Integrated water supply and wastewater treatment system - Rottnest Island

Rottnest Island Authority

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 598
Assessment No 236
November 1991

THE PURPOSE OF THIS REPORT

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

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

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

APPEALS

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

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

ADDRESS

Hon Minister for the Environment

18th Floor, Allendale Square

77 St George's Terrace

PERTH WA 6000

CLOSING DATE

Your appeal (with the $10 fee) must reach the Minister's office no later than 5.00pm on 13 December 1991.

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Summary and recommendations

Development of an integrated water supply and wastewater treatment system on Rottnest Island was promoted in the 1985 Rottnest Island Management Plan. The Rottnest Island Authority has now developed the concept to the point of detailed environmental and financial evaluation.

Following referral of the proposal by the Rottnest Island Authority, the Environmental Protection Authority considered that the proposal, which involves the replacement of the current dual quality water supply with a single freshwater supply, construction of a new wastewater treatment facility and closure of existing facilities, and the reuse of the treated effluent within an irrigated reafforestation project, should be subject to formal and public assessment. A Public Environmental Review was prepared and subsequently released for comment.

The Authority considered that protection of the ecosystems on the Island, especially the lake system, was of primary importance. The following major issues were also important in this assessment:

- the sustainability of the Wadjemup Hill groundwater mound under an increased abstraction regime;
- the suitability of the wastewater treatment site; and
- the opportunities and environmental constraints associated with wastewater effluent disposal.

In broad terms, these were also reflected in public submissions.

The prime consideration of the Authority was to ensure that the proposal would not lead to any unacceptable environmental impacts and, as suggested by the Rottnest Island Authority, some positive environmental benefits were obtainable. In particular, the Environmental Protection Authority considered that the salt lakes and remaining fresh water swamps and seeps are of fundamental importance to the natural ecology as well as the scientific, educational and recreational value of the Island. Any changes of land use or management on the Island which could adversely affect these values would be unacceptable from the environmental viewpoint.

Current wastewater treatment and disposal is considered by the Rottnest Island Authority to be inadequate and unacceptable. The Environmental Protection Authority strongly supports the closure of the marine outfall into Fay's Bay as soon as practicable, and agrees that the primary treatment plant located near the Basin is inadequate. The change to a single class water supply will greatly assist the better treatment of wastewater by enhancing natural breakdown processes.

The change to a potable water supply has been examined from the view of ensuring that the Wadjemup Hill groundwater mound can have additional abstraction whilst maintaining the significant environmental function provided by the fresh water seeps and swamps. These support much of the fauna of the Island, including quokkas and waterbirds, and must be protected. The Authority considers that progressive, incremental implementation of increased groundwater abstraction can be undertaken, with monitoring to ensure that it is not adversely affecting those ecosystems reliant of the on freshwater seeps and swamps.

Additional freshwater supplies are proposed to be drawn from desalinisation of water from a bore into the Yarragadee Formation. Provided appropriate environmental protection controls are applied, the drilling of the bore should not cause any environmental problems. In addition, desalination of the water would be acceptable. Early implementation of this part of the proposals is encouraged by the Authority.

As the existing wastewater treatment and disposal facilities on Rottnest are environmentally unacceptable, there is a requirement to replace them as soon as practical. The Rottnest Island Authority has evaluated alternate sites on the basis of environmental, engineering and economic consequences and selected a site (Site 2 in the Public Environmental Review), to the south west of the airfield. The EPA supports the selection of this site.

The Rottnest Island Authority has proposed that treated effluent from the wastewater plant would be irrigated nearby onto reafforested land. Some of this area would be located within the groundwater catchment of Serpentine and Government House Lakes. Based on samples from Rottnest Island, it is expected that the soils at the irrigation sites would not prevent the movement of nutrients in the effluent into the groundwater, and hence towards the lakes. In view of the EPA's stated objective of protection of the lakes, this possibility has led to the conclusion that the irrigation proposal near Site 2 is environmentally unacceptable.

The EPA agrees that wastewater treatment needs to be improved and the resulting effluent needs to be disposed of somehow. Following initial discussions with the Water Authority, two options appear to be available. The preferred option, if appropriate sites can be agreed, would be irrigation of treated effluent west of Narrow Neck. However, if this could not be used, there may be need to consider a marine outfall, possibly from near Phillip Point. These require additional consideration by the EPA.

An important part of the proposal is the implementation of an effective water conservation programme. This is essential to minimise the use of and wastage of valuable and limited freshwater. If water minimisation strategies are not effective, the Rottnest Island Authority may need to consider restricting the number of visitors to the Island.

This proposal provides the opportunity to improve some facilities that are no longer acceptable. At the same time, considerable care is needed in implementation, particularly increased groundwater abstraction and effluent disposal, because of the high environmental value of Rottnest Island.

Recommendation 1

The Environmental Protection Authority has concluded that the proposal to develop an integrated water supply and wastewater treatment system based on potable water, as modified during the process of interaction between the proponent, the Environmental Protection Authority, the public and the government agencies consulted, is environmentally acceptable. However, the Environmental Protection Authority has also concluded that the proposal to irrigate treated effluent near the proposed wastewater treatment plant is environmentally unacceptable. Another irrigation site or disposal option for the effluent is required.

In reaching these conclusions, the Authority identified the protection of the Island's lakes as the main environmental factor and other environmental issues requiring detailed consideration as:

- **the sustainability of the Wadjemup Hill groundwater mound;**
- **the suitability of the wastewater treatment site; and**
- **methods of effluent wastewater disposal.**

The Environmental Protection Authority considers that these environmental factors have been addressed adequately by environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations given in this report.

Accordingly, the Environmental Protection Authority recommends that the proposal could proceed subject to the Environmental Protection Authority's recommendations in this report, and subject to the proponent's commitments to environmental management as detailed in Appendix 1 of this report.

Recommendation 2

The Environmental Protection Authority recommends that:

- groundwater abstraction from the Wadjemup Hill groundwater mound could be progressively increased to a maximum of 120,000 cubic metres per annum;
- the current monitoring programme for the level and quality of the groundwater mound should continue to be implemented and reviewed to ensure its effectiveness;
- implementation of Recommendation 6.4 (monitoring of swamps and freshwater seeps) of the Rottnest Island Management Plan should occur, with the objective of ensuring the conservation and protection of the remaining freshwater swamps (eg, Barker Swamp) and seeps;
- should monitoring demonstrate any reduction in freshwater flow or quality as a consequence of groundwater abstraction, the level of abstraction from appropriate bores should be modified to return flow and quality to current levels; and
- a contingency plan should be prepared to ameliorate the impact on fauna of any short term reduction in available natural freshwater caused by implementation of this proposal.

Recommendation 3

The Environmental Protection Authority recommends that:

- drilling of a bore into the Yarragadee Formation, provided that it incorporates protection measures that normally apply in environmentally sensitive locations, and
- subsequent desalination of the bore water, with offshore bitterns disposal,

are environmentally acceptable and could proceed as a priority.

Recommendation 4

The Environmental Protection Authority recommends that effluent from the wastewater treatment plant should not be disposed of within the surface or groundwater catchment of the salt lakes of Rottnest Island.

Recommendation 5

The Environmental Protection Authority recommends that the Rottnest Island Authority should investigate treated effluent disposal options including irrigation of a reafforestation area west of Narrow Neck or an marine outfall from the vicinity of Phillip Point, and that a preferred option should be referred to the Environmental Protection Authority for environmental assessment.

1. Introduction

Rottnest Island currently has a dual quality water supply to accommodation units and several wastewater treatment and disposal facilities. The existing wastewater disposal system, involving discharge of raw sewage from Point Clune and primary treatment and seepage into sand near the Basin, is regarded as environmentally unacceptable and has been recommended in the Rottnest Island Management plan to cease as soon as practical. The Rottnest Island Authority considers that both of these systems need to be significantly upgraded, with a view to improving the current standard of reticulated water quality and also effluent treatment.

