposure of potential residents to mosquito-bourn disease has not been adequately addressed. Since the opening of the Dawesville Channel, mosquito carriers have begun to breed all year round and consequently, the frequency of spraying has increased from 4 to 17 per year and this has necessitated a five fold increase in the use of Abate□ insecticide. The long term effects of fortnightly spraying on the ecology of the area and resident population are also not known.

The matter of mosquito borne disease risk in the Peel Region was discussed in some detail at a workshop to discuss the Point Grey project which was attended by key government agencies. Important points to arise from the workshop discussion, following on to discussion given at section 5.2 of the Environmental Review, Environmental Management Recommendation 6.3, and Special Town Planning Scheme Amendment Provision 1a, and 4, were as follows:

- mosquito borne disease risk is a regional problem which affects the whole of the Peel Region, and also in varying degrees all of the coastal parts of Western Australia and other Australian states;
- it is not within the jurisdiction or capability of any single land development project or land-owner to resolve this risk;
- at Point Grey, planning, engineering design and environmental management will have the objective of not creating any new mosquito breeding habitat, and in cooperation with other responsible agencies for existing breeding areas on the site's estuarine fringes and foreshores will rectify drainage patterns to reduce breeding habitat using runnelling techniques to the extent that this rectification will not un-nacceptably impair habitat values for important waterbird species;
- abate is no longer used for spraying of mosquitoes, rather the product Alticine, a short half life juvenile hormone analogue with low environmental persistence is used (Tony Wright HDWA, pers comm).

9.2 **The Robert Bay wetland will potentially create a new mosquito breeding ground, however, as no commitment has been made to construct the wetland, a full assessment of the risk cannot be made (AgWA). No consideration is made of insect movement from areas outside the development within a 5km radius, as the environmental review identifies potential mosquito breeding sites within the development area only (LMPS).**

In the event that the Robert Bay Wetland proposed in the ODP is to be constructed, Special Provision 13 of the Town Planning Scheme Amendment Text provides that a Wetland Management Plan shall be prepared prior to construction, in consultation with the EPA on advice from PIMA, the Shire of Murray and the Water Corporation.

The mosquito borne disease risk associated with the Peel Region and other coastal parts of Western Australia is recognised. However, on this basis, it would not be reasonable to expect development at Point Grey to be treated differently to existing residential areas surrounding the Peel Harvey Estuary, and the incremental expansion within these areas which is ongoing.

9.3 **The Health Department of Western Australia supports the EPA's objective in regard to mosquitoes, however, there are no proven mosquito control measures which are effective in constructed wetlands. The saltmarsh mosquito control program carried out by the Health Department of Western Australia in collaboration with the Shire of Murray and other Peel Region local governments is fully stretched and cannot be expanded to include the Pt Grey area without the availability of additional financial resources (HDWA). No commitment is made for the funding of a spraying program if the wetland is constructed (AgWA).**

In addition, Pt Grey is currently not monitored for mosquito and Ross River virus activity and the Health Department of Western Australia funded surveillance team at the University of WA is fully stretched and could not expand their activities to include Pt Grey without the allocation of additional resources (HDWA).

Following the Approval of the Town Planning Scheme Amendment 104, the proponent will enter into discussions with the Health Department of WA and the Shire of Murray in regard to the funding of additional mosquito control measures which may be required.

9.4 **It would not be responsible to allow development to proceed in an area which is a known breeding area for mosquito species and then seek to mitigate against the impacts. Mitigation measures cannot be totally effective and the measures are invariable environmentally unsound (CCWA).**

Comments made in response to earlier comments in regard to this factor are re-iterated.

- The mosquito borne disease risk associated with the Peel Region and other coastal parts of Western Australia is recognised. However, on this basis, it would not be reasonable to expect development at Point Grey to be treated differently to existing residential areas surrounding the Peel Harvey Estuary, and the incremental expansion within these areas which is ongoing.

- Mosquito borne disease risk is a regional problem which affects the whole of the Peel Region, and also in varying degrees all of the coastal parts of Western Australia and other Australian states.

- It is not within the jurisdiction or capability of any single land development project or land-owner to resolve this risk.

- At Point Grey, planning, engineering design and environmental management will have the objective of not creating any new mosquito breeding habitat, and in cooperation with other responsible agencies for existing breeding areas on the site's estuarine fringes and foreshores will rectify drainage patterns to reduce breeding habitat using runnelling techniques to the extent that this rectification will not unacceptably impair habitat values for important waterbird species.

9.5 **Mosquito control measures may lead to the contamination of local water resources and wetlands. Should chemical management be utilised, it may have a detrimental effect on bird breeding and associated wetland habitat and feeding areas. The WRC does not support management measures such as the filling of wetlands or damplands, or drainage of such areas (PIMA & WRC). Other options such as runnelling would most likely reduce the habitat value for water birds (WCG).**

No assessment is made on the impact of increased insecticide spraying on adjacent Ramsar and National Heritage wetlands Austin Bay, Lake Mealup and Lake McLarty (LMPS).

The proponent will develop a program for mosquito management in cooperation with appropriate responsible agencies.

With agreement by associated agencies the control program will focus on the removal of existing breeding areas using physical control methods, focussing on the implementation of runnelling to remove pooled waters caused by water level fluctuations at the estuarine fringe. At the recent workshop coordinated by the DEP in regard to Point Grey, Tony Wright of the HDWA advised that research at Murdoch University over several years into the effect of runnelling on waterbird habitat values had not identified significant detrimental effects.

The Health Department has advised that the organo-phosphate Abate was no longer used and the current control agent is Altocid- (s-methoprene) which is an insect growth control hormone which has low human toxicity and has high specificity for insect larvae.

Current utilisation of s-methoprene is carried out with approvals from appropriate Commonwealth and State Government regulatory agencies.

9.6 **Saltmarshes provide mosquito breeding habitat, which makes residential development in their proximity undesirable. There area other areas in and near the development area subject to inundation which also provide possible mosquito breeding habitat (LMPS).**

As noted in previous responses, existing mosquito breeding habitat within the site will be removed in consultation with other responsible authorities. The Special Provisions proposed by the Town Planning Scheme Amendment incorporate controls which will prevent the creation of additional mosquito breeding habitat.

OTHER FACTORS

10.0 UNRESOLVED MANAGEMENT ISSUES

10.1 **The responsible authority has indicated that management plans for many environmental issues have been deferred until the project is approved, however, there is no guarantee that satisfactory management plans will be developed or even if it is possible to provide adequate protection for the environment. The proposed development is close to an area of high nature conservation value. The Austin Bay area is a RAMSAR wetland and therefore it seems imperative that environmental issues such as protection of fauna, vegetation and wetlands are fully addressed before the project is approved. Any management plans prepared by the responsible authority should be available for public review.**

The requirement for Management Plans to be prepared in consultation with appropriate regulatory agencies will be incorporated in the Scheme Amendment Special Provisions. Management Plan preparation will therefore be a legal requirement of development.

Assessment of the environmental acceptability of development is not a matter which will determined during the management plan preparation, but during the current DEP/EPA assessment processes set out under Section 48A of the Environmental Protection Act 1986, of which this document is an integral part.

The Environmental Review document proposed that the estuarine environmental values of the Peel-Harvey Estuarine system which are recognised by the RAMSAR listing can be protected by environmental management which has been carried out:

- in the course of planning for the Point Grey development;
- during subsequent active management within the site before, during and after development; and
- by Government Agencies in areas beyond the property boundaries and the jurisdiction of the current proposal.

10.2 The environmental review does not outline the proposed management of fire, domestic pets, household rubbish and incidental litter, weed and grass infestations, increased traffic load causing disturbance to wildlife and wildlife habitat around the foreshore areas, or the inevitable drawdown on water resources due to groundwater abstraction (GS).

The Environmental Review and associated Town Planning Scheme Amendment Special Provisions incorporate a requirement for management plans for foreshores and conservation areas to be prepared in consultation with appropriate regulatory agencies prior to the commencement of construction on the site.

At a recent workshop with government agencies who have commented on the Point Grey project, the core objectives of foreshore and conservation area management for the project area were discussed and proposals for management were put forward by consultants on behalf of the landowner.

Water resource factors are discussed in section 4.8 of the Environmental Review, pages 94 to 98 inclusive.

10.3 Specifications for the woodlot are not given, neither are arrangements to harvest the phosphorus. Fire implications (on the woodlot and adjacent nature reserve) and contingencies to cater for phosphorus uptake if the trees suffer a disaster or are harvested are also not outlined (CALM).

Detailed specifications for the woodlot irrigation area have not yet been developed. Discussions with CALM Sharefarms representatives have been held and following site inspections CALM Sharefarms has advised that the area proposed for the woodlot would be "most suitable" for establishment of a commercial bluegum plantation. (See copy of letter attached at Figure 3).

It should be noted that the management of phosphorus in the woodlot in no way relies on plant uptake and subsequent harvesting, although this process will be of additional benefit to phosphorus management. Appendix E of the Environmental Review presents phosphorus transport modelling which confirms that the underlying soil profile has the capacity to adsorb phosphorus and prevent its export to the adjacent estuary.

There are several factors which will secure the operational reliability of effluent disposal:

- the woodlot will likely be planted in stages as contruction and population growth proceed over up to 30 years, yielding plots of varying age relative to harvesting requirements such that it is unlikely that all of the plot would be ready for or require harvesting at the one time;

- there is an allowance of 15ha of un-irrigated woodlots as a perimeter buffer, which could be incorporated in the irrigation operation as a short term contingency, if required;

- it is intended to incorporate the ability to utilise treated effluent for golf course irrigation in plans for water related servicing at the site: at full development there will be sufficient treated effluent available to fully water an 18 hole golf course and treated effluent could be diverted to the golf course any time prior to full development in the event the irrigation to the woodlot cannot be achieved.

In regard to fire management, fire contingency planning will be incorporated in the detailed design of the woodlot in accordance with the Shire of Murray, the bushfires Board of WA and other appropriate government regulatory agencies. It should be noted that with the existence of a fully articulated irrigation system throughout the woodlot area, the woodlot will be well equipped to deal with bushfire risk.

10.4 **A commitment to the source of the potable water supply, monitoring of the source and possible treatment of the supply should be made by the responsible authority before development approval is given. There appears to be a lack of commitment to any of the suggested options (AgWA). The plan is solely dependent on the Leederville Formation as an independent water supply, however there is no alternative proposed should the "sustainable yield" not be met (MEAC).**

The Special Provisions of the Town Planning Scheme Amendment set out a procedure for the development of the water supply for the site which will be a legal condition of development.

We are advised that recent changes to State government legislation which regulates water supply has made it possible for commercial entities other than the Water Corporation to assume the role of service provider for the water supply.

In this context any commitment to water supply servicing is premature and commercially inappropriate as the identity of the ultimate service provider is yet to be determined.

Any subsequent Development Approvals for the site will be conditional upon the provision of potable water.

The plan focuses on the use of potable groundwater from the Upper Leederville as a preference, however the Water Corporation has indicated that it may be able to supply mains water to the development but at this time is not in a position to more closely evaluate viability.

10.5 **No decision has been made on the source of irrigation water supply. Options have been provided, however, more research and a firm decision should be made as to where irrigation water will be sourced so that impacts can be properly assessed (AgWA).**

The three preferred sources of irrigation water of the five potential sources identified are:

- re-use of agricultural runoff water from the Robert Bay Drain is a preferred option which would have the positive impact of intercepting stormwater and nutrient flows which currently enter Robert Bay and add to the nutrient loading to the estuary;

- use of water from the upper Leederville aquifer using a bore located in the centre of the site is an option for which the effects of abstraction are accommodated in the investigation of potable water supply which is presented in Section 3.4.3 of the Environmental Review;

- the re-use of treated effluent will have the effect of reducing the quantity of water abstracted from the Upper Leederville, and reducing the total amount of nutrient applied to the land surface following the change of land use, however, there will

not be sufficient volume available to irrigate the whole course until the development approaches full development.

10.6 A decision should be made on the construction of the Robert Bay Wetland. If the construction is not to proceed, what will happen to the proposed site? A commitment should be made not to allow a canal development in this area. If the wetland is constructed as a retention basin for summertime irrigation, the potential for salinisation exists. How will this be managed? Who is responsible for the ongoing management of the wetland and silt drains flowing into the wetland?

The ODP does not propose or contemplate a canal development in the area proposed for the Robert Bay Wetland.

In the event that construction does not proceed it is anticipated that the area will be landscaped as appropriate to its setting adjacent to Robert Bay and its location at the entry to Point Grey.

The constructed wetland will not be used as a storage for irrigation water, although abstraction of stormwater flow through the wetland system may be an option. In the event that flow from the Robert Bay Drain is utilised for irrigation, a separate storage dam will constructed for storage of water sourced from the drain during winter. Blending of irrigation water from several sources could be used to overcome salinisation within the storage dam.

10.7 The suggestion that the Robert Bay Drain water may be re-used needs to be confirmed. If the developers are proposing to re-use the drainage water, clarification of Water Corporation ownership needs to be made, along with permission from the Water Corporation to use this water (AgWA).

Informal discussions with the Water Corporation, which has been confirmed as the "owner" of the Roberts Bay Drain, have indicated they would be comfortable with use of the drain as proposed, provided that the drainage function of the facility is not impaired and subject to further detailed discussion and a formal agreement.

10.8 **A decision should be made in regard to which party is responsible for the management of the harbour. The Department of Transport is not a party to the management agreement for the harbour as explained in the Strategic Plan for Maritime Facilities. Management beyond a five year term must also be clearly attributed before the marina can be approved (DOT).**

It is acknowledged that DOT will not be responsible for management of the proposed marina. It is envisaged that it is most likely that the marina precinct will be separately developed by a specialist developer, who will take on marina management responsibility as a requirement of the marina precinct purchase.

11.0 SCALE OF DEVELOPMENT

11.1 Concerns were raised in regard to the huge impact that an additional 7 000 people would have on such a sensitive environment. What measures could be put in place to deal with the cumulative impact of large numbers of people in the region? Impacts would include threats to wildlife from domestic animals, the introduction of exotic species into the bushland from garden plants, rubbish dumping, degradation of the environment from off-road vehicles etc and the impact of fire on the surrounding environment (CCWA).

The indirect environmental effects of establishing a population of 7,000 residents at Point Grey over the next 20 years must be considered in the context of growth which is expected in the Inner Peel Region over the next 50 to 60 years, and the increase in environmental management effort in the region which will be needed to protect the environment under the pressure of this growth.

The Inner Peel Region Structure Plan recognises the existence of **9,420ha** of potential urban land around the Peel Harvey Estuarine system, which could accommodate around **254, 340 people.**

At full development, the 7,000 Point Grey residents would comprise around 2.7% of the population potential recognised for the region.

Human pressure on conservation reserves will be an inevitable consequence of population growth, both local and regional, and this pressure will need to be managed so as to protect the values and beneficial uses of the reserves.

A number of submissions have commented that the Environmental Review postpones environmental assessment of impacts to existing reserves until the preparation of management plans which would occur after approval of the rezoning.

This is incorrect and the following comments are offered in explanation as to why this is so.

The Point Grey ODP is put forward as an acceptable land-use in the Inner Peel Region, in regard to protection of conservation reserves, on exactly the same basis as is any other development proposal, including strategic plans such as the Inner Peel Region Structure Plan. The core proposition in this regard is that conservation reserves **can be acceptably managed** to protect recognised values from the pressures of human usage and general presence in the region.

To argue this point to the contrary is to propose that conservation reserves cannot be acceptably managed, a proposition which would dismiss the validity of the process of *"Conservation through Reserves"*, a management philosophy which has been the cornerstone of the State Government's approach to conservation since the 1970's.

The Environmental Review does not avoid environmental impact assessment by specifying that management plans for matters such as Foreshore and Conservation Reserves should be prepared prior to construction.

In contrast, the core factors for environmental impact assessment put forward in the Environmental Review are as follows:

- the ODP does not propose any direct physical impact (eg clearing, water table changes) to existing conservation reserves, and arranges land-uses within the site in relation to existing reserves so as to minimise indirect impacts;

- the Environmental Review accepts the proposition that the conservation reserves can be acceptably managed to mitigate the indirect effects of general population pressure;

- the Environmental Review proposes a mechanism which provides statutory force to the requirement for the detailed elements of work, infrastructure plans and implementation schedules for management to be assembled prior to commencement of any construction on the site, and the program of active management to commence with construction.

The purpose of management plans such as are proposed for the Foreshores and Conservation area is not to demonstrate that reserve protection can be achieved. As noted this factor is accepted at outset. The purpose of proposing management plans is to demonstrate that the administrative processes and active management measures required

to ensure that reserve protection is achieved **will be implemented** in the normal course of mandatory reference between development plans and the governing conditions of the Town Planning Scheme text.

It is important to note that the existing agricultural land uses have recognised impacts to the site and that these impacts will be teminated when development proceeds.

For example, the present grazing of stock results in their entry to fringing vegetation, where trampling and manure deposition to soil and water constitute real ongoing impacts. Removal of stock from the site and quarantining of badly affected areas from pedestrian, vehicle or animal access to support re-growth will yield positive benefits to remnant fringing vegetation.

11.2 **The large size of the development would ultimately exert the pressure to build more roads to access the development. These roads would most likely cut through bushland and wetlands, further degrading the area (CCWA). The proposed southern access road would be detrimental to the areas' already small bushland reserves (MEAC).**

Only one access road is proposed to service the development. The southern access toad is not required by the project, however is included as a tourist route and provides connection to the existing special rural zone at Birchmont.

11.3 **There are several other residential subdivisions between Mandurah and Pinjarra that have not been fully sold or developed. This suggests that it is premature for more development in the area. The placement of a new town of 7 000 people only 20km from Pinjarra, in an area that has poor infrastructure, seems inappropriate due to the duplication of essential services and cost of the provision of these services (MEAC). Will the additional cost be bourn by the rate payers of the Shire of Murray ?**

The Peel Region is the fastest growing region in Western Australia outside the Perth Metropolitan Region. It is projected that the Peel Region will grow from a population of 61782 in 1995 to 107,000 in 2011 and ultimately a population in the order of 250,000 by

the year 2041 / 2051. The planning and provision of future settlement areas is appropriate to ensure a steady and constant supply of urban land.

There will not be a duplication of services. The services provided will be at the local level such as local shopping, primary school, and public open space. The services are those that are required at the neighbourhood level and would be required irrespective of the neighbourhood's location, either at Point Grey or as an extension to existing urban areas. The requirements for district level services (eg high schools, district hospital) will still be provided at Pinjarra.

12.0 LOSS OF RURAL/AGRICULTURAL AREAS

12.1 Agriculture Western Australia's primary concern with the proposal is the underlying assumption that because land is used for agricultural purposes, it can therefore be developed. This assumption is detrimental to the valuing of farming in the region and to the value of agricultural production in the region.

Since the early 1980's regional planning studies have nominated Point Grey for urban development culminating in the release of the Inner Peel Region Structure Plan in December 1997 which proposes a mix of tourist, development and conservation uses, precluding a significant role for agriculture.

Demonstration of the site's capacity for tourist and residential development does not proceed from the basis of present agricultural land-use, but from the consideration of the environmental carrying capacity of the site for the proposed uses, and from planning analysis which shows the desirability of establishing tourist and residential land uses within the significant landscape and recreational attributes of the Peel-Harvey Estuarine system.

The value of the present agricultural land use is small

12.2 Limited consideration has been given to the impact of the proposed development on neighbouring land uses. Adequate vegetation and suitable buffers separating the development from nearby rural properties is essential, as agricultural activities should not be inconvenienced or limited as a result of the development proceeding. The requirements of urban zonings, such as odour and noise controls, should not be imposed on neighbouring rural landholders as a result of urban development (AgWA).

Apart from around 1500m boundary length of areas proposed for zoning as Rural Residential/Landscape Protection and adjacent land, the ODP proposes that only land zoned as Conservation space will abut neighbouring land. The focus of tourist and residential uses is in the centre and far north of the site.

The smallest separation distance between land proposed for residential uses, and rural land is approximately 1km.

12.3 Once this development is established, there will be a tendency for expansion of residential areas, encroaching into good agricultural land.

The proving of this site's capacity to support the land use changes proposed the viability of the establishment of essential services is specific to land within the present site boundaries and the Outline Development Plan and does not translate to any neighbouring land.

13.0 OTHER ALTERNATIVES

13.1 The environmental review does not discuss any alternatives or compromises. Developments which allow a small increase in international and local tourism without major alterations to the natural attributes could be researched in a feasibility study (GS).

The Outline Development Plan is the result of a four year programme of research in which the environmental constraints to development and the carrying capacity of the site for alternative land uses to the present agricultural uses have been identified.

The land uses which have been superimposed on the site are responsive to these factors and represent efficient and best use of the development attributes whilst complying with environmental management objectives.

14.0 PREVIOUS ASSESSMENT

14.1 In 1987, the EPA rejected an earlier development proposal for the same area of Point Grey (EPA Bulletin 306). The area has not changed and is no more suitable for a development today, ten years later. The impact of the Point Grey development on surrounding nature reserves would still be severe and unacceptable and the impact on the water quality of the estuary itself remains of concern (CCWA).

A summary of the report and recommendations is as follows:

The development was seen to have the potential to contribute phosphorus and nitrogen into the estuarine ecosystem through the disposal of treated sewage effluent and septic tank waste, the application of fertilisers on domestic lawns and gardens, and the leaching of agricultural fertiliser already in the soil. The proximity of residential and rural residential type lots abutting the System 6 reserves was seen to have adverse impacts, given the proposed population levels, unless stringent management conditions were implemented. The foreshore reserve and proposed open space areas were not seen to be adequate as all vegetation associations were not thought to be adequately represented in conservation areas. Point Grey was seen to be the most significant topographical feature in the Peel Harvey system and consequently requiring conservation and landscape protection priority. Reduced environmental amenity would have been experienced by Point Grey residents if the proposal progressed, including significant problems associated with macroalgal accumulations along the foreshores, contributing to odour and beach fouling and high mosquito numbers.

Several points are raised in this comment, and responses are made individually below.

Phosphorus and Nitrogen Export

Significant advances have been made over the last decade to the technical understanding and published database describing the movement of phosphorus and nitrogen through sandy soil profiles on the Swan coastal plain, particularly the Spearwood Sands (which

underlie much of the urban and agricultural development on the south west coast of the State).

Technical work based on published agreed data and analytical procedures is presented in the Environmental Review and in this document lead to the conclusion that the site can comply with the Peel Harvey Estuarine System EPP in regard to phosphorus and will not yield significant additional nitrogen to the present loadings to the estuary.

Impacts of Development on Existing Reserves

The arrangement of land uses proposed by the ODP and the requirement for foreshore and conservation area management plans to be finalised and implemented prior to construction leads the conclusion that existing reserves can be acceptably managed under the influence of the proposed land uses and additional local population.

Foreshore Reserves and Open Space

The ODP provides for the retention of major tracts of land for the purpose of conservation, including a continuous core area of foreshore and upland vegetation forming a link between Harvey Estuary and Peel Inlet totalling around 100ha.

When recreational areas including the golf course and woodlot are included, the ODP will result in the retention of around 45 %of the total land area for "green space".

Peel Harvey Estuary Landscape Protection

Detailed assessment of the physical landscape was carried out in the course of developing the Outline Development Plan, and has been incorporated in the planning process.

The landscape Study findings are presented in the Planning Amendment document and show that land uses are arranged so as to preserve the essential landscape features of the site as these may be viewed from shoreline vantage points around the adjacent shore of the Peel Inlet and Harvey estuary.

Reduced Environmental Amenity

The earlier land use proposal was put forward at a time when water quality in the adjacent estuarine waters was poor leading to problems with blooms of macroalgae and phytoplankton.

The completion of the Dawesville Channel in 1994 has brought about a dramatic improvement in water quality off Point Grey, in particular on the western shores, but also on the eastern shores.

The north-west parts of the site lie directly opposite the Dawesville Channel and is the immediate recipient of ocean water brought into the estuary on the incoming tide.

Water quality off the site's western shores is visibly significantly better than prior to the opening of the cut.

It may well be that there is inadequate certainty that water quality has improved in those parts of the estuary that are most remote from the channel, there can be no doubt that this cannot be said of the Point Grey area.

15.0 SYSTEM 6 UPDATE

15.1 The development should be halted until the finalisation of the System 6 update as is believed by local residents that parts of the Pt Grey area may be recommended for conservation by the EPA.

The Outline Development Plan proposed the retention and protection in either foreshore reserve or conservation areas of effectively all areas of remnant vegetation in good biological condition. Analysis shows that the total amount of clearing proposed by the ODP is under 20ha.

In contrast, the management of foreshores to allow significant re-growth and rehabilitation particularly on the eastern shores, and the replanting of vegetation within the golf course to support the sustainability of Tuart trees on the site, will add back a far greater area of vegetation in good biological condition located in areas protected from physical impacts.

16.0 REGIONAL PLANNING CONSIDERATIONS

16.1 The proposed development as outlined in the environmental review and the ODP is not consistent with the recommendations for regional planning. The Inner Peel Region Structure Plan (IPRSP) was released in December 1997 and includes recommendations with regard to the proposed Peel Regional Park (PRP). The IPRSP identifies significant areas of 'Open Space - Conservation' within the subject land that currently contain remnant vegetation. These areas include the remnant foreshore vegetation and areas to the south of the proposed 'Residential Village'. These areas, as identified in the IPRSP as 'Open Space - Conservation', are recommended to be vested in the National Parks and Nature Conservation Authority (NPNCA) with a view to be managed by the future manager of the PRP. All future planning should take into account the areas recommended for protection. Inconsistencies between the ODP and the conservation areas outlined in the IPRSP include the area proposed to contain the marina, the proposed site for the constructed wetland and some areas of the 'Special Residential' subdivision (PIMA & WRC).

The nature of a Structure Plan as defined by Section 1.6 of the Inner Peel Region Structure Plan is:

> *"... an ideas plan, as opposed to a town planning scheme which is a statutory plan. A structure plan is not a legal document and has no legal status"* (p.5 Inner Peel Region Structure Plan).

A structure plan serves as a guide and is not a static document, so that the contents of the Inner Peel Region Structure Plan can not be seen to preclude development options at Point Grey.

This aspect is acknowledged further in recognition that *"other developer initiatives not previously featured in any plan ... will influence the form of future urban development in the region"* (p.8 Inner Peel Region Structure Plan). The examples refer to Murray Lakes Golf Course Estate (population 3000) and the Ravenswood Sanctuary (population 10,000) which have not featured in all previous structure planning for the Peel Region, yet are proposed as part of the new Structure Plan.

Furthermore the importance of Point Grey, and acknowledgment of its future potential is recognised in the Structure Plan by the statement that final decisions in respect to *"the scale of the development at Point Grey should be reassessed once the results of the environmental review process are known"* (p40 – Inner Peel Region Structure Plan).

The Outline Development Plan proposes the protection of conservation areas and the provision of green space in excess of the recommendations contained within the Inner Peel Region Structure Plan. Whilst an area of vegetation measuring 7% of the foreshore area is removed, this is compensated by the creation of the two offshore islands and the retention of 252ha of land as conservation space.

16.2 **The 'Tourist' area as shown on the ODP seems consistent with the IPRSP, which identified the area as 'Tourist - Existing and Future', however, some of the proposed urban areas which fall under the responsible authority's classification of 'Tourist', including the 'Waterfront Tourist Village/ Harbour-side Village and Golf Course Estate' may be inconsistent with the urban density requirements under the IPRSP's 'Tourist' zone. Careful consideration should be given to the density of development for the 'Tourist Areas' in relation to land capability and site characteristics (PIMA & WRC).**

Please refer to the response to 16.1.

16.3 **A large portion of the 'Residential - Traditional neighbourhood village' as described in the ODP is also inconsistent with the IPRSP, which identifies the area as 'Greenbelt Rural Living'. The IPRSP classification suggests that larger lot subdivision such as 'Special Residential' and 'Rural Residential/ Landscape Protection' would be more suited to this area (PIMA & WRC).**

Please refer to the response to Comment 16.1

16.4 The 'Boating facilities study for the Peel Region (1996)' was based heavily on local input, community involvement and its outcomes are consistent with planning requirements, financial, technical and environmental considerations and boating demands. The report identified the need for regional boat launching ramps and finger jetties at Point Grey rather than a boat harbour or marina. Further investigation should be made into the appropriateness and the location of the proposed marina and sailing club developments (PIMA & WRC).

The 'Boating Facilities Study for the Peel Region (1996)' recommended a Regional Boat launching facility at Point Grey. The boating facility would provide a regional level of service for the local community and "visitors from outside the Peel Region could be encouraged to use these facilities" (p 38 – Boating Facilities Study for the Peel Region 1996). A significant facility is envisaged encompassing a multiple number of ramps, finger jetties, formal sealed car parking and overflow unsealed car parking, public toilets, boat washdown facilities, recreational shopping, landscaped areas and **"appropriate planning in place to allow for the possible upgrade of the facility to boat harbour status at some time in the future"** (p33. Boating Facilities Study for the Peel Region 1996).

Although the Study's findings resulted in the requirement for a regional facility, which in itself would require a substantial area of land the Study made no allowance for the development proposed at Point Grey and the consequent increase in demand. In accordance therefore, with both the recommendations of the Study and the proposed development of Point Grey, the Outline Development Plan in proposing a marina has provided the "appropriate planning" as recommended by the study.

16.5 The establishment of this development could trigger an undesirable sprawl similar to that on the western side of the estuary.

There is no supporting documentation or information supplied in support of this statement and therefore it is not possible to develop a cogent response.

17.0 PUBLIC COSTS OF THE DEVELOPMENT

17.1 Long term maintenance of public water supply. The cost of treating water by reverse osmosis is around 50c/kL, which is more than twice the cost of water treatment in the Perth metropolitan area. As potable water is proposed to be provided privately (ie not by the Water Corporation), all costs will need to be met by either the residents of the Point Grey area or via a subsidy paid by ratepayers in the Shire of Murray. The environmental review should outline details of how this additional cost (potentially up to several hundred dollars per service per annum) will be met (LMPS).

The project Engineers advise that the cost of RO is about 50 c/KL.

- preliminary net present value costs have been estimated for the potable water system, and confirms that costs to local Point Grey users will be only moderately higher than standard Perth rates. Given the living environment and remoteness this surcharge is not likely to be of any significance to the Pt. Grey consumers.

- recovery of the Pt Grey water supply operating and maintenance costs will be via water rates levied on the Pt Grey consumers, in similar fashion to Water Corporation rates.