The Environmental Protection Authority considered that these related changes were environmentally significant and required the preparation of a Public Environmental Review (PER). This document was released for public comment for eight weeks, until 3 April 1991.

Following the receipt of the proponent's response to the issues raised during the submission period, the EPA indicated to the Rottnest Island Authority that other options with regard to treated wastewater disposal would need to be further investigated. In view of this and the project timetable, the EPA suggested that it report on the deep bore and associated desalination plant prior to completing its review of the remainder of the proposal. Although some initial investigations were undertaken and some early advice was provided to the EPA, the Rottnest Island Authority subsequently advised the EPA in October 1991 that it considered that the whole project should be reviewed and reported on together.

2. The proposal

As a continuation of the implementation of the Rottnest Island Management Plan, the Rottnest Island Authority proposes to substantially change the existing water supply and also wastewater disposal systems currently in operation on Rottnest Island.

As outlined in the PER, the proposal involves the following water management components:

- To provide a single potable standard water supply to each dwelling;
- To provide additional potable water by expanding the Wadjemup Hill borefield and desalinisation of bore water;
- To implement a water consumption awareness programme;
- To construct a wastewater treatment facility south of the airport to treat domestic effluent collected from the Geordie-Longreach and Thomson Bay settlements; and
- To dispose of the treated wastewater by irrigation on revegetated land near Barnett's Gully.

The existing fresh and separate brackish water supply on the Island is based on bores abstracting fresh water from the superficial aquifer located beneath Wadjemup Hill, in the centre of the Island, two bitumen catchments near Geordie-Longreach settlement collecting rainwater, and brackish quality water pumped by shallow bores within the Thomson Bay and Geordie-Longreach settlements. Approved abstraction from the Wadjemup Hill groundwater mound is 96,000 cubic metres per annum. Fresh water is supplied to kitchen and bathroom sinks while brackish water goes to showers, toilets and outside taps. Approximately 150,000 cubic metres per annum of water is used on the Island. Current sources and their supply capacity is presented in Table 1.

This dual quality system would be replaced with a single fresh water supply provided by a combination of the current surface catchment area near Geordie-Longreach, expansion of the groundwater bore network to draw up to 120,000 cubic metres per year and a deep bore into the Yarragadee aquifer, with this water source possibly requiring desalination. This deep bore, which would be located near Kingstown, would supply water above that available from the surface catchments and Wadjemup Hill groundwater mound. The proposed supplies from these sources is outlined in Table 2.

Table 1 Current dual quality water supply

source	nominal supply
Fresh water	
• Wadjemup Hill	40,000 cubic metres per annum
• Longreach surface catchment	30,000 cubic metres per annum
Brackish water	
• Settlements brackish bores	80,000 cubic metres per annum

Table 2 Proposed fresh water supply

source	nominal supply
Wadjemup Hill	120,000 cubic metres per annum
Longreach surface catchment	30,000 cubic metres per annum
Yarragadee bore	30,000 cubic metres per annum

Wastewater treatment is currently based on direct marine discharge of untreated sewerage from Longreach and Geordie Bay settlements at Point Clune, and primary treatment then infiltration pond disposal near the Basin for the Thomson Bay settlement. With the adoption of a single class water supply, these systems would be progressively replaced by a new centralised aerated lagoon-based wastewater facility identified as Site 2 in the PER and located about 1.5 kilometres south south west of the Thomson Bay settlement. This site, and others related to this proposal, are shown in Figure 1. Treated effluent would be pumped to reafforestation area located to the south west of this plant. No treated effluent is intended to be reused within the existing developed portion of the island.

3. Public review

During the public review period a total of 15 submissions were received by the Environmental Protection Authority. These comprised 13 submissions from the public and community groups and another 2 from government agencies.

The principal issues raised in the submissions were as follows:

- Environmental capacity of the Island to accept more visitors.
- Justification for a single class water supply seems based solely on economic considerations.
- Not all of the water supply options (eg. pipeline from the mainland) have been adequately considered.
- Not all of the wastewater treatment options (eg. vacuum collection, chemical toilets) have been adequately considered.
- The superficial aquifer in the Wadjemup Hill groundwater mound is limited.
- Increased abstraction from the superficial aquifer will adversely affect seeps and springs fed by the Wadjemup Hill groundwater mound.
- Increased abstraction will lead to rising salinity levels in the Wadjemup Hill groundwater mound.
- The development of the Wadjemup Hill groundwater mound should only be in stages.
- The wastewater treatment plant and the effluent disposal area is located too close to the lakes.
- The wastewater should be tertiary treated to remove nutrients.

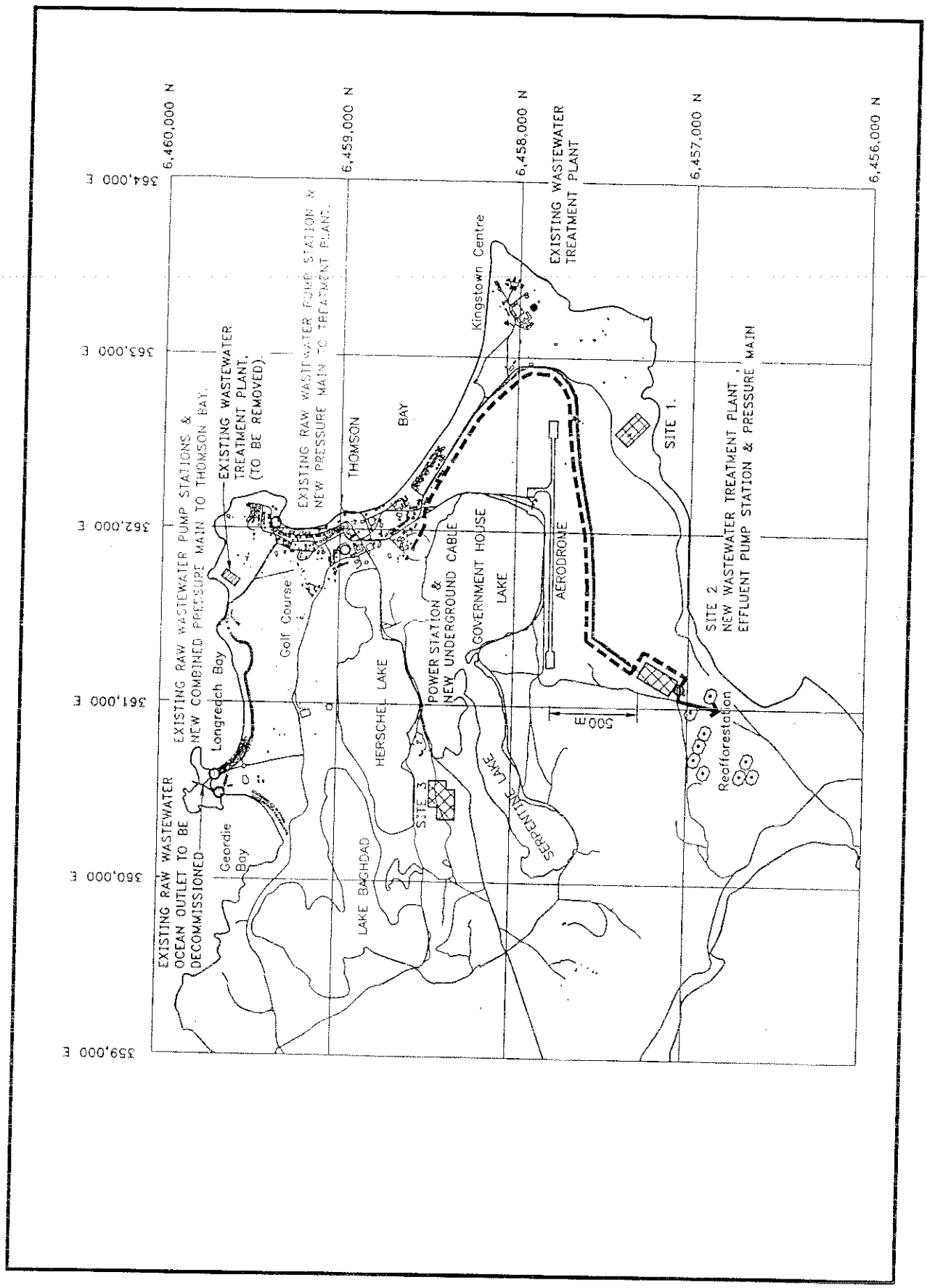

Figure 1. Major elements of the proposed water supply and wastewater treatment system

- The wastewater treatment plant will lead to the destruction of more vegetation.
- Disposal of wastewater treatment plant sludge needs to be addressed.
- The nature and effectiveness of the afforestation disposal proposal has not been defined.
- Groundwater flow is towards Government House and Serpentine Lakes.
- How will nutrient enriched groundwater be prevented from contaminating the lakes.
- Other options for effluent disposal, eg. the golf course or settlements, have not been adequately considered.
- Consideration of an ocean outfall should be made now.
- The monitoring programme needs to be more comprehensive and predictive.
- The deep bore and desalination proposal need detailed environmental assessment.
- Additional power requirements have not been considered.
- There should be no work until Aboriginal ancestral concerns have been cleared.
- An effective water conservation programme is essential to minimise water use.

A more detailed listing of all of the issues raised in submissions is presented in Appendix 2 while the detailed response prepared by the Rottnest Island Authority is presented as Appendix 3.

4. Environmental impacts and management

This proposal has been developed by the Rottnest Island Authority to address concerns related to the expectations of visitors to the Island about a potable water supply to accommodation units as well as overcoming what are considered to be inappropriate effluent disposal systems and present and future maintenance costs. At the same time, the Rottnest Island Authority has recognised the special environmental values of the Island and its selection of the preferred groundwater abstraction scheme and wastewater treatment site and disposal options have been guided to a large extent by those values.

The Authority has focussed on protection of the ecosystems on the Island, especially the lake system, and its consideration has three main aspects:

- the sustainability of the Wadjemup Hill groundwater mound under an increased abstraction regime;
- the suitability of the wastewater treatment site; and
- the opportunities and environmental constraints associated with wastewater effluent disposal.

There are clearly a number of important issues related to these three aspects, including the removal and rehabilitation of the existing effluent disposal and treatment facilities, management of the use of fresh water, location and management of works and operations associated with the proposed Yarragadee bore, performance of the proposed reafforestation programme as part of effluent disposal, and long term control of the use of wastewater effluent.

Following its review of all of the environmental issues associated with the proposal, and taking into account additional information provided by the Rottnest Island Authority and other agencies advising it, the Authority believes that there are significant environmental advantages to be gained by the redevelopment and proper treatment of wastewater on the Island but the proposed effluent disposal plan has potential environmental impacts that are unacceptable. With regard to the change to a single quality water supply, the Authority has no environmental objections to the deep bore and desalination of the raw water, but considers that increased abstraction from the Wadjemup Hill groundwater mound needs to be carefully monitored to ensure that the ecosystems that depend on that resource, particularly the Island fauna, are not adversely affected. If they are, the abstraction regime will need to be altered to mitigate such effects.

Recommendation 1

The Environmental Protection Authority has concluded that the proposal to develop an integrated water supply and wastewater treatment system, as modified during the process of interaction between the proponent, the Environmental Protection Authority, the public and government agencies that were consulted, is environmentally acceptable. However, the Environmental Protection Authority has also concluded that the proposal to irrigate effluent near the proposed wastewater treatment plant is environmentally unacceptable.

In reaching these conclusions, the Authority identified the main environmental factors requiring detailed consideration as:

- **the sustainability of the Wadjemup Hill groundwater mound;**
- **the suitability of the wastewater treatment site; and**
- **protection of the ecosystems on the Island, especially the lake system.**

The Environmental Protection Authority considers that these environmental factors have been addressed adequately by environmental management commitments given by the proponent, or by the Environmental Protection Authority's recommendations given in this report.

Accordingly, the Environmental Protection Authority recommends that the proposal could proceed subject to the Environmental Protection Authority's recommendations in this report, and subject to the proponent's commitments to environmental management as detailed in Appendix 1 of this report.

The Authority's experience is that it is common for details of a proposal to alter through the detailed design and construction phase. In many cases alterations are not environmentally significant or have positive effects on the environmental performance of the project. The Authority considers that such insubstantial changes should be provided for within the assessment process.

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

4.1 Single potable quality water supply

Rottnest Island's current water supply system is a combination of fresh water and brackish water. According to the PER, the reasons for changing this dual quality supply to a single fresh quality supply are:

- visitors desire a single high quality water supply;
- maintenance costs associated with operating a dual supply including the specific maintenance costs of the brackish supply are very high; and
- the dual water supply reduces wastewater treatment options.

The potable standard water is supplied from two sources, bitumen catchment and bores. The former has a nominal capacity of 30,000 cubic metres per annum, which will obviously vary with rainfall. The borefield into the superficial aquifer beneath Wadjemup Hill supplies the remainder of the 70,000 cubic metres per annum of freshwater presently used.

Expectations presented in the PER predict that the average number of visitors to the Island will increase by almost 20 per cent over the next 5 years, to 380,000 in 1994/95. This would lead to a rise in demand for water to 180,000 cubic metres per annum, necessitating an increase in current supplies. This rise is incorporated within the proposal contained in the PER. There are,

therefore, two components to the water supply proposal, the first being to provide for increased water demand, and the second being to replace the brackish water with fresh water.

4.1.1 Water demand

As outlined in Section 4.3.1 of the PER, recent reviews of the capacity of the freshwater aquifers near Wadjemup Hill have lead to several significant increases in the predicted safe yield obtainable from that source. The approved draw from this source was increased from 49,500 cubic metres per annum to 96,000 cubic metres per annum in 1990. This is more than sufficient to cope with the projected increase in demand from the additional 60,000 people each year.

The envisaged growth in visitor numbers to the Island reflected in the PER was a major point raised in public submissions. Of concern was the desirability of an increase in the total number of visitors and their effect on the quality and character of the Island. In itself, this proposal does not promote an increase in visitors to the Island. Rather, it anticipates and provides for their water requirements. However, it does remove one of the aspects of the Island that has been often criticised, its dual quality water supply, and this may encourage some people who were previously deterred.

This issue is addressed by the Rottnest Island Authority in Section 1.2 of its response to submissions (Appendix 3) to this report

The Environmental Protection Authority has assessed the proposal to supply sufficient water for an annual visitor population of 380,000 on the basis of the anticipated environmental impact related to water supply and wastewater disposal. Whether this number of visitors is desirable has not been addressed by the Environmental Protection Authority. However, the Authority notes the environmental protection and management objectives that are in place for the Island through the Rottnest Island Management Plan.

The Authority addresses the important issue of water conservation in Section 4.3 of this report.

4.1.2 Water supply options

The supply of water to Rottnest Island has been an important issue for many decades. The Rottnest Island Management Plan and the PER provide some background to this. As noted in submissions and reflected in the proposal, water supply is a natural constraint to activity on the Island.

The PER outlines five potential sources of fresh water to the Island. These are groundwater, surfaced catchment, desalination or importation from the mainland by either pipeline or barge. A sixth, that of demand management, is also mentioned in the PER, but mainly as part of a single class supply as it is already in place under the dual supply system.