17.2 **Long term maintenance of sewerage systems. Very few communities in Western Australia are serviced by such high standard of waste water treatment as is proposed for this development. The cost of such treatment is very high. The capital cost of similar plants of a comparable size in Western Australia, such as those on Rottnest and at Australind, are at least $300 to $500 per capita. This implies a capital cost of $1 million to $2 million more for Point Grey. The operating cost may be at least three times the cost of metropolitan waste water treatment. Further costs include maintenance of the waste water collection system. Details of how the costs for the waste water treatment plant and disposal system will be met should also be outlined in the environmental review for the development (LMPS).**

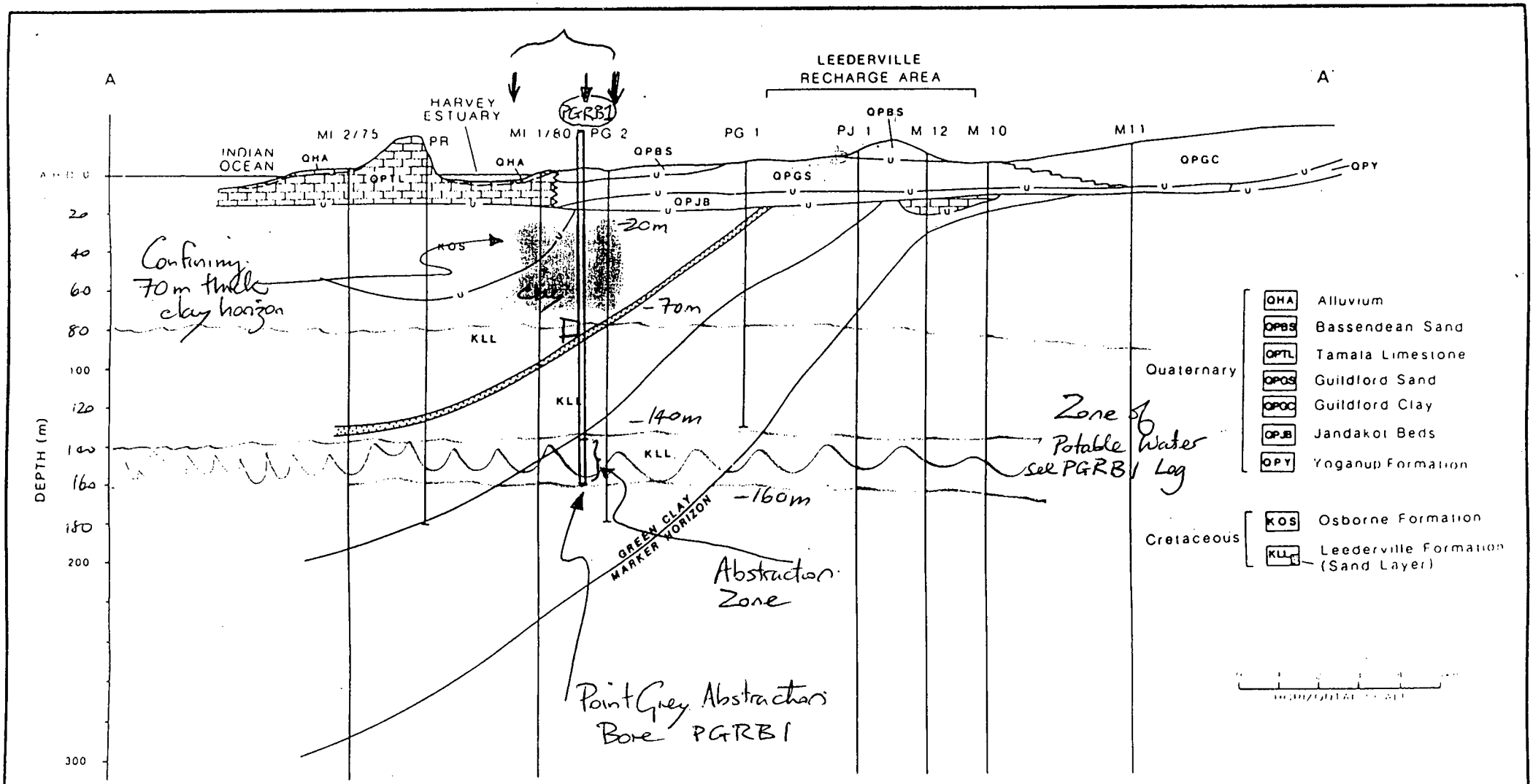
Preliminary net present value costs have been estimated for the potable water system, and confirms that costs to local Point Grey users will be only moderately higher than standard Perth rates. Given the living environment and remoteness this surcharge is not likely to be of any significance to the Pt. Grey consumers.

Recovery of the Pt Grey water supply operating and maintenance costs will be via water rates levied on the Pt Grey consumers, in similar fashion to Water Corporation rates.

17.3 **Other ongoing costs that need to be considered and allocated funding include long term maintenance of drainage systems, road maintenance, dredging to maintain boat launching facilities, general marina maintenance, mosquito control, removal of algal accumulations (at least in the short to medium term), and fire control. These should be discussed in the environmental review (LMPS).**

The allocation of funding for these factors is a planning and development matter which remains within the jurisdiction of the Shire of Murray and other appropriate government regulatory agencies, and is not within the scope of the Instructions of this environmental impact assessment.

FIGURES



DESIGNED: IZ	DATE: 3-Nov-95	PM APPROVAL:	DATE	CLIENT: Halpern Glick Maunsell P/L	RUST PPK Environment & Infrastructure	Figure A3
DESIGN CHECKED:		CLIENT APPROVAL:				
DRAWN: IZ	3-Nov-95			TITLE: Geological Section	DOCUMENT IDENTIFICATION: 93G053B: PR2: 0377: RevA	ISSUE: 1
DRAWING CHECKED:		SCALE: 1: 150000				

Diagram to Accompany Response to Comment 7.4

FIGURE 1

FIGURE 2

RUST PPK
Environment & Infrastructure

BORE COMPLETION DETAILS: PGPB1

Point Grey Production Bore

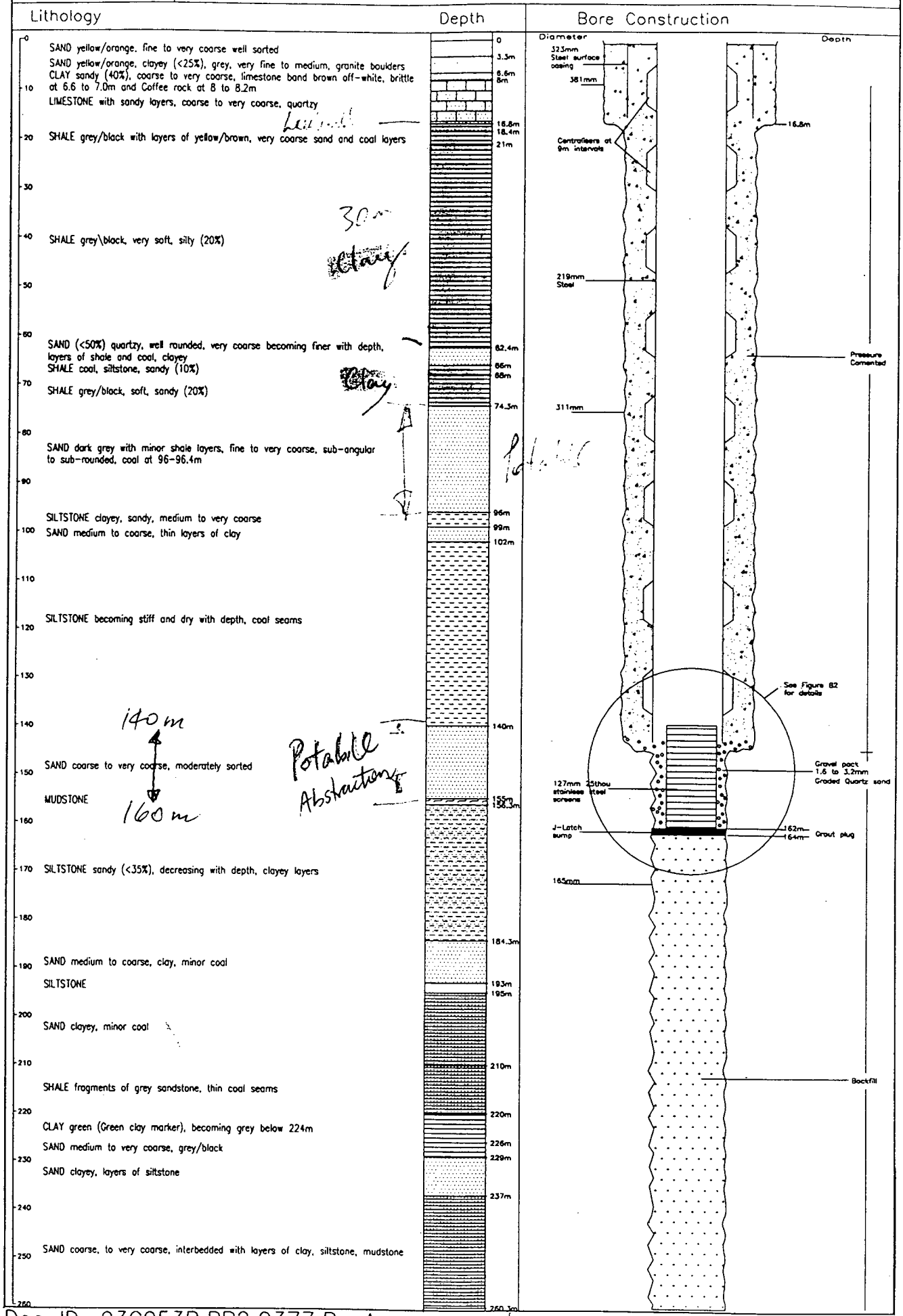


Figure B1

Diagram to Accompany Response to Submission 7.4

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

Please address all enquiries to:

CALM Sharefarms
39 Throssell Street
COLLIE WA 6225

Your Ref:
Our Ref: Temp-Pt Grey
Enquiries: Tym Duncanson

Ph: (097) 34 1688 Fax: (097) 34 5649

Bowman Bishaw and Gorham
PO Box 946
WEST PERTH WA 6872

Attn: Peter Sillem

Dear Peter

FEASIBILITY OF IRRIGATED COMMERCIAL PLANTATION AT POINT GRAY

Thankyou for the opportunity to comment on this very interesting development proposal.

I have forwarded the information on irrigation quantity and quality supplied by you to Dr John McGrath, CALM's resident expert on plantation nutrition. John's response can be summarised in the following table:-

Parameter	Plantation requirements	Point Gray parameters
Precipitation	at least 600 millimetres per annum	2000 to 1550 millimetres per annum including natural rainfall
Total nitrogen	50 kg/ha/an*	62 to 36 kg/ha/an
Total phosphorus	12 kg/ha/an*	7 to12 kg/ha/an

The above figures were determined assuming an irrigated site of between 40 and 70 hectares. The site would be irrigated with similar waste water all year round and the water table would not significantly exceed the present height above sea level.
*These figures were determined using data from effluent irrigated plantations in NSW.

Rainfall of about 900mm
Irrigation of about 900mm
= 1800mm/annum

Using these figures and assumptions it is apparent that the modified site would be most suitable for the establishment of a commercial bluegum plantation with CALM Sharefarms, Lower West.

In respect to potential financial returns from the plantation, it is estimated that a base figure of $1 500 per hectare would be received by the land owner at the end of each crop (expressed in 1996 value). This figure assumes that the land owner does not elect to pay for any establishment or maintenance work associated with the plantation. This return would increase if the land owner chose to do work such as fire break maintenance.

This base figure is very conservative and is estimated from sites which are not irrigated with waste water. If, as expected, the irrigation causes the plantation to grow at a faster rate then the owner's revenue would increase proportionally. This system of linking plantation productivity to revenue is called cropsharing and is detailed in the draft contract (called a Profit a Prendre) previously forwarded to you.

Attachment for Response to Submission 7.5.

APPENDIX A

SUMMARY OF SUBMISSIONS

SUMMARY OF SUBMISSIONS FOR SHIRE OF MURRAY TPS 4 AMENDMENT 104 TO REZONE FROM "RURAL" TO "SPECIAL DEVELOPMENT" LOTS 75, 137-139, 293, 299, 322, 672, 727, 729, 738, 1132, 1133 & 1145 POINT GREY SECTION 48 ENVIRONMENTAL REVIEW

ISSUES RAISED IN PUBLIC SUBMISSIONS

This amendment to the Shire of Murray Town Planning Scheme No 4 is to rezone the area known as the Point Grey Peninsula to allow the development of residential village allotments; tourist accommodation and associated facilities; a marina and sailing club; reserves for conservation, recreation and open space; low density Special Residential and Rural-Residential lots; a golf course ; and a sewerage treatment plant and eucalypt woodlot irrigated with the treated effluent. The Point Grey Peninsula is located opposite the Dawesville Channel on the eastern shores of the Peel Inlet and the Harvey Estuary in the Shire of Murray. The area to be rezoned is approximately 1 159 ha and is adjacent to System 6 areas C50 and C51, and near by to Lake McLarty and Lake Mealup which constitute System 6 area C52. The Point Grey Peninsula is internationally recognised as a wetland of international importance (Ramsar Convention) and consequently is on the Register of the National Estate. Lakes McLarty and Mealup are also Ramsar listed.

The public submission period for the Environmental Review for the above amendment commenced on 17 October 1997 for a period of 60 days, ending on Tuesday 16 December 1997. This summary is an amended document, subsequent to that dated 30 December 1997, as further submissions have been received by this office.

A total of 46 environmental submissions were received by the Shire of Murray and forwarded to the Department of Environmental Protection. These included 28 letters from individual members of the public and submissions from the following agencies and organisations:

Aboriginal Affairs Department (AAD)
Agriculture Western Australia (AgWA)
Bush Fires Board of WA (BFB)
Department of Conservation and Land Management (CALM)
Department of Transport (DOT)
Health Department of Western Australia (HDWA)
Peel Inlet Management Authority & Water and Rivers Commission (PIMA)
Water Corporation (WC)
Conservation Council of WA (CCWA)
The Environment Centre of WA (ECWA)
Goodale Sanctuary Pty Ltd (GS)
Lake Mealup Preservation Society (LMPS)
Mandurah Environmental Advisory Committee (MEAC)
River Districts Association (RDA)
Soroptimist International of Joondalup (SIJ)
Waterbird Conservation Group Inc (WCG)
Western Australian Naturalists' Club (Inc) (WANC)
Wildflower Society of WA (WSWA)

The Department of Environmental Protection is not required under Division 3, Part IV of the *Environmental Protection Act* 1986 to provide the responsible authority with a summary of

environmental submissions. This summary of submissions has been assembled for the responsible authority in good faith, to highlight the environmental issues that were raised in submissions and aid in the preparation of the response to submissions.

A number of issues were identified in submissions and are summarised under the following headings:

Biophysical factors

1. Vegetation
2. Fauna
3. Wetlands
4. Estuarine vegetation and fauna habitat
5. Groundwater quantity

Pollution Management factors

6. Groundwater quality
7. Surface water quality: effluent disposal
8. Estuarine water quality

Social Surroundings factors

9. Mosquitoes

Other factors

10. Unresolved management issues
11. Scale of development
12. Loss of rural/agricultural areas
13. Other alternatives
14. Previous assessment
15. System 6 update
16. Regional planning considerations
17. Public costs of the development

Further work

In order for the EPA to complete its assessment and make recommendations it must have sufficient scientific information. To that end the responsible authority must demonstrate with a high degree of certainty that the EPA's objectives can be met. Where insufficient information is available or it is unclear whether the environmental objectives can be met, the EPA will adopt an approach consistent with the *precautionary principle*. Based on submissions from lead agencies there is sound justification for additional work to be undertaken. On this basis and under Section 40 (6)(b) of the EP Act the responsible authority is required to provide the following additional information;

1. Review the assessment of potential nutrient contributions (both phosphorus and nitrogen) to the estuary from the proposed development. Calculations should include consideration of issues such as:- variations in nutrient loading of the final effluent produced by the BNR plant; all options of disposal of effluent from the treatment plant; irrigation options of the golf course, active recreation areas and landscaped areas including associated fertiliser, pesticide and insecticide applications; and other issues outlined in the summary of submissions under the headings of surface water quality and estuarine water quality. All calculations should be provided.
2. Preparation of the Conservation and Foreshore Management Plan. Due to the sensitivity of the Peel-Harvey estuary and its regional and international conservation significance as a habitat for migratory and local water birds, the EPA needs to assess the proposed Conservation and Foreshore Management Plan to determine if the proposed management considerations will be

sufficient to maintain and sustain the foreshore areas consistent with the broad objectives of the Ramsar Convention and the Japan, Australia and China Migratory Bird Agreements. This management plan should be submitted to the EPA, WRC, PIMA and the Shire of Murray prior to finalisation.

Biophysical factors

1. Vegetation

1.1 The project will result in increased pressure on the existing reserves within and adjacent to the development area from inflated public access and recreation, fire protection and other operational tasks within the reserves such as fox baiting. The responsible authority has not demonstrated that these impacts will be manageable (CALM). The EPA's environmental review Instructions state that "Particular attention should be given to the interface between [conservation] areas adjacent to the development, management of human pressures, dieback and hydrological impacts (if any). Attention should also be given to criteria used which trigger implementation of specified management measures." The response to this is to defer the above issues to the development phase and no further detail is given (LMPS). Consequently, further discussion of the potential impacts of the proposed development, such as fire, rubbish dumping, threats to wildlife from domestic pets, weeds, degradation of the environment from off-road vehicles, management of human pressures, and dieback, on existing nature reserves adjacent to the amendment area is required.

1.2 The Foreshore Reserve Boundary is considered to be inconsistent in certain areas with remnant vegetation, landforms and soil characteristics. The alignment of the foreshore reserve boundary should be consistent with Water and Rivers Commission's (WRC) emerging State Foreshore Policy; existing Peel Inlet Management Authority (PIMA) policy; and Western Australian Planning Commission (WAPC) policy. The Outline Development Plan (ODP) and the environmental review states that the environmental values and preservation of existing remnant vegetation, due to the site's regional significance are to be upheld. It is considered that the ODP does identify and preserve much of the existing vegetation, however, several other important areas of foreshore are proposed to be cleared for development (PIMA & WRC). The inclusion of a 1.5km road along the north eastern foreshore is totally unacceptable and the inclusion of larger buffer zones of at leat 100m should be a major consideration (MEAC).

1.3 The Conservation and Foreshore Management Plan, as required by PIMA and WRC, should address issues such as vesting arrangements; the control of public access and pressures, especially to sensitive foreshore areas; and mosquito management (PIMA & WRC).

1.4 The proposed location of the marina is in a very valuable and sensitive area as it contains a significant strip of remnant vegetation. This remnant foreshore vegetation varies in width from 120 to 200 metres and is considered to have regional significance. Development should not lead to the loss of remnant vegetation on the proposal site as the vegetation in the area has already been largely degraded. The proposed location of the marina is not supported by WRC and PIMA as it is felt that the location has been chosen in terms of Best Planning Practices such as aesthetics and accessibility to the Dawesville Channel, rather than on environmental grounds. The development could easily be facilitated in an area that is already degraded (PIMA & WRC).

1.5 Edge effects may have a negative impact on the existing reserves as a result of the proposed development. The subdivision design for the "Tourist", "Residential", and "Rural-Residential" zones as outlined in the environmental review and the ODP shows that a significant amount of private land holdings directly abut Public Foreshore and Conservation areas, without any physical demarcation between the reserves and private property. Past experience has shown that indiscriminate access tracks, the damaging of vegetation and the dumping of potentially noxious garden refuse in the reserve may occur without a physical barrier between reserves and residences. All boundaries of lots abutting the reserves should be demarcated by a physical barrier such as a road and appropriate fencing (PIMA & WRC).

1.6 The areas proposed for reservation should be defined to ensure that the integrity of the nature conservation values is retained over time. The responsible authority has not discussed buffers, security of tenure, management arrangements or the possibility of reforestation (CALM). The proposed nature reserves should be vested in either CALM, NPNCA, WRC etc or protected by a covenant so that their long term purpose does not change.

1.7 There is not enough discussion of, or information provided, in reference to the retention of areas of remnant vegetation to determine if strategic nature conservation values will be maintained (CALM).

1.8 The impact of additional clearing for Carrabungup Road on the existing nature reserve is not adequately discussed (CALM). The realignment of Carrabungup Road and any other major access routes away from System 6 Area C50 to a more suitable location is advised (PIMA & WRC).

The discussion of other potential access roads is very limited. No detail is given for the location of the southern access road, nor any reason why the link is required. This road has the potential to be extremely destructive, as it is likely to be routed close to Lakes Mealup and McLarty, and would split lengthwise the adjacent high quality bushland proposed for the Peel Regional Park. The failure of the ODP to consider the impacts of other access roads as part of the Scheme Amendment is a major deficiency (LMPS).

1.9 The flora and fauna survey for the environmental review, undertaken on only 2 days in April, is not adequate to determine the diversity of species present. The large area of land involved in this proposal and the presence of ten different vegetation types suggests more time would have been required for an adequate plant census. The flora survey should have been conducted in spring to allow accurate identification of plants using floral structures and to observe species which would be dormant over summer and early autumn. Thus the survey must seriously underestimate the biodiversity of the site. A more detailed survey needs to be carried out before a decision on the proposal can be made (WSWA).

1.10 The loss of habitat caused by the removal of 18Ha of remnant bushland as well as the development of the sailing club and marina is by no means compensated by the planting of Tuart trees on the golf course or by the sitting of two offshore islands, both of these, besides taking a long period of time to become established, are going to be subject to human disturbance (MEAC).

2. Fauna

2.1 The environmental review does not provide adequate information or discussion on bird utilisation of the proposal area and potential impacts of the project on bird life during the construction and post-construction stages. (CALM).

2.2 The intertidal flats in Robert Bay provide feeding and loafing habitat for the trans-equatorial migratory waterbirds. The area that directly abuts these intertidal flats is proposed for rural-residential development. No discussion of management of impacts on the waterbirds from pedestrians, domestic pets, off-road vehicles or boats is made in the environmental review (LMPS).

2.3 Concern was raised that the waterbird monitoring program is deferred to the post-approval stage. No specific actions were proposed in the environmental review to minimise impacts on waterbirds in the System 6 areas and other reserves due to the proposed increase in human population (LMPS).

2.4 The fauna study of 20 hours without trapping is too brief to be called adequate. Research at the nearby Goodale Sanctuary south-east of Point Grey and at Lake Mealup suggests that the Point Grey Fauna list is far from complete. Inadequate management measures are proposed to protect the potential habitat for the carpet python (LMPS).

3. Wetlands

3.1 A large wetland complex exists along the eastern side of the development area, containing sumplands, damplands and a small estuarine wetland. Each wetland seems to have unique species composition and zonation of species. A full assessment of all wetlands on the development site should be undertaken and taken into consideration in the environmental review. Protection of all wetlands on-site and maintenance and restoration of adequate vegetation buffers around the wetlands should be incorporated into the ODP. Approval for a Wetlands Management Plan should be sought from PIMA and the WRC prior to the development proceeding to the next planning stage and before any works commence on site (PIMA & WRC).

3.2 The development threatens significant wetlands, including Lake McLarty and Lake Mealup. These wetlands are RAMSAR listed wetlands (as is the Peel-Harvey estuary) and there is an international obligation by the Australian Government to ensure that RAMSAR wetlands are not damaged. The Point Grey development threatens the integrity of these wetlands and consequently if this proposal was approved, the Government would be in breach of the RAMSAR Convention (CCWA).

The environmental review does not deal at all with the potential impacts of the development on Lake Mealup and Lake McLarty as required by the EPA's Environmental Review Instructions. In particular, the assumption that the expected drawdown of the Leederville aquifer will not significantly impact shallow water table levels or groundwater-dependent vegetation and wetlands is not explained (LMPS).

3.3 Intensive development such as is proposed at Point Grey would adversely affect nearby RAMSAR wetlands which are on the Register of the National Estate (WANC).

3.4 The basis for the proposed buffer widths is not described and they are inadequate (LMPS).

4. Estuarine vegetation and fauna habitat

4.1 The development of the marina and sailing club will necessitate dredging. The very shallow water in this part of the inlet is a known bird roosting and foraging area and it attracts many water birds including migratory wading birds that are protected by international agreements such as CAMBA and JAMBA. The impacts of the proposed marina, sailing club, dredging activities and the increase in aquatic and other associated activities on the waterbirds and other associated fauna has not been adequately discussed.

4.2 The area of the shoreline and estuary bed that are proposed to be dredged for the construction of the marina are considered to be highly sensitive and valuable in terms of sandy beach accretion and the emergence of seagrass beds along these shorelines. The seagrass beds are considered valuable in terms of providing habitat and feeding grounds for the low order marine and estuarine creatures which inhabit the Peel-Harvey estuary, especially since the opening of the Dawesville Channel and the increased movement and exchange of marine water from the ocean to the estuary (PIMA & WRC). The proposal to use signage to protect seagrasses from boating is totally inadequate (LMPS).

4.3 The Austin Bay Nature Reserve is the only area in the Peel-Harvey estuary that remains without intensive development. The proposal for such a large development in close proximity to the reserve and to the shoreline of the estuary is likely to have detrimental impacts on the natural estuarine vegetation of the area.

4.4 The habitat of the proposed constructed dredge spoil islands is too high for optimal value to ground nesting species such as pelicans and fairy terns. In addition, the proposed jetty for public access to these islands totally negates their value as waterbird habitat (LMPS).

4.5 There is no detail given to expected changes to the waters and seabed associated with the marina and sailing club developments (DOT).

4.6 There are indications that the marine works have not been planned properly. The Harvey estuary has a maximum natural depth of 1.6m and this limits the general size of sailing vessels to 10m. The environmental review claims that the marina should be able to be utilised by 15m yachts, however, for this to occur, a channel would need to be dredged wholly across the estuary and into the throat of the Dawesville channel itself.

The environmental review also mentions a small channel that may be dredged to allow access to the sailing club. As the low water mark is approximately 100m offshore and the presumed power boat depth some 250m offshore, this "minor channel" is likely to involve some 3 000 sq.m of surface and 2 000 cu.m of spoil (DOT). Further clarification is necessary of depth requirements for both sail and powered craft and consequent dredging needs or proposals.

4.7 The environmental review quotes "old" predictive data in regard to estuary water levels. The extreme event reviews of 1997 should be utilised for the rare event planning leading to the design water levels in section 2.2.3 of the environmental review (DOT).

4.8 The section in the environmental review regarding shoreline stability (section 2.2.7) quotes a long-term photo record to substantiate a claim for stability. This is quite invalid for Point Grey, which now experiences a significantly changed regime at the

post-Dawesville water levels. There is a need for close study of the post 1994 record for indicators of possible natural change. It is reasonable to presume some significant local variation of sandy shore reaches (DOT).

4.9 Seabed sediments should be monitored within harbours and swimming areas as heavy metals such as zinc tend to build up near boats and urban drainage outlets (DOT).

5. Groundwater quantity

5.1 The impact of drawdown of the Leederville aquifer on the nature reserves (from the Murray River mouth to the Harvey River mouth) and important wetlands for migratory birds requires further discussion and investigation (CALM). As waterbird usage of wetlands is a good indicator of their integrity, the responsible authority should be required to fund comprehensive surveys of waterbird usage of the Waroona mound wetlands to monitor the effects of drawdown as suggested by the Royal Australian Ornithological Union when the previous development proposal for this land was submitted (PPS).

5.2 Potable water for the development is proposed to be supplied through the abstraction of groundwater. The impact of increased bore-water use on the bores and land of neighbouring land users has not been addressed (AgWA).

5.3 The information presented in the environmental review is inadequate to sufficiently characterise the hydrology of the area to justify claims that the development will not have unacceptable environmental effects. There is a lack of site-specific detail upon which to base and verify the modelling (LMPS).

5.4 No information is provided to support the claim that lowering the Leederville aquifer will not affect the superficial aquifer (LMPS).

5.5 The stratigraphic/hydrologic framework of the site is not established (LMPS).

Pollution Management factors

6. Groundwater quality

6.1 The aquifer from which drinking water is proposed to be abstracted is unconfined and as such is vulnerable to contamination. A modelling exercise was undertaken to determine the estimated length of time before phosphorus would leach through the soil and reach the drinking water aquifer, however this exercise was not performed for nitrogen. An estimate of time before the aquifer begins to become contaminated with nitrates is needed so preventative and protection measures, such as proclaiming a water reserve around the production bores, installation of monitoring bores and an initial risk assessment of pollutants entering the water source, can be considered. (PIMA & WRC).

6.2 Both the potable and irrigation water descriptions do not account for the potential salinisation of groundwater as consumption increases. Salt intrusion could prove to be a significant problem and the "salt factor" should be incorporated into the calculations of

available supply, particularly as ground water is the proposed source of potable water (AgWA).

Salinisation of the groundwater is also possible if 'salty' water from the proposed artificial wetland at Robert Bay is utilised for irrigation of the golf course and landscape vegetation. This possibility needs to be clarified and taken into consideration when a decision on potable water supply is made (PIMA & WRC).

6.3 If the Water Corporation is not able to provide potable water for the development, the water quality must be to standards specified in the National Health and Medical Research Council and ARMCANZ document "Australian Drinking Water Guidelines (1996)", and monitoring of the water quality should be done at the cost of developers (HDWA).

6.4 The developer has not identified and confirmed an alternative supply of potable water as required by "Council Special Provisions Relating to Specified Land", paragraph 7 item f(i). This provision states if a reticulated water supply cannot be provided by the Water Corporation, paragraph 9 item (iii) requires the developer to "identify an appropriate contingency option for water supply".

6.5 The inclusion of a golf course within the development increases the potential for pollution of the estuary from fertilisers, herbicides and pesticides. The proposed application rate of phosphorus on the golf course of 20 kg/ha/annum exceeds the amount set by the Peel-Harvey SPP No. 2 which equates to 15 kg/ha/annum (PIMA & WRC).

7. Surface water quality: effluent disposal

7.1 The provision of a sewer by the Water Corporation is recommended, given the scale of the proposed development (HDWA).

7.2 "Biological Nutrient Removal" (BNR) is cited as an option for sewage treatment, however no explanation or reference is given. This should be clarified to ensure ecological standards are truly considered in the sewage treatment operations. Research into sewage treatment technology may have progressed significantly, however insufficient attention is given to the type of technology to be implemented by the developers (AgWA).