Extensive economic, engineering and environmental consideration has been given to this range of options over the past decade and the Environmental Protection Authority is satisfied that the external water supply options only need to be considered should no environmentally acceptable supply be available on Rottnest Island.

The proposal does not include expansion of the area of surfaced catchment, mainly for environmental reasons. Some public submissions indicated a preference to increase the availability of water from this source. However, surfaced catchments are aesthetically intrusive and can be environmentally damaging and disruptive in sensitive environments. Rottnest is clearly such a place. Just to cater for increased water demand due to visitor growth, and implementing the approved level of abstraction from Wadjemup Hill aquifer, would mean that an additional area equivalent to the existing surfaced catchment (6.34 ha) would be needed. The Rottnest Island Authority considers that this option is not acceptable, even though it formed part of the water supply scheme suggested in the Rottnest Water Supply Scheme Review (WAWA 1989)

The two remaining options form the basis of the proposed water supply changes.

4.1.3 Water supply - Wadjemup Hill

The proposal includes an increase in the approved abstraction from the Wadjemup Hill groundwater mound from 96,000 cubic metres per annum to 120,000 cubic metres per annum. The present bore network of 11 production wells will be increased by progressively converting some of the 23 monitoring bores to production wells.

There are two groundwater mounds on Rottnest Island, the main one being located around Wadjemup Hill, while a smaller mound is near Oliver Hill. Extensive monitoring of the Wadjemup Hill groundwater mound has been occurring for many years. This data has been used to assist in quantifying the safe yield from the superficial aquifer and to manage individual wells in the borefield. It has been mainly as a consequence of the performance of the existing borefield that approval was given to increase the abstraction rate to a maximum of 96,000 cubic metres per annum, and a further increase to 120,000 cubic metres per annum is now proposed. This is still considered to be significantly less than the predicted long term safe yield of the wellfield, 190,000 cubic metres per annum.

As mentioned in the Rottnest Island Management Plan, these groundwater mounds supply freshwater to seeps located along some of the lakes, as well as to a number of swamps. Unfortunately most of these swamps have been quarried and are no longer as fresh.

The Rottnest Island Management Plan makes the following comments in relation to the value of these fresh water seeps and swamps.

> "Natural surface freshwater sources are very limited on the island, and consist of four ephemeral freshwater pools and several freshwater seeps which occur around the margins of the salt lakes.
>
> These freshwater sources are vital to the quokka, mountain duck and other waterbirds as water sources. They only exist as superficial expressions of the fresh groundwater lenses, which are perched over denser, saline water. The freshwater lenses are sensitive to salinisation through poor management of groundwater extraction, and local mixing of the salt and fresh groundwater layers has already occurred from marl mining of freshwater wetlands." (Rottnest Island Management Planning Group, p 36)

Barker Swamp, near Wadjemup Hill, has not been quarried and is the largest remaining fresh water swamp on the Island. It represents the only large, intact, seasonally freshwater swamp available for studies on the evolution, sedimentology, ecology and biology of Rottnest Island (Rottnest Island Management Planning Group, p 42). It is also an important freshwater source to fauna on the Island. Recommendations 6.2 and 6.4 of the Rottnest Island Management Plan called for the protection and the monitoring of the water levels and salinity of the swamps and freshwater seeps.

While the Environmental Protection Authority is confident that the 120,000 cubic metres per annum was recommended as a conservative limit based on aquifer performance and well distribution, there is concern that some of the environmental aspects, particularly those related to the continued availability of fresh groundwater to the freshwater seeps and swamps, was not taken into account. In its response to submissions, the Rottnest Island Authority has indicated that groundwater flow to Barker swamp will be reduced by increased abstraction from near the swamp. The effects, however, are not expected to be significantly deleterious and the effects should be monitored (Appendix 3).

Given their importance to the survival of quokkas and waterbirds on the Island, the Authority is of the view that the maintenance of these natural freshwater flows is essential. To ensure their protection, the Authority considers that implementation of the increased abstraction rate from 49,500 cubic metres per annum to 96,000 cubic metres per annum, and then to a maximum of 120,000 cubic metres per annum, should be subject to careful monitoring of fresh water flows and quality into Barker Swamp and the seeps along the margins of the lakes. Any deleterious change in freshwater quantity or quality of flow should lead to modified pumping from the wellfield to return the quality or quantity to the level that currently prevails.

In addition, the Rottnest Island Authority should develop, as part of its water resource management programme, contingency arrangements for the provision of freshwater to fauna on the Island where there is a diminution of natural supplies as a consequence of short term effects of this proposal. As much as possible, these supplies should be made available at sites which would normally by used and should not cause the character or quality of the site to significantly alter.

The Rottnest Island Management Plan recommends (Recommendation 10.68) that further development of the Wadjemup Hill groundwater mound should not exceed a rate of 2 or 3 new bores per year. This has previously been supported by the Environmental Protection Authority and should not only apply to the increase to 96,000 cubic metres per annum, but also expansion toward the maximum of 120,000 cubic metres per annum.

Recommendation 2

The Environmental Protection Authority recommends that:

- **groundwater abstraction from the Wadjemup Hill groundwater mound could be progressively increased to a maximum of 120,000 cubic metres per annum;**
- **the current monitoring programme for the level and quality of the groundwater mound should continue to be implemented and reviewed to ensure its effectiveness;**
- **implementation of Recommendation 6.4 (monitoring of swamps and freshwater seeps) of the Rottnest Island Management Plan should occur, with the objective of ensuring the conservation and protection of the remaining freshwater swamps (eg Barker Swamp) and seeps;**
- **should monitoring demonstrate any reduction in freshwater flow or quality as a consequence of groundwater abstraction, the level of abstraction from appropriate bores should be modified to return flow and quality to current levels; and**
- **a contingency plan should be prepared to ameliorate the impact on fauna of any short term reduction in available natural freshwater caused by implementation of this proposal.**

4.1.4 Water supply - Yarragadee Formation

Current water demand on Rottnest is approximately 150,000 cubic metres per annum. To meet the expected future demand as well as replacement of the brackish water supply, the Rottnest Island Water Supply Scheme Review estimated that a total of 180,000 cubic metres per annum will be required by 1994/95. If the Wadjemup Hill wellfield provides up to 120,000 cubic metres per annum and the surfaced catchment a maximum of 30,000 cubic metres per annum, the additional 30,000 cubic metres per annum will need to be supplied from elsewhere. An additional source would also be desirable should the available yield from the Wadjemup Hill groundwater mound be less than projected, either because of adverse water quality or altered pumping as a consequence of monitoring of the freshwater swamps and seeps. Likewise, this new source could be expected to compensate for any reduction in supply from the Longreach catchment. This additional source would also provide for any increase in water use resulting from the single class potable water supply.

The Rottnest Island Authority has proposed that a bore into the Yarragadee Formation would be drilled to a depth of up to 1,500 metres from a point east of Kingstown. The Water Authority has indicated that the drill site would occupy a cleared and prepared area of approximately 60 metres by 50 metres. In view of the depth of the well, provision would be made to deal with oil and/or gas encountered during drilling. This would involve installation of adequate blowout prevention equipment, casing of the well to a depth of 800 to 900 metres, and a standby supply

of suitable drilling mud. Inert drilling mud and cuttings would be disposed of at a site approved by the Rottnest Island Authority (possibly near the rubbish tip) while contaminated muds and cuttings would be taken to the mainland for disposal. The drill site would be cleaned up and holes filled at the completion of drilling.

The Environmental Protection Authority would expect that all necessary provisions for drilling to such a depth would be adhered to. The current intention of the Rottnest Island Authority is that drilling of the well would be placed out to tender, in which case it may be undertaken by private contractor or an oil drilling company. Rottnest Island is not within an Petroleum Exploration Permit.

While water quality, particularly salinity, in that confined aquifer is not known below Rottnest, it is expected that it may contain water at less than 10,000 mg/L Total Dissolved Solids (TDS). If this is the case, the proposal would then involve the desalination of this water by reverse osmosis. It is anticipated that such a plant would be located at the bore site and would require a building of about 60 square metres. Desalination plants generate a concentrated brine solution in the process which would have to be disposed of. The Water Authority anticipates that this brine effluent, which may be marginally higher in salinity than seawater would be disposed of at the Army Jetty. Along with a higher salinity, the brine effluent may also contain calcium, magnesium or iron concentrations, depending on the water from the bore. There may be circumstances where some of the calcium in the effluent may precipitate.

The Authority considers that development of this bore into the Yarragadee Formation and subsequent desalination of water from the bore can be undertaken without having adverse environmental impacts. The most significant environmental concerns occur at the time of drilling of the bore, due to the site disturbance and the possibility of the presence of oil and/or gas. The Environmental Protection Authority is confident that these concerns can be effectively minimised by ensuring that the area of the drill site is the minimum possible, the normal safeguards against blowout are in place, as would be required by the Mines Department, and the drill site is rehabilitated as a priority.

The quality of water in the Yarragadee Formation will determine whether it can contribute to Rottnest's water supply. If its salinity is too high, the next preferred position of the Rottnest Island Authority is to desalinate the brackish superficial aquifer beneath the Island. This has not been considered by the Environmental Protection Authority in this assessment. Any change in water levels resulting from either increased brackish water abstraction from existing bores or establishment of a new borefield may affect vegetation, nearby lakes and freshwater lenses on top of these aquifers. Such effects would need to be examined to determine whether they would be environmentally deleterious.

Recommendation 3

The Environmental Protection Authority recommends that:

- **drilling of a bore into the Yarragadee Formation, provided that it incorporates protection measures that normally apply in environmentally sensitive locations, and**
- **subsequent desalination of the bore water, with offshore bitterns disposal,**

are environmentally acceptable and could proceed as a priority.

4.2 Wastewater treatment

Wastewater from the Geordie-Longreach settlement, comprising raw sewage, is pumped directly into the sea at Fay's Bay, near Point Clune. This is regarded as environmentally unacceptable and has been identified in the Rottnest Island Management Plan and its recent mid-term review as a practice to be stopped as soon as practical.

Wastewater generated in the Thomson Bay settlement is pumped to a primary treatment plant and infiltration ponds located adjacent to Pinky Beach and the Basin. This is unsatisfactory in terms of odour problems generated from this plant.

Part of the difficulty associated with the poor performance of the primary treatment plant, and hence odour formation, is a consequence of the brackish feed water. The existing dual quality system inhibits the biological treatment and breakdown of the effluent. The PER indicates that a potable water supply would enable a more efficient wastewater treatment plant. The proposal would involve:

- construction of a new wastewater treatment plant;
- linking of the sewers at Geordie-Longreach and Thomson Bay to the treatment plant;
- removal of the existing treatment plant near the Basin and decommissioning of the Point Clune outfall; and
- disposal of treated effluent by irrigation into a reafforestation area near the treatment plant.

Following a review of suitable sites, the Rottnest Island Authority has proposed that the new wastewater treatment be located to the south of the airstrip. This plant would provide primary and secondary treatment in sealed ponds, and the effluent would then be irrigated into a tree plantation located nearby.

The Environmental Protection Authority agrees with the major rationale for this part of the proposal, that the current wastewater treatment and disposal facilities at the Geordie-Longreach and Thomson Bay settlements are environmentally unacceptable. The Rottnest Island Management Plan contained a series of recommendations pointing to the need to improve the operation of the existing primary treatment plant near the Basin in the short term, cessation of use of the Point Clune outfall as soon as practicable, and development of new upgraded wastewater treatment facilities (Rottnest Island Management Planning Group, p 135-137).

Apart from the treatment of the sewage on the Island, the only practical option would be to dispose of untreated effluent to sea by pipeline. This has been practiced previously at Rottnest. However, community expectations and environmental standards of today preclude that option as a long term solution.

4.2.1 Wastewater treatment plant sites

Three sites were identified as potential locations for the wastewater treatment plant. Two of these, Site 2 (to the south of the airstrip) and Site 3 (between Serpentine and Herschel Lakes) were closely evaluated, with the former having environmental and engineering advantages and the latter economic benefits. The Rottnest Island Authority decided on Site 2 as the preferred location. A new wastewater pressure main and underground power cable would be laid from Thomson settlement to Site 2 along existing roads and the old railway alignment to Oliver Hill.

According to the PER, Site 2 has the following environmental advantages:

- it is not adjacent to any lakes (about 750 metres away from Government House and Serpentine Lakes), which minimises any risk of seepage of effluent into the lakes;
- no settlements are located nearby and Thomson Bay is about 1.5 km away, sufficient to minimise the possibility of odour problems;
- the site is relatively close to proposed reafforestation areas;
- apart from the last 200 metres, all pipes and cables to the site will be buried along previously disturbed corridors;
- public access is currently restricted at and near the site, and the plant will therefore not be visually intrusive; and
- the pipeline route will enable the Kingstown Centre to be connected should its current septic tank system fail.

It is clear from this list of perceived advantages that Site 2 and the reasons mentioned in the PER against the other two possible sites that Site 2 has significant environmental preference. These natural locational advantages have been supported by commitments install impervious lining of all lagoons and filters at the plant, establish a groundwater monitoring bore network around the site and prevent fauna (especially birds and quokkas) from using the site (Appendix 1).

Issues of major interest to the Authority with regard to the siting of the treatment plant were odour, potential for contamination of groundwater and the lakes and standard of effluent from the plant. Minimisation of the potential for the spread of disease by fauna using the site is also important.

The Authority is satisfied that the Rottnest Island Authority and the Water Authority have selected the preferred site to ensure that adverse environmental impacts are unlikely. Although the site is located within an area that has been replanted, some additional screening of the plant may need to be undertaken as the site is visible from the Oliver Hill lookout. Existing treed areas should reduce the visibility of the plant from roads.

The plant's design is consistent with current Water Authority criteria. Table 3 outlines the design standards for the treated effluent.

Table 3 Expected wastewater treatment plant effluent characteristics

parameter	effluent quality	
Volume	160,000 cubic metres per annum	(400-800m^3/day)
Nitrogen	7,000 kg per annum	(40 mg/L)
Phosphorus	2,600 kg per annum	(15 mg/L)
Bacteria	10,000-100,000 faecal coliform per 100 mL	
Salinity	400-800mg/L	

The wastewater treatment plant and effluent disposal will require works approval and licencing under the Environmental Protection Act.

It is proposed that the current practice of using sludges from the wastewater treatment plant as a soil conditioner within the settlements would continue for the new treatment plant.

4.2.2 Wastewater treatment plant effluent disposal

Treated effluent from the wastewater treatment plant is proposed to be disposed by irrigation to tree plantation located nearby. As outlined in the PER, the effluent would be pumped to a reafforestation area of 50 - 70ha at Barnett's Gully. Vegetation which naturally occurs on the Island would be selected on the basis of their ability to supply wood for fuel. These are likely to be the Rottnest Island Pine (Callitris preissii), Acacia species (eg. Acacia rostellifera) and Melaleuca species (eg. Melaleuca lanceolata).