The calculations for the proposal were based on the lower extremity of effluent concentrations expected from a BNR plant, and no Water Corporation BNR plant in Western Australia is achieving this level on a continuous basis. Consequently the estimated nutrient loads to the estuary as stated in the environmental review may be lower than what are actually achievable. Further calculations of estimated nutrient loads to the estuary should be performed using a range of expected BNR effluent concentrations (PIMA & WRC). An average of near 10 mg/L for the most advanced plants (such as Rottnest and Pemberton) is a more typical final effluent concentration value from BNR plants (LMPS).

Experience with BNR plants has shown that effluent concentrations, hence loads, vary significantly over the day and week due to different levels of human activity. This is important in the operation of a BNR plant where cycle times must be carefully controlled to ensure that the biological nutrient removal processes are optimised. As the

development at Point Grey proposes to include tourist facilities, the loadings would be more variable than expected from a purely residential development. The variability of the nutrient output from the BNR plant should also be taken into consideration when calculating the expected nutrient output of the development (LMPS).

7.3 The loading from sullage waste from the marina has not been examined in the assessment of water water treatment and effluent disposal considerations. In addition, sullage may contain salt, which is undesirable from an effluent reuse point of view, and chemicals such as glutaraldehyde which are biocidal to the microorganisms in the BNR plant. the impact of sullage on the BNR plant should be further investigated (LMPS).

7.4 The proposed disposal of effluent by way of irrigation of woodlots within the bore water extraction areas for potable water supply is not acceptable as there is potential for contamination of the water source (HDWA).

7.5 The modelling of the woodlot assumes uniformity of the soil profile and does not mention variations which may cause much quicker phosphorus saturation or transport of phosphorous through the profile. Such "preferred channels of flow" may significantly effect the model output (CALM). No geotechnical information has been provided on the suitability of the effluent disposal areas (LMPS).

The environmental review also gives no indication of the woodlot's capacity to absorb the volume of effluent proposed to be applied to the area without surface runoff or tree failure and does not consider rainfall during winter (LMPS).

7.6 The disposal of saline reject water from the reverse osmosis plant has not been considered in enough detail, as no indication of size and location of the proposed "soakage pit" is provided.

7.7 The nutrient risk of effluent disposal in the rural-residential development on Bassendean sand to the east of Point Grey requires further consideration as these sands are generally unsuited to on-site effluent disposal (AgWA). The suggested lot size in the rural-residential subdivision is 1250m^2 and it is unlikely that this size lot could support long term on-site disposal of treated wastewater from any on-site treatment unit required by the Health Department. It is recommended that this development be included in the sewerage scheme (WC).

7.8 On-site effluent disposal systems on lots over 4 000m^2 should be aerobic treatment units in accordance with SPP No. 2 (PIMA & WRC).

7.9 The buffer for the waste water treatment plant should be located within the scheme area, not overlapping on adjacent properties, unless outright purchase of the affected area is contemplated (WC).

8. Estuarine water quality

8.1 Concerns were raised about the accuracy of the estimates of potential nutrient contributions to the estuary as outlined in the environmental review. Contributions from various sources, including tourist/short stay accommodation, were included in the

modelling of phosphorus (P) export, however, they were not included in the estimate of nitrogen (N) export.

8.2 The proposed 312ha identified as 'Reserve/Conservation' was not included in the P-retention modelling exercise as it is assumed no P will be applied to this land. However, forested areas have been proven to contribute significant amounts of P through natural processes and this land is part of the development. Consequently, this aspect should be factored into the modelling exercise (PIMA & WRC).

8.3 The WRC cannot assess the validity of the calculations for the final P export figure as they have not been included in the environmental review. The value of 70 kg/annum is one third of the amount of export of P from the current land-use and equal to what a relatively pristine, forested catchment would contribute. Given that P is harder to immobilise that N and that the final export figure of P is equivalent to what a relatively pristine, forested catchment would export, it does not seem likely that a change in land-use from pastoral to urban could result in such a large reduction in P export. This discrepancy needs to be investigated further (PIMA & WRC).

8.4 The environmental review states that N export from the development area to the Peel-Harvey estuary are to be 4.2 tonnes/annum, which equates to approximately 1% of the total N export from the estuary to the ocean. One of the overall objectives of the Peel-Harvey EPP is to reduce nutrient inputs to the estuary. The Point Grey proposal is considered to be contrary to that objective as the development proposes a significant and unacceptable amount of N export to the estuary (PIMA & WRC).

8.5 Modelling of predicted nutrient outputs from the development does not account for the possible use of treated effluent for irrigation of the golf course. Further calculation of predicted nutrient output should be made for the above circumstance to provide a more accurate representation of likely outcomes (PIMA & WRC).

8.6 The increased stormwater runoff resulting form the conversion of agricultural land to a relatively large percentage of hard stand areas, as well as irrigated areas such as golf courses, lawns and gardens has the potential to both increase and hasten the flow of nutrient to the Peel-Harvey estuary. Consequently, a stormwater system should be designed to cater for stormwater discharge from a 1 in 10 year storm event and to capture at least the first 25mm of any rainfall event. Consideration should also be made of the potential for heavy metal contamination from urban areas through stormwater runoff (PIMA & WRC).

8.7 The proposed marina development may increase the risk of nutrient, heavy metal or hydrocarbon contamination of the waters of the Peel-Harvey estuary. The proposal should satisfy water quality objectives to standards set out in ANZECC water quality guidelines. This should be demonstrated through continued monitoring and a comparison of baseline data prior to any site works with water samples throughout the life of the marina (PIMA & WRC).

8.8 There is no consideration of the effects caused by the constructed islands on the hydrology of the area (MEAC) or algal bloom frequency (LMPS).

Social Surroundings factors

9. Mosquitoes

9.1 The exposure of potential residents to mosquito-bourn disease has not been adequately addressed. Since the opening of the Dawesville Channel, mosquito carriers have begun to breed all year round and consequently, the frequency of spraying has increased from 4 to 17 per year and this has necessitated a five fold increase in the use of Abate® insecticide. The long term effects of fortnightly spraying on the ecology of the area and resident population are also not known.

9.2 The Robert Bay wetland will potentially create a new mosquito breeding ground, however, as no commitment has been made to construct the wetland, a full assessment of the risk cannot be made (AgWA). No consideration is made of insect movement from areas outside the development within a 5km radius, as the environmental review identifies potential mosquito breeding sites within the development area only (LMPS).

9.3 The Health Department of Western Australia supports the EPA's objective in regard to mosquitoes, however, there are no proven mosquito control measures which are effective in constructed wetlands. The saltmarsh mosquito control program carried out by the Health Department of Western Australia in collaboration with the Shire of Murray and other Peel Region local governments is fully stretched and cannot be expanded to include the Pt Grey area without the availability of additional financial resources (HDWA). No commitment is made for the funding of a spraying program if the wetland is constructed (AgWA).

In addition, Pt Grey is currently not monitored for mosquito and Ross River virus activity and the Health Department of Western Australia funded surveillance team at the University of WA is fully stretched and could not expand their activities to include Pt Grey without the allocation of additional resources (HDWA).

9.4 It would not be responsible to allow development to proceed in an area which is a known breeding area for mosquito species and then seek to mitigate against the impacts. Mitigation measures cannot be totally effective and the measures are invariable environmentally unsound (CCWA).

9.5 Mosquito control measures may lead to the contamination of local water resources and wetlands. Should chemical management be utilised, it may have a detrimental effect on bird breeding and associated wetland habitat and feeding areas. The WRC does not support management measures such as the filling of wetlands or damplands, or drainage of such areas (PIMA & WRC). Other options such as runnelling would most likely reduce the habitat value for water birds (WCG).

No assessment is made on the impact of increased insecticide spraying on adjacent Ramsar and National Heritage wetlands Austin Bay, Lake Mealup and Lake McLarty (LMPS).

9.6 Saltmarshes provide mosquito breeding habitat, which makes residential development in their proximity undesirable. There area other areas in and near the development area subject to inundation which also provide possible mosquito breeding habitat (LMPS).

Other factors

10. Unresolved management issues

10.1 The responsible authority has indicated that management plans for many environmental issues have been deferred until the project is approved, however, there is no guarantee that satisfactory management plans will be developed or even if it is possible to provide adequate protection for the environment. The proposed development is close to an area of high nature conservation value. The Austin Bay area is a RAMSAR wetland and therefore it seems imperative that environmental issues such as protection of fauna, vegetation and wetlands are fully addressed before the project is approved. Any management plans prepared by the responsible authority should be available for public review.

10.2 The environmental review does not outline the proposed management of fire, domestic pets, household rubbish and incidental litter, weed and grass infestations, increased traffic load causing disturbance to wildlife and wildlife habitat around the foreshore areas, or the inevitable drawdown on water resources due to groundwater abstraction (GS).

10.3 Specifications for the woodlot are not given, neither are arrangements to harvest the phosphorus. Fire implications (on the woodlot and adjacent nature reserve) and contingencies to cater for phosphorus uptake if the trees suffer a disaster or are harvested are also not outlined (CALM).

10.4 A commitment to the source of the potable water supply, monitoring of the source and possible treatment of the supply should be made by the responsible authority before development approval is given. There appears to be a lack of commitment to any of the suggested options (AgWA). The plan is solely dependent on the Leederville Formation as an independent water supply, however there si no alternative proposed should the "sustainable yield" not be met (MEAC).

10.5 No decision has been made on the source of irrigation water supply. Options have been provided, however, more research and a firm decision should be made as to where irrigation water will be sourced so that impacts can be properly assessed (AgWA).

10.6 A decision should be made on the construction of the Robert Bay Wetland. If the construction is not to proceed, what will happen to the proposed site? A commitment should be made not to allow a canal development in this area. If the wetland is constructed as a retention basin for summertime irrigation, the potential for salinisation exists. How will this be managed? Who is responsible for the ongoing management of the wetland and silt drains flowing into the wetland?

10.7 The suggestion that the Robert Bay Drain water may be re-used needs to be confirmed. If the developers are proposing to re-use the drainage water, clarification of Water Corporation ownership needs to be made, along with permission from the Water Corporation to use this water (AgWA).

10.8 A decision should be made in regard to which party is responsible for the management of the harbour. The Department of Transport is not a party to the management agreement for the harbour as explained in the Strategic Plan for Maritime Facilities.

Management beyond a five year term must also be clearly attributed before the marina can be approved (DOT).

11. Scale of development

11.1 Concerns were raised in regard to the huge impact that an additional 7 000 people would have on such a sensitive environment. What measures could be put in place to deal with the cumulative impact of large numbers of people in the region? Impacts would include threats to wildlife from domestic animals, the introduction of exotic species into the bushland from garden plants, rubbish dumping, degradation of the environment from off-road vehicles etc and the impact of fire on the surrounding environment (CCWA).

11.2 The large size of the development would ultimately exert the pressure to build more roads to access the development. These roads would most likely cut through bushland and wetlands, further degrading the area (CCWA). The proposed southern access road would be detrimental to the areas' already small bushland reserves (MEAC).

11.3 There are several other residential subdivisions between Mandurah and Pinjarra that have not been fully sold or developed. This suggests that it is premature for more development in the area. The placement of a new town of 7 000 people only 20km from Pinjarra, in an area that has poor infrastructure, seems inappropriate due to the duplication of essential services and cost of the provision of these services (MEAC). Will the additional cost be bourn by the rate payers of the Shire of Murray ?

12. Loss of rural/agricultural areas

12.1 Agriculture Western Australia's primary concern with the proposal is the underlying assumption that because land is used for agricultural purposes, it can therefore be developed. This assumption is detrimental to the valuing of farming in the region and to the value of agricultural production in the region.

12.2 Limited consideration has been given to the impact of the proposed development on neighbouring land uses. Adequate vegetation and suitable buffers separating the development from nearby rural properties is essential, as agricultural activities should not be inconvenienced or limited as a result of the development proceeding. The requirements of urban zonings, such as odour and noise controls, should not be imposed on neighbouring rural landholders as a result of urban development (AgWA).

12.3 Once this development is established, there will be a tendency for expansion of residential areas, encroaching into good agricultural land.

13. Other alternatives

13.1 The environmental review does not discuss any alternatives or compromises. Developments which allow a small increase in international and local tourism without major alterations to the natural attributes could be researched in a feasibility study (GS).

14. Previous assessment

14.1 In 1987, the EPA rejected an earlier development proposal for the same area of Point Grey (EPA Bulletin 306). The area has not changed and is no more suitable for a development today, ten years later. The impact of the Point Grey development on surrounding nature reserves would still be severe and unacceptable and the impact on the water quality of the estuary itself remains of concern (CCWA).

A summary of the report and recommendations is as follows:
The development was seen to have the potential to contribute phosphorus and nitrogen into the estuarine ecosystem through the disposal of treated sewage effluent and septic tank waste, the application of fertilisers on domestic lawns and gardens, and the leaching of agricultural fertiliser already in the soil. The proximity of residential and rural residential type lots abutting the System 6 reserves was seen to have adverse impacts, given the proposed population levels, unless stringent management conditions were implemented. The foreshore reserve and proposed open space areas were not seen to be adequate as all vegetation associations were not thought to be adequately represented in conservation areas. Point Grey was seen to be the most significant topographical feature in the Peel Harvey system and consequently requiring conservation and landscape protection priority. Reduced environmental amenity would have been experienced by Point Grey residents if the proposal progressed, including significant problems associated with macroalgal accumulations along the foreshores, contributing to odour and beach fouling and high mosquito numbers.

15. System 6 update

15.1 The development should be halted until the finalisation of the System 6 update as is believed by local residents that parts of the Pt Grey area may be recommended for conservation by the EPA.

16. Regional planning considerations

16.1 The proposed development as outlined in the environmental review and the ODP is not consistent with the recommendations for regional planning. The Inner Peel Region Structure Plan (IPRSP) was released in December 1997 and includes recommendations with regard to the proposed Peel Regional Park (PRP). The IPRSP identifies significant areas of 'Open Space - Conservation' within the subject land that currently contain remnant vegetation. These areas include the remnant foreshore vegetation and areas to the south of the proposed 'Residential Village'. These areas, as identified in the IPRSP as 'Open Space - Conservation', are recommended to be vested in the National Parks and Nature Conservation Authority (NPNCA) with a view to be managed by the future manager of the PRP. All future planning should take into account the areas recommended for protection. Inconsistencies between the ODP and the conservation areas outlined in the IPRSP include the area proposed to contain the marina, the proposed site for the constructed wetland and some areas of the 'Special Residential' subdivision (PIMA & WRC).

16.2 The 'Tourist' area as shown on the ODP seems consistent with the IPRSP, which identified the area as 'Tourist - Existing and Future', however, some of the proposed urban areas which fall under the responsible authority's classification of 'Tourist', including the 'Waterfront Tourist Village/ Harbour-side Village and Golf Course Estate'

may be inconsistent with the urban density requirements under the IPRSP's 'Tourist' zone. Careful consideration should be given to the density of development for the 'Tourist Areas' in relation to land capability and site characteristics (PIMA & WRC).

16.3 A large portion of the 'Residential - Traditional neighbourhood village' as described in the ODP is also inconsistent with the IPRSP, which identifies the area as 'Greenbelt Rural Living'. The IPRSP classification suggests that larger lot subdivision such as 'Special Residential' and 'Rural Residential/ Landscape Protection' would be more suited to this area (PIMA & WRC).

16.4 The 'Boating facilities study for the Peel Region (1996)' was based heavily on local input, community involvement and its outcomes are consistent with planning requirements, financial, technical and environmental considerations and boating demands. The report identified the need for regional boat launching ramps and finger jetties at Point Grey rather than a boat harbour or marina. Further investigation should be made into the appropriateness and the location of the proposed marina and sailing club developments (PIMA & WRC).