The nominated effluent disposal area has calcareous sands over limestones of more than 1 metre and often more than 3 metres (McArthur & Associates, p 13). Barnett's Gully itself is a large sand blowout, and has considerable depth of calcareous sand. The Rottnest Island Authority's consultant (McArthur & Associates) concluded that there is a large area of land in the vicinity of Barnett's Gully which has sufficient soil depth and would be suitable for irrigation. McArthur & Associates also made a number of recommendations regarding the need to establish sound environmental objectives for the programme, to monitor effects of irrigation and to select species following the determination of their tolerances to effluent.

The Environmental Protection Authority focused its review of this aspect of the proposal on the ability of the irrigation site and vegetation to ensure that no adverse effects resulted. Of paramount importance to the Authority was the need to protect the salt lakes.

The PER indicated that a major concern is the possibility of the contamination of groundwater flowing into the salt lakes by irrigated effluent. Exploring this possibility further, the PER indicates that

> "Preliminary modelling suggests that a groundwater mound with an elevation of 1 to 2m AHD would form beneath the irrigated area, the majority of that groundwater would flow towards the coast with a minority towards Serpentine and Government House Lakes located about 1.5km to the north" (Rottnest Island Authority, p 38)

The PER goes on to point out the need to further assess the potential impact of irrigation on the lakes. It also proposes that monitoring bores would be established and remedial action taken, if necessary.

Concern about possible contamination of the groundwater flowing into the lakes was raised by public submissions and further information was also sought by the Environmental Protection Authority. As indicated in the response to submissions, the advice from the Rottnest Island Authority and its advisers is that groundwater flows from beneath the irrigation area would be towards the lakes and the ocean (Appendix 3)

Following analysis of soils at selected sites on Rottnest Island, including one from the Kingstown Centre which had been subject to irrigation of primary treated effluent, McArthur & Associates commented that the low levels of nitrogen and phosphorus in the soils, "even following wastewater irrigation, are indicative of the sand's low capacity to absorb these elements" (McArthur & Associates, p 15).

The lakes of the Island are of fundamental importance to its ecology and character. They have already been subject to considerable disturbance, and the Rottnest Island Management Plan places considerable emphasis on their protection and preservation as productive ecosystems. Land uses in their catchment will have an influence. It is essential that land uses that threaten their function and other values do not occur or are managed in ways that guarantee no deleterious effect. It is clear that there is potential for the contamination of groundwater by nutrients from the irrigated effluent, and that some of this groundwater will flow towards Serpentine and Government House Lakes.

It would be difficult and very expensive to either remove contamination from the groundwater once it had occurred or prevented the groundwater from flowing to the lakes. Indeed, this latter option would also be undesirable as these freshwater flows are environmentally important, as previously mentioned.

As a consequence of this review, the Authority considers that no wastewater effluent should be disposed of within the catchment of any of the lakes system.

Recommendation 4

The Environmental Protection Authority recommends that effluent from the wastewater treatment plant should not be disposed of within the surface or groundwater catchment of the salt lakes of Rottnest Island.

Having arrived at this conclusion, the Environmental Protection Authority appreciates that, as proposed in the PER, there would be secondary treated effluent requiring disposal but no place to put it. The PER considered the option of an ocean outfall from the treatment plant at Site 2 in Section 7.4. That discussion pointed out a number of potential environmental impacts that would arise from such an option. These related to the effects on the conservation value of the receiving waters and physical damage from construction. The Rottnest Island Management Plan identifies the very high conservation and recreational value of all of the waters around the Island, as did the Environmental Protection Authority's System 6 Report (Environmental Protection Authority, 1983).

In its response to submissions, the Rottnest Island Authority reconsidered the possibility of an ocean outfall and has made a commitment to place an additional pipe in the services trench to

Site 2 in case irrigation of the effluent had to be discontinue (Appendix 3). Such a plan would envisage a marine outfall being launched from the vicinity of Phillip Point, near the Kingstown Centre. The Rottnest island Management Plan indicates that there are reef areas extending from the Point and located offshore. The bottom is generally sandy immediately east of the Point, and seagrasses are found to the north and south. On this basis, this may present an opportunity for a marine pipeline to be constructed without significant physical disturbance. The effects on the biota would require detailed examination. The waters offshore from Phillip Point are included within an area recommended (System 6 Recommendation C45) by the Environmental Protection Authority for the establishment of a Marine Reserve (Environmental Protection Authority, 1983)

Should an outfall be proposed, the Authority would expect to receive a referral for assessment. Clearly the prime concerns of the Authority would be the physical and biological implications arising from construction and operation of the outfall. Water circulation and effects on reef and seagrass communities would be important issues requiring clear demonstration of acceptable impacts.

This option would not address the desire of the Rottnest Island Authority to reuse the treated effluent. As a consequence of further design consideration, the idea of irrigating the treated effluent into reafforestation areas west of Narrow Neck has been mooted. Disposal in this area would guarantee protection of the lakes from this source, and could be undertaken economically. However, no site investigations have been undertaken to determine whether reafforestation would be successful. The landform comprises Pleistocene coastal sand dunes, which is comparable to much of the area near Barnett's Gully (Rottnest Island Management Planning Group, p 35). However, the West End is much more exposed to the prevailing winds and this would be expected to affect both species selection and possibly tree vigour.

The Environmental Protection Authority considers that the possibility of the establishment of reafforestation areas west of Narrow Neck should be further explored by the Rottnest Island Authority. It would be necessary to demonstrate that the reafforestation areas would be physically stable, the plants would grow and remain vigorous, that the vegetation and soils are capable of using the irrigated effluent, and that nearshore reef communities would not be affected. **This option should be initially preferred to a marine outfall** and, as with an outfall, should be referred to the Environmental Protection Authority for detailed environmental review.

The Rottnest Island Authority has indicated in the PER that the option of effluent use within the area of the settlements is not supported. This position is fully endorsed by the Environmental Protection Authority.

As a consequence of a review of effluent disposal options, the Rottnest Island Authority may identify other possibilities which are consistent with the recommendations in this report. These should also be examined. One possibility mentioned in the PER but dismissed on cost grounds would be the installation of nutrient removal facilities at the treatment plant.

Recommendation 5

The Environmental Protection Authority recommends that the Rottnest Island Authority should investigate treated effluent disposal options including irrigation of a reafforestation area west of Narrow Neck or an marine outfall from the vicinity of Phillip Point, and that a preferred option should be referred to the Environmental Protection Authority for environmental assessment.

4.3 Water conservation strategy

An essential part of the proposal to implement a potable standard water supply to the settlements is the need to ensure that per capita water consumption continues to be minimised. The PER anticipates that there would be an increase in per capita demand under a fresh water supply. It

also contains the commitment to initiate a water consumption awareness and demand management programme which will include notices encouraging limited use, installation of automatic metered taps and dual flush cisterns, low volume shower roses and user education information.

It is in the interest of the Rottnest Island Authority and all visitors to the Island to minimise water use. As demand grows, the pressure on the groundwater resource of the Island will increase. In addition, minimisation of use of fresh water outside accommodation units will assist in maintaining the character of the settlements, which reflect the aridity of the Island.

The possibility that the establishment of a single class potable water supply will increase per capita consumption of water has to be seriously considered. Although the Rottnest Island Authority will carry out a campaign to encourage conservative water use, this may not be as effective as the present provision of brackish water to showers etc. Any such increase in use will have to be managed by the Rottnest Island Authority. If the proposed demand management arrangements are not effective, a possible management requirement may be to offset any increase in water use per visitor by reducing the total number of visitors.

In implementing the water conservation programme, specific targets in terms of total annual growth, per capita consumption and water consumptions according to type of use (including type of accommodation) should be defined on an annual and five year basis. This would permit evaluation of the effectiveness of the programme and should enable the programme to be focussed on parts of the system that do not meet targets.

4.4 Other issues

4.4.1 Aboriginal issues

A major focus of attention on Rottnest in recent times has related to the historical use of the Island as a prison, and the presence of Aboriginal sites. A submission to the Authority advised that implementation of this proposal should be deferred until these issues have been resolved.

The Authority recognises that the Rottnest Island Authority is aware of its responsibilities in relation to the Aboriginal Heritage Act and would be expected to continue to undertake consultations with appropriate authorities.

5. Conclusion

The Environmental Protection Authority considers that the proposal for a new single quality potable standard water supply and new wastewater disposal system would be beneficial to the recreational use of Rottnest Island and could be made acceptable from an environmental point of view.

The key areas originally identified were the additional water resource, the creation of the wastewater treatment plant site and the disposal of wastewater. In regard to these, the additional water resource can be supplied by additional abstraction from the Wadjemup Hill groundwater mound, subject to careful monitoring and availability of additional water from desalinisation of deep bore water from the Yarragadee Formation. Secondly, the site identified for wastewater treatment plant is satisfactory.

The third issue — the wastewater disposal — remains to be solved. Plantation irrigation at the original site is not environmentally acceptable but further consideration should be given to identifying a site west of Narrow Neck or alternatively an ocean outfall, probably from Phillip Point.

In the absence of action on this integrated water supply and wastewater treatment proposal, action must be taken to cease the discharge of raw sewage close inshore from Point Clune.

6. References

Environmental Protection Authority (1983). Conservation Reserves for Western Australia as Recommended by the EPA. The Darling System - System 6. Department of Conservation and Environment Report No 13.

McArthur & Associates (1990). Wastewater Afforestation Project Evaluation - Rottnest Island.

Rottnest Island Authority (1991). Provision of an Integrated water Supply and Wastewater Treatment System - Public Environmental Report.

Rottnest Island Management Planning Group (1985). Rottnest Island Management Plan.

Water Authority of Western Australia (1989). Rottnest Island Water Supply Scheme Review.

Appendix 1

Proponent's commitments on the proposal

SUMMARY OF COMMITMENTS

The Rottnest Island Authority undertakes to provide an integrated water supply and wastewater treatment system to Rottnest Island.

Water Supply

1. An adequate single supply of fresh water will be established to each dwelling on Rottnest.

2. The potable water borefield will be developed to its sustainable level.

3. Potable groundwater abstraction bores will be equipped with suitably rated pumps to ensure no overpumping and the borefield will be automated with flow control of the bores.

4. Monitoring of drawdown and salinity of the bores is being and will continue to be implemented.

5. The bitumen rainfall catchment will continue to be utilized.

6. If desalination is required to supplement the available potable water resource, a deep bore will be drilled into the Yarragadee formation in a manner as determined by the salinity level. The bore would be drilled near Kingstown and the desalination plant sited at this location or adjacent to tanks near the bitumen catchment.

7. A water consumption awareness programme will be initiated by the Rottnest Island Authority and will include such measures as limited use notices beside taps, automatic metered taps, duo flush cisterns, low volume shower roses and educational articles in visitor information literature.

8. Both water supply and sewage reticulation systems will be upgraded to meet the new demands placed upon them.

Wastewater Treatment

9. The Rottnest Island Authority undertakes to discontinue the present undesirable practice of discharging untreated effluent to the sea.

10. A central wastewater treatment plant will be relocated to a site south of the airport and north of Barnett's Gully.

11. All septage systems, with the exception of those at Kingstown Environmental Education Centre and isolated outlying toilet blocks, will be connected to the central wastewater system.

12. All lagoons and filters will be sealed with a 1mm thick density polyethylene (HDPE) plastic liner.

13. A suspended wire grid will be incorporated for bird control.

14. The plant will be fenced.

15. With the exception of the final 200m, the laying of pipes and attendant service cabling to the site of the proposed wastewater treatment plant will be along the previously disturbed sites of roads and for the Bickley to Oliver Hill railway line.

16 At the time that the service lines are laid, a further pipeline will be laid between the proposed wastewater treatment plant and the most easterly point of the service trench, being adjacent to the Kingstown Environmental Education Centre entrance.

17. Groundwater monitoring bores will be located immediately to the west and north of the plant.

18. The present Point Clune ocean disposal system and the existing treatment facilities adjacent to the Basin will be abandoned.

Reafforestation

19. Effluent will be pumped to a reafforestation area at Barnett's Gully, adjacent to the wastewater treatment plant.

20. Effluent will be utilized to trickle irrigate a 50 - 70ha area of native vegetation.

21. Effluent will not be used in the settlement area. Should this be contemplated in the future, it would be the subject of environmental and health assessment by the EPA and the Health Department of WA. Such a process would involve public consultation before any decision was taken. It is not intended to use treated effluent on the Golf Course.

22. All reafforestation areas will be signposted.

23. As a precaution, the use of effluent for reafforestation will not be undertaken within 1km of a water extraction bore.

24. The Authority undertakes to establish afforestation areas and therefore disposal of effluent at least 800 metres from the salt lakes until comprehensive monitoring and an environmental impact assessment confirms that it is safe to proceed within this boundary.

25. Should the need arise to expand the area required for effluent reuse, the matter would be referred by the Rottnest Island Authority to the EPA for environmental assessment.

Monitoring

26. Further work will be carried out to assess the impact of the land disposal of effluent on water quality in the Rottnest salt lakes. This work will be carried out by a competent hydrogeological consultant.

27. Monitoring systems will be initiated to identify the first sign of any adverse effects. If it was found that nutrients were migrating towards sensitive areas in significant concentrations, modification to the approved disposal system will then be required, for example:

    - relocation of the reafforestation area, or an increase in the irrigated area to reduce mounding effects.

- installation of nutrient removal facilities at the treatment plant.
- installation of an ocean outlet.

28. Should use of the pipe already in position for linkage to an ocean outfall, probably at Bickley Point, be required, this will become the matter of a separate environmental review in consultation with the Environmental Protection Authority, the Water Authority of WA and interested members of the public.

29. A monitoring programme will be established to ascertain whether effluent re-use can be expanded into other areas of the island (for example, for revegetation establishment).

30. Bacterial and nutrient levels of groundwater will be monitored for at least 5 years after commencement of disposal.

31. Monitoring could cease if no changes were detected within the 5 year period. However, reintroduction of monitoring would occur if disposal volume exceeded 150% of the last monitoring period.

32. Should elevated groundwater nutrient or bacterial levels become apparent, a marine monitoring programme, as described in the Ocean Disposal section, will be commenced.

Appendix 2

Issues raised during the public review period

SUMMARY OF COMMENTS RAISED DURING THE PUBLIC REVIEW PERIOD

The following comments, issues and questions have been raised with the Environmental Protection Authority during the public review period on the Rottnest Island Integrated Water Supply and Wastewater Treatment System.

A total of 15 separate submissions were received.

Project Objectives and Options

1.1. A social issue related to the increased extraction fresh water is whether it is appropriate to use the Island's hinterland, which is an A Class Reserve for Public Recreation, to support commercial development. While the whole "Rottnest experience" is based on use of the Reserve, this is for activities that are related to the landscape, floral and faunal values of the Island, which the RIA is obliged to protect (RIMP Section 4.3).

1.2. Does Rottnest have a limit to the annual number of visitors that it can absorb without fundamental change to its character.

1.3. My main criticism of Section 7 is that it does not consider the long term effects of the pressure to "develop" tourism on Rottnest. Improved water quantity and quality will inevitably lead to pressure for an expansion of tourist facilities, with increased environmental impacts.

1.4. The PER only addresses the short term needs related to visitation by up to 380,000 people by the year 1994/94 and makes no commitments to the medium or long term arrangements or the need to restrict visitor numbers in view of environmental and servicing constraints.

1.5. Why has 1994/95 been adopted as the benchmark for design, when that is only three years hence. Are the authors assuming that visitor numbers will then be saturated and remain at 380,000 for ever.