16.5 The establishment of this development could trigger an undesirable sprawl similar to that on the western side of the estuary.

17. Public costs of the development

17.1 Long term maintenance of public water supply. The cost of treating water by reverse osmosis is around 50c/kL, which is more than twice the cost of water treatment in the Perth metropolitan area. As potable water is proposed to be provided privately (ie not by the Water Corporation), all costs will need to be met by either the residents of the Point Grey area or via a subsidy paid by ratepayers in the Shire of Murray. The environmental review should outline details of how this additional cost (potentially up to several hundred dollars per service per annum) will be met (LMPS).

17.2 Long term maintenance of sewerage systems. Very few communities in Western Australia are serviced by such high standard of waste water treatment as is proposed for this development. The cost of such treatment is very high. The capital cost of similar plants of a comparable size in Western Australia, such as those on Rottnest and at Australind, are at least $300 to $500 per capita. This implies a capital cost of $1 million to $2 million more for Point Grey. The operating cost may be at least three times the cost of metropolitan waste water treatment. Further costs include maintenance of the waste water collection system. Details of how the costs for the waste water treatment plant and disposal system will be met should also be outlined in the environmental review for the development (LMPS).

17.3 Other ongoing costs that need to be considered and allocated funding include long term maintenance of drainage systems, road maintenance, dredging to maintain boat launching facilities, general marina maintenance, mosquito control, removal of algal accumulations (at least in the short to medium term), and fire control. These should be discussed in the environmental review (LMPS).

APPENDIX B

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POINT GREY DEVELOPMENT

(Subject to agreement by WRC, PIMA, CALM, DEP, EPA)

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APPENDIX C

PHOSPHORUS MODELLING ADDITIONAL WORK

1.0 BACKGROUND

The Environmental Protection Authority (EPA), under section 40 (6)(b) of the EP Act has requested that further work be undertaken to assess the potential nutrient, pesticide and insecticide contributions to the Peel Harvey estuary from the proposed Point Grey development.

The EPA, based on the submissions from lead agencies considered that the following issues needed addressing:

- The effect of variations in nutrient loading of the final effluent produced by the BNR plant on the storage capacity of the soils underlying the effluent disposal area.
- An assessment of disposal options including irrigation to golf course, active recreation and landscaped areas.
- An assessment of the potential impact of pesticide and insecticide application to the golf course, active recreation and landscaped areas.

This section addresses the above issues with regards to the phosphorus (P) content of the BNR wastewater and associated disposal options. An assessment is also made of the potential impact of pesticide usage.

The P retention model used is described in Appendix E of the ER document (attached). The following section provides a summary of the retention model and describes calculations of exhaustion times of the soils underlying the proposed golf course and effluent disposal area under the above scenarios.

2.0 PHOSPHORUS RETENTION MODEL

The model used to evaluate the P retention capacity of the soils at Point Grey was based on accepted standard mathematical, soil sampling, laboratory and data analysis procedures.

The basis for calculating P retention was the Barrow-Shaw equation:

$$C_s = A \times C_m^{\,b1} \times T^{b2}$$

Where:

C_s = P sorbed to soil (mg/kg)

C_m = equilibrium concentration of P (mg/L)

$A, b1$ = coefficients determined from short term isotherm tests

$b2$ = long term adsorption coefficient (typically range: 0.1-0.35)

The Barrow-Shaw equation will calculate the retention capacity in mgP/kg soil and is concentration dependant (ie at higher soil solution concentrations more P will be retained). The concentration of P for use in the model was calculated using the P application rates and irrigation rates combined with historical rainfall data (see Attachment 1, section 4.2).

Table 1 shows the storage capacity (converted to kg/ha/m) using soil profiles with the lowest, highest and average of measured P retention capacities (see Attachment1, section 3.3.3) for the golf course and effluent disposal areas.

Table 1

Phosphorus Storage Capacity

	Storage Capacity (kg/ha/m)		
Landuse	**Lowest[1]**	**Highest**	**Average**
Golf Course	571	1324	947
Effluent Disposal Area	462	1053	758

Note:

1. Lowest value was used in ER document to reflect worst case scenario.

Calculating exhaustion of the soils underlying landuses involved multiplying the storage capacity by the soil depth at that particular landuse and dividing the resultant number by the annual P application rates associated with the landuse (see Table 2). Added to this number is an allowance for storage in the top 0-0.5m of the soil horizons. The typically high organic content found in the top 0-0.5m of sandy soil profiles prohibits the use of the Barrow-Shaw equation for calculating storage (see Attachment 1, section 3.3.3).

The highest exhaustion time for the golf course (Table 2, column 6, row 3) was calculated using the highest P storage capacity 1324kg/ha/m (Table 1, column 3), multiplying this by the soil depth of 7m (Table 2, column 2), adding the average topsoil storage capacity of 221kg/ha (Table 2, column 4), and dividing the resultant number by the P application rate of 20kg/ha/yr (Table 2, column 3) as follows:

$$(1324kg/ha/m \times 7m + 221kg/ha)/20kg/ha/yr = 474yrs$$

Similarly, lowest and average exhaustion times were calculated and are shown in Table 2.

Using highest measured retention capacity results in a doubling of exhaustion times and using average measured retention capacity results in a 50% increase in exhaustion times, compared to the use of the lowest measured retention capacity. The ER used the lowest measured soil profile retention capacity to reflect conservatism in the model outputs. However, in practice the use of average measured storage capacities are more realistic and would result in higher exhaustion times.

Table 2

Soil Profile Exhaustion Times

Land use	Soil Depth (m)	Phosphorus Application Rate kg/ha/yr	Topsoil Storage Capacity (kg/ha)	Exhaustion Times with Varying Soil Storage Capacity[1] (yrs)		
				Lowest[2]	Highest	Average
Golf Course	7	20	221	211	474	342
Effluent Disposal Area	5	13	221	195	405	300

Note:

1. from Table 1
2. The lowest exhaustion time was used in the ER document to reflect a worst case scenario

3.0 VARIATIONS IN BNR EFFLUENT QUALITY

Advice from Halpern Glick Maunsell, the consultant engineers for the development, has confirmed that the design effluent P concentration of 1mg/L is routinely achievable utilising the BNR plant proposed for the treatment of sewage for the development.

However, to allow for an evaluation of the impact of variation of effluent quality, it is assumed that the plant will continuously produce twice (2mg/L P) the design P concentration. Given the direct proportionality between the annual P application rate and effluent concentration, a doubling of concentration will result in a doubling of the application rate. The annual application rates are therefore 13 and 26kg/ha respectively.

Table 3 shows the exhaustion times calculated utilising the same modelling input parameters referred to in the ER document (see Attachment 1, section 4.0) and using the calculations described in section 2.0

As this scenario deals specifically with the tree lot where under CALM supervision tree harvesting will be practised, a more realistic evaluation utilising P removal (15kg/ha) from the system through tree cropping is provided in column three.

The exhaustion time for 2mg/L P effluent quality using P removal (Table 3, column 4, row 2) was calculated using the lowest P storage capacity of 462kg/ha/m (Table 1, column 2), multiplying this by the soil depth of 5m (Table 2 column 2), adding the topsoil storage capacity of 221kg/ha (Table 2, column 4), and dividing the resultant number by the net P application rate of 11kg/ha/yr. The net P application rate is calculated through subtraction of the application rate of removal/tree uptake rate of 15kg/ha/yr from the application rate of 26kg/ha/yr (Table 3, column 2).

Overall the calculation is as follows:

(462kg/ha/m x 5m + 221kg/ha)/(26kg/ha/yr - 15kg/ha/yr)= 230yrs

Under worst case scenario conditions the saturation time of the soil underlying the woodlot is 97 years. It must be emphasised that to achieve the 97 year exhaustion time, the plant has to produce twice its design effluent quality continuously for the 97 year period which is highly unlikely. Also, retrofitting of better future technology to produce better quality effluent is a realistic possibility given the current trends in wastewater treatment technology.

It must also be noted that the use of average rather than worst case soil storage scenario parameters will increase exhaustion times by at least 50% as described in section 2.0

The P removal rate of 15kg/ha used in column three of Table 3 is higher than the application rate of 13kg/ha under the design effluent concentration of 1mg/L. As uptake is higher than application no excess P will leach through the profile.

Table 3

Results of Water Quality Variation at Woodlot Disposal Area

P concentration (mg/L)	P application (kg/ha/yr)	Exhaustion Time[1] (yrs)	Exhaustion Time[2] (yrs)
1	13	195	-[3]
2	26	97	230

Notes
1. Assuming no P uptake and lowest measured soil storage capacity
2. Assuming P uptake at 15kg/ha and lowest measured soil storage capacity
3. Application rate less than uptake

4.0 TREATED EFFLUENT DISPOSAL OPTIONS

The only alternative disposal option under consideration at present is the use of treated effluent for golf course irrigation. This option could be exercised during the final phases of development. The two scenarios evaluated are:

- Summer irrigation of treated effluent on golf course greens and fairways with winter disposal to the woodlot.

- Year round irrigation to golf course.

It is assumed that all parameters are the same as used in the ER document and shown in section 2.0

The exhaustion time for the effluent disposal area assuming summer irrigation to the golf course was calculated using the lowest P storage capacity of 462kg/ha/m (Table 1, column 2), multiplying this by the soil depth of 5m (Table 2 column 2), adding the topsoil storage capacity of 221kg/ha (Table 2, column 4), and dividing the resultant number by the P application rate of 6.5kg/ha/yr, half the annual application rate of 13kg/ha/yr (Table 2, column 3) as follows:

$$(462kg/ha/m \times 5m + 221kg/ha)/6.5kg/ha/yr = 389yrs$$

Table 4 shows the saturation times of the soils underlying the effluent disposal area and the golf course. The effect of summer irrigation to the golf course is to increase the saturation time at the disposal area from 195yrs to 389yrs. However, breakthrough will occur at the golf course at the previously modelled time of 211yrs. Full time irrigation of the golf course with treated effluent will also make no difference to the saturation time as P application per hectare at the golf course will remain unchanged. In fact, additional P will have to be applied.

Table 4

Treated Effluent Disposal Options

Area	Saturation Time[1] (years)	Saturation Time[2] (years)
Effluent Disposal Area	389	-
Golf Course	211	211

Notes
1. Summer disposal to golf course assuming lowest measured soil storage capacity
2. Year round disposal to golf course assuming lowest measured soil storage capacity

5.0 PESTICIDE USE

Pesticide application at the proposed Point Grey development can be broadly associated with the following landuses:

- Residential use in the form of pesticide application on private lawns and gardens.
- Centrally managed golf course and landscaped areas.

Cargeeg *et al* (1987) and Gerritse *et al* (1990) state that pesticide use in residential areas on the Swan Coastal Plain has not had an adverse effect on groundwater quality.

Given the relatively low density of residential development proposed for Point Grey that pesticide use is unlikely to be a significant factor in regard to groundwater quality.

The use of specified pesticides with known suitability (Table 5) for overall management of turf and general landscaping will ensure that the mobility, persistence and toxicity normally associated with poor pesticide management can be minimised.

Table 5

Selected Pesticides

Herbicides	Insecticides	Fungicides
Bromoxynil, Dicamba, DSMA, Mecopropamine, Glyphosate, Siduron 2,4,D	Chlorpyrifos, Cyfluthrin, Isofenphos	Iprodione, Mancozeb, Triadimenol

6.0 REFERENCES

Cargeeg G C, Boughton G N, Townley L R, Smith G R, Appleyard S J, and Smith R A (1987) Perth Urban Water Balance Study. Water Authority of Western Australia Publication.

Gerritse R G, Barber C, and Adeney J A (1990) The Impact of Residential Urban Areas on Groundwater Quality: Swan Coastal Plain, Western Australia. CSIRO Water Resources Report No 3.

ATTACHMENT 1 - PHOSPHORUS EXPORT MODEL

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1.0 INTRODUCTION

1.1 Objectives

Using soil science and accepted mathematical models in conjunction with data from previous studies a predictive integrated model is developed to assess the sites' phosphorus (P) retention capacity and hence the potential future export of P determined by the proposed landuses of the development to the adjoining waters of the Peel-Harvey.

The prediction of P export from the site is then compared to the allowable P export in the context of the long term protection of the water quality of the Peel-Harvey estuary (see relevant sections of main report)

The overall objective of this section of the report is therefore to analyse the capacity of the site to sustain the proposed development with regards to the future export of P.

1.2 Contents of the Report

A brief description of the contents of each major section of this report is as follows:

Section 2.0 ***Nutrient Export***

Describes the P export mechanisms at the Point Grey peninsula.

Section 3.0 ***Phosphorus Transport Modelling***

Provides a discussion and explanation of the current theories and chemical analyses regarding the retention of phosphorus. This section also discusses the results of the soil investigations and evaluates the parameters of the models that best describe the retention characteristics and groundwater recharge of the Point Grey site.

Section 4.0 ***Point Grey Model***

This section discusses the integrated phosphorus transport model applied to the various proposed landuses under their prospective phosphorus application and groundwater recharge rates at full occupancy.

Section 5.0 ***Results***

Provides a compilation of the results of the modelling exercise.

Section 6.0 ***Discussion and Conclusion***

This section analyses the sensitivity of the proposed model and in this light evaluates the results and the conclusions which can be drawn from the modelling exercise.

2.0 NUTRIENT EXPORT

2.1 Point Grey Nutrient Export Mechanisms

At full occupancy P input to the site can be expected to occur at differing rates from the following proposed landuses:

- 18 hole Golf Course
- Residential areas
- Public open space
- Tourist/short stay accommodation
- Effluent irrigated disposal areas

Runoff from these landuses, in particular from residential and tourist nodes, will be managed through a series of compensation and infiltration basins to accomplish complete infiltration of the collected precipitation from impermeable surfaces such as roads, carparks and paved areas. Drainage from the site will therefore occur through recharge of the superficial aquifer and subsequent discharge to the adjacent Peel-Harvey estuary.

2.2 Conclusion

As the site will be engineered to accomplish complete infiltration of all the generated wastewaters, annual P export from the site will therefore be through the P content in the volume of annual groundwater recharge. The strategy to evaluate the site's P export rate under the proposed landuses is discussed in the following sections.

3.0 PHOSPHORUS TRANSPORT MODELLING

3.1 Introduction

The two most important parameters which determine the export rate of P from the proposed development are:

- The amount of P retained in the soil profile under the proposed landuses.
- Groundwater recharge from the site through evaluation of the irrigation needs associated with the proposed landuses in conjunction with historical rainfall data.

Through modelling both these parameters a prediction can be made regarding future concentrations of P in the groundwater recharge from the site which in turn discharges directly to the Peel-Harvey estuary.

The following sections provide an explanation of the technical background needed to evaluate the above parameters and discusses an integrated model.

3.2 Technical Background

Phosphorus Retention

The concentration and hence the mass of P in a soil solution is controlled by a number of processes including:

- Adsorption-desorption;
- Plant uptake;
- Immobilisation-decomposition;
- Precipitation, and;
- Leaching.

The removal of P from the soil solution is controlled by a combination of adsorption and precipitation. As it is difficult to differentiate between the two processes, it is generally referred to as sorption (Allen & Jeffery, 1990).

The uptake and release of P by soils is best described by sorption-desorption reactions . The relationship between the amount of P sorbed and the concentration of P in the soil solution (desorbed) at equilibrium is referred to as the P adsorption isotherm. A knowledge of the P sorption isotherm characterises a soil in terms of the soil's P sorption capacity.

The Freundlich isotherm is the relationship which best describes the P sorption-desorption characteristics of Western Australian sandy soils. The most widely used mathematical function used to describe this isotherm is the Barrow-Shaw equation (WAWA, 1992):

$$C_s = A \times C_m^{\,b1} \times T^{b2}$$

Where:
C_s = P sorbed to soil (mg/kg)
C_m = equilibrium concentration of P (mg/L)
$A, b1$ = coefficients determined from short term isotherm tests
$b2$ = long term adsorption coefficient (typically range: 0.1-0.35)

The Barrow-Shaw equation is valid only for virgin soil profiles which can be determined through analysis of the phosphorus retention index (PRI) and bicarbonate extractable phosphorus (Bic-P) of a profile at predetermined sampling depths.

A typical virgin profile will exhibit low (<2 mg/L) Bic-P results. In contrast, a soil which has a history of P application will have low or negative PRIs and high Bic-P results.

Large amounts of P are sorbed onto organic particulate matter typically contained in the top horizons of sandy soil profiles. McPharlin *et al* (1990) noted that up to 100% of applied P was retained in the top 100 cm of a Spearwood sand profile after five years of vegetable cropping. Total applied P on to these profiles ranged from 708-1266 kg/ha with annual application rates typically ranging from 130-350 kg/ha.

It is however not possible to predict or model the long term P sorption characteristics of top horizons using the Barrow-Shaw (or equivalent) equation as historical P application (natural or "artificial") has meant that these soils can no longer be classified as virgin. The amount of P sorbed can however be calculated from PRI and Bic-P results taken from samples of top soils that have historically been subjected to high P application rates (Jeffery, pers. comm.).

3.3 Soil Investigations

As the previous section highlights, a number of parameters and laboratory analyses are needed to evaluate soil P sorption, particularly in terms of historical P application and the effects this has on the short and long term P sorption characteristics. It was therefore necessary to conduct a comprehensive investigation of the soil profiles at the Point Grey site prior to the formulation of a suitable model to predict the discharge of P as a result of long term P application.

The soil investigation strategy consisted of the following elements:

1. *Initial Site Evaluation*

2. *Soil Profile Investigation*

3. *Sampling and Analytical Investigation*

Each element of the soil investigation strategy is discussed in the following section.

3.3.1 Initial Site Evaluation

Soil investigations were conductedto characterise the occurrence and extent of the dominant soil profiles and to gain a broad understanding of their P retention capabilities and history of P application.

During this phase of the investigation 9 test holes were excavated using a handauger. Fourteen soil samples were collected of representative horizons and analysed for PRI and Bic-P. The results of the analyses are shown in Table 1.

The soil samples in Table 1 are grouped in terms of colour and position in the horizon. PRIs of the Yellow Phase Spearwood Sand typically ranged from 10 ml/g at the surface increasing to 22 ml/g with depth. The Grey sand profile had low PRIs at the surface with one PRI of 40 ml/g at a depth of 1m (PS8-4). Most sites showed very low Bic-P levels with one site (PS6) showing evidence of P accumulation, with a Bic-P of 120 mg/L at the surface (PS6-1) and 10 mg/L deeper down (0.6m) the profile at PS6-2.

Table 1

Initial Investigation

PRI and Bic-P Analyses of Representative Soils

Sample ID	Analysis		Soil Type
	PRI (ml/g)	Bic-P (mg/kg)	
PS4-1	9.4	5	Yellow Medium/
PS5-1	14	5	Coarse Surface
PS6-1	11	120	Sand
PS7-1	<1	5	Grey Coarse
PS8-1	<1	5	Surface Sand
PS9-1	<1	5	
PS4-3	10	5	Yellow/Orange
PS4-4B	4.3	5	Fine/Medium
PS5-3	6.9	5	Sand
PS5-4	17	5	
PS6-2	22	10	
PS6-4	14	5	
PS8-4	40	5	Brown/Grey with Ferruginous Nodules

The main conclusion from this phase of the investigation was that the Yellow Phase Spearwood Sands displayed a fair P adsorption capacity and showed an increase of PRIs with depth. Only one site investigated showed evidence of historical P application but this did extend beyond 0.6m.

As the main elements of the proposed development will to occur in elevated areas, generally associated with the occurrence of Yellow Phase Spearwood Sands, it was necessary to initiate a second phase of soil investigations to further define this soil association particularly in terms of the nature and extent of limestone outcropping, a common feature of Yellow Phase Spearwood Sands. This element of the soil investigation is discussed in the following section

3.3.2 Soil Profile Investigation

The second phase of soil investigations comprised of excavation and description of soil profiles to a depth of 3-3.5m at 33 sites. Each soil profile was described in terms of the composition, colour and depth of occurrence of each horizon. For reasons outlined above, all sites were located in Yellow Spearwood Sands. A number of these sites were adjacent major limestone outcrops.

Table 2 shows an example of the typical Yellow Phase Spearwood Sand profile encountered as a result of this investigation. The dominant features of this profile were as follows:

- Brown organic top soil horizons to a depth of 500 mm.
- Uniform/gradational fine to medium yellow/orange sand to 3500 mm.
- No occurrence of groundwater, impermeable layers, or massive limestone.

The absence of massive limestone at depth indicates that no lateral spreading of limestone occurs adjacent outcrops or at any of the sites investigated.

3.3.3 Soil Sampling and Analytical Investigations

Four soil profiles (B, C, D and E) distributed throughout the site were sampled to a depth of approximately 2m, starting at 0.4m (below groundlevel) at 0.2m intervals and analysed for PRI and Bic-P.

Table 2

Typical Yellow Phase Spearwood Sand Profile

Depth (mm)	Description
0-100	Dark Brown Organic Medium Sand
100-200	Light Brown Organic Medium/Fine Sand
200-500	Pale Yellow/Orange Fine Sand
500-3500	Yellow/Orange Fine Sand

Based on the analyses of these results, short term isotherm tests were performed on bulked samples of low Bic-P soils showing a similar range of PRI to obtain typical *A* and *b1* coefficients. Tables 3 and 4 show the results of the PRI/Bic-P and isotherm tests respectively. The average *b1* coefficient of 0.34 obtained from the three bulked samples is in close agreement with results from tests done on similar soils (Jeffery, pers. comm.).

Storage Capacity of Top Soils

To determine the P storage capacity of the Point Grey top soils, 2 samples were taken from the top 50 cm at 6 locations distributed throughout the site and analysed for Bic-P and PRI. These results were then used to calculate the percentage saturation and capacity for additional storageof each sample. The results of the tests and subsequent calculations are shown in Tables 5.

The storage capacity was calculated using the averages of Bic-P and degree of saturation to represent an average capacity for additional storage for the entire site.

3.4 Conclusions

The Yellow Phase Spearwood Sands of Point Grey are distributed over approximately 80% of the site in higher (>3m AHD) areas. Results of previous investigations (Dames & Moore, 1987) indicate soil depths of the Yellow Phase Spearwood Sands ranging from 7m in the centre of the site feathering out to 3-5m on the edges where and Alluvial Estuarine deposits become the dominant soil profile. This investigation largely confirms this soil sequence and depths of soil profiles.

The main conclusions that can be drawn from the soil analyses are as follows:

- Representative soil profiles of the Yellow Spearwood Sands indicate a fair P retention capacity with average PRI values of 3.8 ml/g at 50 cm below surface increasing to 25 ml/g at a depth of 3-4 m.
- Storage capacity in the topsoil horizons ranged from 68 to 420 kg/ha depending on previous application rates.

Table 3

Selected Soil Horizons

Results of PRI and Bic-P Analyses

	Horizons							
	B		C		D		E	
Depth (cm)	PRI (ml/g)	Bic-P (mg/l)	PRI (ml/g)	Bic-P (mg/l)	PRI (ml/g)	Bic-P (mg/l)	PRI (ml/g)	Bic-P (mg/l)
40-60	2.6	18	43	2	14	2	3.4	8
60-80	3.8	<2	11	<2	8.5	2	5.0	2
80-100	3.5	2	9.5	<2	3.4	<2	5.9	<2
100-120	3.6	<2	11	<2	5.0	<2	10	<2
120-140	4.0	<2	9.5	<2	4.8	<2	27	<2
140-160	4.0	<2	9.8	<2	4.5	<2	25	2
160-180	4.8	<2	9.4	<2	20	2	23	<2
180-200	5.1	2	9.4	<2	26	2	16	<2

Note:

detection limit for Bic-P analysis is 2 mg/L

Table 4

Barrow-Shaw Coefficients of Selected Soil Profiles

Bulked Samples	**Mean PRI** (ml/g)	***A* coefficient**	***b1* coefficient**
B[1]	3.8	14	0.46
C[2]	9.5	35	0.31
E[3]	25	67	0.25

Notes:
1. 80-160 cm
2. 120-200 cm
3. 120-180 cm

Table 5

Results of Top Soil Analyses

Sample ID	Results and Calculations				
	PRI (ml/g)	Bic-P (ppm)	Saturation (%)	Capacity (ppm)	Storage Capacity (kg/ha)
S1-1	4.2	36	80	9	68
S1-2	6.7	29	54	25	188
S2-1	6.5	26	50	13	98
S2-2	11	20	29	49	368
S3-1	8.4	19	35	35	263
S3-2	20	7	<20	56	420
S4-1	3.4	18	57	16	120
S4-2	2.8	11	46	13	98
S5-1	8.0	7	<20	56	420
S5-2	9.4	4	<20	36	270
S6-1	6.4	20	41	29	218
S6-2	3.4	8	32	17	128
Average:	7.5[1]	17[1]	38[1,2]	28[1]	221[1]

Notes:

1. Errors due to rounding off.
2. Average calculated assuming 0.5 of detection limit (<20)

4.0 POINT GREY MODEL

4.1 Phosphorus Retention Model

Logically, the scenario through which P will be retained on and leached through the soil profile is as follows:

- Storage in the top 20-50 cm of topsoil until the storage capacity is reached.
- Leaching of P from the topsoil horizon into the underlying horizons at concentrations determined by landuse application rates and rainfall data and irrigation needs.
- Sorption of P on to the underlying soil profile until saturated.
- Loss of P through groundwater recharge and subsequent discharge to the Peel-Harvey Estuary.

The elements of the model used to evaluate this scenario were as follows:

- Using the average P storage capacity value, calculation of the time taken for the top 50 cm of soil to become exhausted at the various application rates.
- Calculation of the storage of P in the underlying virgin soil profile using the Barrow-Shaw equation applied to the the soil profile with the lowest measured average *A* coefficient (Profile B, Table 4) and assuming soil saturation occurs when total sorption equals twice the A coefficient. The *b1* coefficient was set at 0.34 in accordance with the results of the analytical investigations. Based on literature values obtained from tests performed on similar soils, a value of 0.1 was adopted for the *b2* coefficient (Jeffery, pers. comm.).

Following P saturation of the soil profiles underlying each landuse area, the P content of the groundwater recharge, based on the modelled recharge rates, was calculated. Groundwater recharge is discussed in the following section.

4.2 Groundwater Recharge Model

4.2.1 Introduction

Groundwater recharge rates were estimated from historical daily rainfall and pan evaportation data for the nearby town of Medina. These values were used as driving variables in the MACRO model (Jarvis, 1994). The MACRO model is a one dimensional, two domain (micropores and macropores) finite difference solute and water transport model. In one domain (micropore flow only) the water balance is calculated from a standard numerical solution of the Richards equation. Amongst the many output parameters the model allows the calculation of the groundwater recharge rate.

Average literature values of saturated hydraulic conductivity, diffusion pathlength, saturated and residual volumetric water contents estimated for Spearwood sands were used. The model allows the simulation of both perennial and annual crops and vegetation. The soil profile can be divided into one to fifteen layers. A ten-layer model was used which ensured an accurate representation of the water balance particularly near the soil surface.

4.2.2 Groundwater Recharge Rates

The irrigation rates were estimated for each major land use from details of the proposed areas, population and activity type provided by Roberts Day Group, the consultant land use planners for this development. The daily irrigation rates for each land use are presented in Table 6. They were added to the daily rainfall data for use with the MACRO model.

4.3 Phosphorus Application Rates

4.3.1 Landuses

Table 7 shows the P application rates associated with each proposed landuse. Area sizes were determined from the Outline Development Plan. Given that no P will be applied on Reserve/ Conservation landuse areas, the 312ha dedicated for this usage was omitted from the P retention modelling exercise.

Table 6

Application and Recharge Rates

Land Use	Irrigation Rate (mm/day)	Rainfall and Irrigation (mm/day)	Recharge Rate (mm/day)
Golf Course	3.5[1]	4.17	2.63
Public Open Space	1.8[1]	3.22	1.97
Residential/Golf Course Estate	1.8[1]	3.22	1.97
Tourist/Foreshore Village	1.8[1]	3.22	1.97
Rural Residential	2.0[1]	3.42	2.05
Effluent Disposal Area	2.4[2]	4.83	3.11
Conservation Areas	0	2.42	1.67

Notes:

1. Summer irrigation only
2. Continuous irrigation

Table 7

Phosphorus Application Rates

Landuse	**Area** (ha)	**Percentage of Total Area** (%)	**Phosphorus Application Rate** (kg/ha/annum)
Golf Course	90	7.7	20[1]
Residential/Golf Course Estate (7.1 houses/ha)	324	28	9[2]
Tourist andFacilities (4.8 houses/ha)	178	15	4[2]
Rural/Special Residential (1.0 house/ha)	203	17	4.0[2]
Effluent Disposal Area	65	4.3	13[3]
Conservation Areas	312	27	0

Notes:

1. Recommended maintenance application rate for golf course on similar soils (Bowman Bishaw Gorham, 1993)
2. Based on Gerritse *et al* (1991)
3. Based on 1 mg/l P and 200l/day/EP

5.0 RESULTS

5.1 Phosphorus Retention

Table 8 shows the results of the P modelling exercise. Exhaustion times of the P retention capacity in the top soil ranged from 11 to 55 years. Exhaustion timesof the underlying soil profile ranged from 160 to 420 years.

5.2 Phosphorus Discharge

The results of modelling determined that the soil profile underlying the effluent disposal area will become exhausted after 160 years. Given that P will move as a sharp front through the soil profile (WAWA, 1992), it is assumed that no P prior to exhaution (ie 160 years) will discharge from the site.

Table 8

Exhaustion Times

Landuse	Phosphorus Application Rate (kg/ha/annum)	Storage Capacity (20-50 cm) (years)	Storage Capacity (50-700 cm) (years)	Total (years)
Golf Course	20	11	200	211
Residential/Golf Course Estate	9	24	374	398
Tourist Facilities	4	55	365	420
Rural/Special Residential	5	44	310	354
Effluent Disposal Area	13	17	143	160

Note: An average soil depth of 5m was used for effluent disposal area

6.0 DISCUSSION AND CONCLUSIONS

6.1 Model Sensitivy

A crucial factor in determining the quality of a model is an evaluation of its' sensitivity to the input parameters. Through modelling extreme values of input parameters and evaluation of range of results obtained, a judgement can be made as to the sensitivity of the model to each respective parameter.

The parameters, the extreme upper and lower values chosen to evaluate the model sensitivity and the subsequent results are contained in Table 10.

The results and conclusions are summarised as follows:

Soil Depth

At the extreme input values of 3 and 9m, exhaustion times increased approximately threefold. In view of the fact that sorption is directly proportional to the mass and hence depth of soil, this variation was to be expected.

The extensive soil excavation programme undertaken to classify the soil profile at Point Grey, in conjunction with previously published data (Dames & Moore, 1987) determine quite conclusively that the profile extends from at least 4.5m to an average of 7m. Although the model is sensitive to the soil depth, the input value of 7m applied to the majority of landuses (see Table 8) can be considered valid.

A Coefficient

The input *A* coefficients values, ranging from 12 to 67mg/kg, represent the total range of values obtained as a result of the soil sampling and analytical investigation. The resultant 5 to 6-fold increase in exhaustion times shows direct proportionality of the Barrow-Shaw equation to this input parameter.

Table 9

Model Sensitivity

SATURATION TIMES (yrs)	PARAMETERS									
	Soil Depth (m)		*A* Coefficient[1] (mg/kg)		b1 Coefficient[1]		b2 Coefficient		Saturation Factor	
	3[2]	9[3]	12[2]	67[3]	0.25[2]	0.46[3]	0.05[2]	0.35[3]	1[2]	3[3]
Golf.Course	80	219	136	713	171	174	127	863	91	253
Public Open Space	80	219	136	713	171	174	127	863	91	253
Residential and Golf Course Estate	146	398	248	1297	312	317	231	1569	166	461
Tourist and Foreshore Village	80	219	136	713	171	174	127	863	91	253
Rural Residential	402	1096	684	3567	858	874	636	4316	458	1268
Effluent Disposal Area	123	337	210	1097	264	269	195	1328	141	390

Notes:

1. Range determined from results of soil analyses.
2. Lower value
3. Upper value

The profile chosen (see Table 4, B horizon) for the purpose of modelling had the lowest measured PRIs and an average *A* coefficient of 14mg/kg. The average *A* coefficient of horizons B, C, D and E is 38, comparable to average literature values for Spearwood sands (Jeffery, pers. comm.). Using this average value, which would logically more closely represent the average of the entire site leads to a 2-3 fold increase in adsorption capacity and hence soil exhaustion times.

Therefore, the model, using the lower *A* coefficient value of 14mg/kg, underestimates the potential sorption capacity of the Point Grey soils by a factor of at least 2. In view of this, the *A* coefficient value is assumed valid.

b1 Coefficient

Using the upper and lower values of the *b1* coefficient had a minimal effect on the range of exhaustion times. The model can therefore be assumed to be insensitive to the *b1* coefficient values.

b2 Coefficient

A 6-fold increase in exhaustion times was produced using lower and upper *b2* values. The model was therefore sensitive to the input value of the *b2* coefficient.

Given the fact that the range of *b2* coefficients, based on results from experiments on similar soils, is reported to be between 0.1 and 0.35, the value (0.1) assumed for modelling the Point Grey soils represents the lowest sorption rate (Jeffery, pers. comm.).

The value of the *b2* coefficient used for this modelling exercise therefore represents a worst case scenario and on this basis is assumed valid.

Saturation Factor

The model was sensitive to the input values of the saturation factor with a 3-fold increase in exhaustion times. The value of 2 used in the model to represent exhaustion of the soil profile was chosen following expert advice based on results obtained after two years of field monitoring of P leaching on sandy soils (Jeffery, pers. comm.).

6.2 Conclusions

The P sorption characteristics of the Point Grey soils, based on a comprehensive soil survey and laboratory analyses, showed a capacity to retain applied P for a minimum of 160 years.

The input parameters used to model P retention either represented worst case scenarios or were based on results from scientific experiments on similar soils. Validation of the model confirmed the conservative values adopted for the parameters. In particular, the A coefficient value used was half the average of values obtained from the soil investigation and accepted literature values.

The model also assumed P application and irrigation rates at full occupancy which under the planned phasing of the development will will not be reached for a number of years.

In view of the above, soil P saturation of the Point Grey soils is most likely to occur well beyond the 160 years obtained as a result of the modelling exercise.

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APPENDIX D

ESTIMATES OF NITROGEN LOADS AND EXPORTS

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APPENDIX D:ESTIMATES OF NITROGEN EXPORT FROM POINT GREY

1.0 INTRODUCTION

Estimates of potential nitrogen export presented in the Environmental Review have been questioned in certain submissions. This paper reviews and refines the Environmental Review estimates and provides best and worst case estimates for nitrogen export potential based on the best and most recent of the available research findings for nitrogen application and export on Swan Coastal Plain sands. Particular emphasis is given to research reports relating to Spearwood Sand, recognising that this soil type forms the substrate for most but not all of the proposed development areas.

2.0 SOURCES OF NITROGEN APPLICATION

Four sources of nitrogen application may be identified from the ODP. These are :

- irrigation of treated wastewater to Eucalypt Woodlot,
- fertilisation of golf course
- fertilisation of domestic gardens
- fertilisation of public open space and active recreation areas.

3.0 ESTIMATES OF NITROGEN APPLICATION

3.1 Treated Effluent Irrigation to the Woodlot

The project engineers have estimated that at full development (ie in 15 to 30 years time), the potential population of 7,000 people will produce 1500m^3/day of effluent, which when treated will contain residual nitrogen at 5mg/L. Treated effluent will be disposed by irrigation to the Eucalptus woodlot.

The annual application of nitrogen to the woodlot is therefore calculated as,

1500m^3/day x 365 days x $5x10^{-3}$ kg/m^3 (kg/annum) = 2.7×10^3 kg/annum.

3.2 Golf Course Fertilisation

It is estimated that around 40 ha of the land allocated to golf course would comprise fairways under fertilisation and irrigation. An allowance for fertilisation of fairways at 200kg/ha/annum yields an estimate of 8×10^3 kg /annum.

Greens and tees are estimated to total 5,000m^2 which at the higher fertilisation rate of 560kg/ha/annum, yields an annual application of 280 kg/annum.

The total annual nitrogen application to the golf course is therefore estimated at 8.28×10^3 kg/annum.

3.3 Fertilisation of Domestic Gardens

Gerritse *et. al.*, (1991) reported mean annual nitrogen application of 80 kg/ha for sewered residential lots at density of 10 houses/ha, which was assumed to be transformable to an estimate of 8 kg/house/annum.

The ODP proposes a total of 1500 residential lots and a further 1500 "dwelling units" comprising a combination of tourist uses, special residential and special rural lots.

Recognising that tourist dwelling units form the vast majority (1260) of the additional 1500 units, and that these units will generally not have the same emphasis on domestic garden areas as normal residential lots, it is considered reasonable, indeed conservative, to use a figure of 8kg/house/annum of nitrogen application to all of these lots.

On this basis, the 3,000 residential dwelling units would apply a total of 24×10^{-3} kg/annum of nitrogen to the site.

3.4 Public Open Space and Active Recreation Areas

Figures presented here incorporate refinements to the estimates provided in the Environmental Review by further breakdown of land uses based on the ODP.

The ODP incorporates a District Recreation Centre of around 20ha. Gerritse *et. al.*, (1988) found rates of 200kg/ha/annum of nitrogen were applied to areas of irrigated turf by local authority parks and garden maintenance, yielding an estimate of 4,000 kg/annum nitrogen application to the District Recreation Centre.

The ODP provides for traditional neighbourhood village of 220 ha, of which 10% (ie 22ha) will likely be set aside for public open space. If it assumed that half of this POS was managed as irrigated turf, then total annual nitrogen application would be 11ha x 200kg/ha = 2,200 kg/annum.

Gerritse *et. al.*, (1988) also provide a figure of 30 to 40 kg/ha/annum for broadacre grasslands in areas maintained by shires. If the balance of the POS was assumed to be managed as broadacre grasslands, an additional 11ha x 40kg/annum – 440kg/annum of nitrogen application may be estimated for these areas.

The ODP allows for residential tourist areas including waterside tourist, marina precinct, harbourside village and golf course tourist areas totalling 233 ha. The project planners have advised that 5% of the land area of these areas may be required to be set aside as POS, yielding a further 12 ha of POS. If as previously assumed, half of this POS is assumed to be managed as irrigated turf and the balance as broadacre grassland, a further element of nitrogen application may be calculated as follows,

- 6 ha irrigated turf = 6 ha x 200 kg/annum = 1200 kg/annum
- 6 ha broadacre grassland = 6 ha x 40 kg/annum = 240 kg/annum.

In summary, the total nitrogen application in residential dwelling areas may be estimated as 8,080 kg/annum. (NB this represents a small increase of around 1080kg.annum from the estimate presented in the ODP).

3.5 Summary of Nitrogen Application

The total nitrogen application estimate for the site at full development is therefore calculated as,

*	Treated Effluent Irrigation	2,700 kg/annum
*	Golf Course Fertilisation	8,280 kg/annum
*	Domestic Gardens	24,000 kg/annum
*	POS and Active Recreation	8,080 kg/annum
	Total Estimate	43,060 kg/annum

4.0 ESTIMATE OF POTENTIAL NITROGEN EXPORT

The site in it's present condition, and following development will not have any direct surface water exports. Therefore the only export mechanism for nutrients (including nitrogen), from the site is through soil leaching to the superficial aquifer and groundwater discharge to the adjacent estuary.

The model used for nitrogen export estimation applies a variety of methods drawn from the published literature to determine the proportion of applied nitrogen which may leach into the unconfined aquifer, then applies the conservative estimates that all leached nitrogen does in fact reach the watertable (ie there is zero allowance made for denitrification during soil percolation, and aquifer flow).

Further conservatism is incorporated in the model by assuming that all nitrogen which may reach the unconfined aquifer will enter the estuary, thus there is no allowance for the uptake of nitrogen by fringing vegetation, or for the time delay of up to 100 years which represents the length of time required for groundwater to flow from the site to the point of discharge in the estuary.

4.1 Treated Effluent Irrigation

Gerritse *et. al.*, (1990) reported findings of Kolenbrander (1972) that nitrogen is very efficiently taken up in the root zone and possibly less than 10% of applied nitrogen leaches to groundwater if lawn clippings and tree loppings are exported.

For the woodlot, the intention of management is indeed to harvest the trees for sale, and thus export from the site is expected. The irrigation method will likely involve dripper irrigation of individual trees and therefore efficient uptake by the root zone is reasonable to expect.

Therefore, in the absence of more specific published research findings, the maximum proportion of applied nitrogen which could leach to the unconfined aquifer is estimated at 10 %. This proportion yields an export estimate of 270 kg/annum from the woodlot.

A further range of export estimates may be made by reference to advice from CALM Sharefarms. Their correspondence dated 5/6/96 (copy attached), advised that 36 to 62 kg/ha/annum of nitrogen would be required to support the growth of a bluegum plantation established at Point Grey.

Over the 65 ha area anticipated for the woodlot at full development, this equates to a requirement for 2340 kg to 4030 kg of nitrogen to be supplied each year to support tree growth.

On this basis, the supply of 2,700 kg/annum of nitrogen in the form of treated effluent could yield either full uptake of applied nitrogen, (if requirement for tree growth is 4030 kg/annum), ie zero discharge, to a surplus of 360 kg/annum (if uptake is 2340 kg/annum).

Recognising that the CALM advice is more specific than the figures of Kolenbrander (1972) noted by Gerritse *et. al.,* (1990), the best and worst case nitrogen export rates proposed for the woodlot are:

* maximum expected export 360 kg/annum
* minimum expected export zero.

It is further noted that when full development is reached, there will be sufficient volume of treated effluent to irrigate the proposed golf course, and under these circumstances, the export potential of the woodlot will also be zero.

4.2 Golf Course Irrigation and Fertilisation.

Sharma *et. al.,* .(1996) conducted research on the amount of applied nitrogen (in the form of fertiliser) that could pass through the root zone of irrigated lawn on Spearwood sand. The research was based on the analysis of leachates which were collected by a lysometers about 1m below the ground surfaces.

Sharma *et. al.,* (1996) estimated that turf is fertilised at an average rate of 210 kb/N/ha/annum. On the basis of this work, yield estimates were presented ranging between 2.4 to 7.8 kg N/ha/annum for nitrogen transmission below the root zone ie 1.1% to 3.7% of applied nitrogen.

If these yield estimates are utilized to estimate export of nitrogen from the irrigated golf course fairways, green and tees the following maximum and minimum annual export quantities may be derived;

* maximum potential N export 8280 kg/annum x 3.7% = 306 kg N/annum
* minimum potential N export 8280 kg/annum x 1.1% = 91 kg N/annum

4.3 Domestic Gardens

Sharma *et. al.,* (1996) also provide the best reference to estimate potential N export from domestic gardens.

Using the range of export proportions identified by the Sharma *et. al.,* (1996) data, the following range of potential nitrogen export may be derived,

- maximum potential export is 24,000 kg/annum x 3.7% = 888 kg/N/annum
- minimum potential export is 24,000kg x 1.1% = 264 kg/N/annum.

4.4 Public open Space and Active Recreation Areas

Similar to the estimates for domestic garden export, application of the Sharma et al (1996) findings to the 8,080kg/annum of N which is expected to be applied for the maintenance of POS and active recreation areas, yields the following range ;

- maximum potential export is 8080 kg/annum x 3.7% = 299 kg/N/.annum
- minimum potential export is 8080 kg/annum x 1.1% = 89 kg/N/annum

4.5 Summary of Potential Export Quantities

The estimates set out above may be summarised as follows,

* maximum potential N export estimate 1853 kg/annum
* minimum potential N export estimate 444kg/annum

These refined figures are lower than the conservative estimates presented in the Environmental Review (1700 kg/annum to 4300 kg/annum) and demonstrate that the conclusions made in the Environmental Review are conservative and realistic.

Recognising that the Southern Metropolitan Waters Study found that between 450 and 900 tonnes N/annum were estimated to discharge from the Peel Harvey inlet to the adjacent ocean waters, it is reasonable to conclude that the export of nitrogen from Point

Grey to southern metropolitan waters will not be environmentally significant, and would represent between 0.04% and 0.4% of estimated current outflow.

4.6 Effect of Removing Blue Lupin Crop

As a final note it is worth noting that the site currently supports areas cropped with Blue Lupin, which are a nitrogen fixing plant grown for soil nitrogen enrichment and stock fodder. In any particular year the site may contain up to around 100 ha of Blue Lupin crop. We are advised by agricultural researchers at CSIRO that there is no specific research data in regard to nitrogen fixation and soil accumulation processes for Blue Lupins. However, recent work by Dr Ian Fillery on White Lupins west of Moora suggest that atmospheric nitrogen transfer to the deep soil profile by this plant is significant as a result of the following processes and factors,

- accumulation of root system biomass,
- decay of this biomass following seasonal senescence of the crop, and
- inefficient re-use of accumulated soil N by the subsequent seasons crop : grain lupin is known to be an inefficient user of soil nitrogen.

If Blue Lupin is similar to White Lupin in this regard, it is possible that 30 to 50 kg/ha/annum of leachable organic nitrogen may be lost to the water table by the sequence of processes comprising nitrogen fixation, deep root penetration and decay and natural rainfall recharge and associated leaching.

Over a 100 ha crop area this process could account for 3,000 to 5,000 kg/ha/annum of N transfer from the atmosphere to the soil/groundwater system. This compares to the 1700 to 3400 kg/annum estimate derived above, for potentially leachable nitrogen which would be introduced to the site following full development in accordance with the ODP.

The change of land use from agriculture will remove the annual lupin crop. This process in fact represents a balancing factor in the assessment of nitrogen export in that these figures suggest the export of nitrogen from the site may actually fall when the proposed new land uses are implemented.

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