1.6. This proposal is aimed at increasing visitor numbers to Rottnest and yet the Island has a finite environmental capability to support the population while protecting its values.

1.7. Due to the high cost of desalinated water, alternative sources of fresh water which are dismissed in the report need to be given closer attention. This option has the potential to create an excessively heavy burden on the RIA if demand for waster escalates.

1.8. I accept that the discharge of untreated sewerage from Fay's Bay needs to cease and the difficulties of expanding the Basin pond, because of location. However the solution is clouded by the RIA's wish to upgrade the water supply to all outlets on the Island.

1.9. In itself the provision of a single class of potable water to the whole Island is to be applauded.

1.10. It is estimated from effluent data in the PER that per capita consumption of water would be approximately 412L per person/ day, above the level suggested in Appendix 10.2 of the RIMP. The aim should be to use this as a maximum and to reduce it to 75 per cent of this value.

1.11. It seems a heavy burden on a small community for Rottnest to supply its own water. It is suggested that WAWA should be responsible for supplying fresh water to the Island.

1.12. It seems strange that the WAWA has abrogated its normal water supply and wastewater disposal responsibility in favour of the RIA. The RIA, having a small and non-expert staff, is not particularly well equipped to fulfil this function and we would recommend WAWA assume this responsibility, providing water to the RIA at a standard rate per kilolitre. This would mean that WAWA personnel would be located on the Island.

1.13. No satisfactory rationale is provided for wanting to upgrade to a single class of water. The two reasons given are (a) that visitors want it and (b) that it would result in lower maintenance costs. The claim that visitors want a one class water system is related to the social values of Rottnest. The social character of Rottnest has been built on a two class water supply and it is indisputable that a one quality system will change that character. This contradiction of the commitment in Section 3.3 is not explained. Furthermore, while visitor numbers continue to increase it is difficult to believe a change of water is necessary to maintain visitor numbers.

1.14. On what basis does the Rottnest Island Authority believe that a single fresh water supply is appropriate or necessary from the visitors viewpoint when most visitors (> 85 per cent according to Appendix 5.1) have up until now accepted a dual system.

1.15. Public health and aesthetics require a new method of sewerage disposal on Rottnest but there is no sound reason for a one quality water system. The existing two quality water system should be maintained with a ceiling on visitor numbers, while detailed investigations are conducted into the suitability of an ocean outfall to dispose of effluent after primary treatment.

1.16. Recycling should not be rejected out of hand. Environmentally it is the best option (no nutrients nor 160,000 m^3 of water to disturb Rottnest's sclerophytic flora; no depletion of underground water supplies).

1.17. Rottnest Island experiences a dilemma with the supply of water that the rest of WA may well face in the future. This deserves a more creative solution than to continually supply copious amounts of fresh water when very little is truly available and the production of which has repercussions in the conservation zone.

1.18. The Rottnest Society commends the decision not to extend the bitumen catchment.

1.19. The catchment area at present is unobtrusive and is of historical significance. It is suggested that the Environmental Committee reconsider the desirability of an extension to the bitumen catchment area (or the establishment of other catchment zones e.g. from runoff in the settlement)

1.20. The desirability of retaining the bitumen catchment areas is not supported.

1.21. The claim that a one quality water system will reduce maintenance costs is undoubtedly true but the PER does not quantify the savings. It needs to be shown that the savings exceed the true costs of installing and maintaining the freshwater supply for this argument to have any validity.

1.22. The effects of an ocean outfall are known and this would be our preferred option.

1.23. Consideration needs to be given to initiating environmental impact assessment of a long term alternative to irrigation disposal, probably an ocean outfall.

1.24. The following Net Present Values have been prepared on the basis of the information in the PER. It is noted that the formula NPV = - Initial Capital Cost + $\frac{\text{Cash Flow (O+M)}}{\text{Rate of Interest (12\%)}}$ is more appropriate for most of the options:

• Groundwater	-$1.65m
• Catchment	-$1.65m
• Seawater Desalination	-$4.95m
• Shallow Well Desalination	-$4.95m
• Yarragadee Desalination	-$4.95m
• Barge	-$13.65m
Pipeline	-$10.65m - -$13.65m
Tertiary Treated Recycle	-$6.82
Tertiary Treated Recycle plus RO	-$9.17m

1.25. The omission of minus signs in the discussion of Net Present Value in the PER makes a nonsense of the whole argument in relation to options.

1.26. The justification for the upgrading of current water supply appears hinge on the finances of maintaining wet plumbing serviced by salt water and visitors expectations. This latter reason is clearly rubbish given the increase in total accommodation lets over the period 73/743 to 83/84 (RIMP) and projected growth outlined in the PER. The former reason appears little justification to undertake a project which may have major impacts on the vegetation, salt lakes and marine environment adjacent to the proposed treatment plant.

1.27. The main disadvantage of a single water supply system is the use of an expensive, limited resource for ablution facilities when second class water would continue to do the job.

1.28. The most environmentally benign solution to Rottnest's water problems is (a) the maintenance of the fresh water supply for drinking purposes only and (b) disposal of waste saline water after secondary treatment via a deep offshore diffuser.

1.29. The option of not changing the existing water supply is better than making ill-considered changes.

1.30. The PER recognises that nutrient removal may be required in the reafforestation option. If this happens the reafforestation option will be substantially more expensive than an ocean outfall.

1.31. The present disposal of effluent at Point Clune has resulted in the degradation of the offshore environment and presents occasional health risks when broken pipes are not repaired.

1.32. The principle that the intrinsic landscape of Rottnest Island is semi-arid in character and should remain so is paramount. The impact of too plentiful a supply of fresh water might destroy this character.

1.33. The reference to Health Department standards is specious. The current dual water system satisfies the Health Department which recognises the semi-arid status of the Island.

1.34. The RIA identifies major problems when considering water usage should plans proceed but does not identify the ecological problems that will arise when it does escalate.

1.35. The RIMP delineates areas for development and areas for conservation. No proposal that relates to the development zone should be allowed to impact on the conservation zone. Full development of the wellfield and effluent disposal , both of which are in the conservation zone, will not confine development to the development zone. Further, the impact of these two aspects on the Island's flora and fauna, especially that of the salt lakes, is not addressed in the PER.

1.36. The specific uses to which the single class water can be put should be listed to enable a full assessment of the consequences of the proposal.

1.37. The water supply and wastewater treatment system will fulfil a long term need and will greatly increase the enjoyment of Rottnest by visitors. I wish the RIA success in its implementation.

1.38. There is no doubt that an upgraded wastewater treatment system for Rottnest is necessary for environmental and public health reasons. As it appears that saline wastewater cannot be treated satisfactorily then the introduction of a new disposal system would have to be accompanied by the provision of fresh water to all facilities.

1.39. What assumptions have the authors of the PER made to determine the estimated water consumption figure and what is the design figure.

1.40. What effect will the additional operational and maintenance costs per year have on the accommodation costs on the Island.

1.41. With regard to water supply options:

- the Binnie and Partners 1984 study nominated three possible pipeline routes: Gage Roads, Success Bank and Garden Island. Of these, the latter was free of the problem of ship's anchor dragging;
- all three schemes had a common 3ML storage tank. Would this not allow for pressure reduction;
- the Garden Island route was the cheapest option, with a maintenance cost one fifth as expensive as the desalination plant. Moreover, it could be argued that each dwelling on the Island should be entitled to the 150kL 'free allowance'. Even if the cost of this allowance was not included in the previous annual maintenance cost estimates the "attendant cost of purchasing water consumed" argument seems to be weak; and
- even if the metropolitan demand for water completely overwhelms the extra amount required by Rottnest, the Rottnest shortfall amounts to of the order of 0.1 per cent of demand and can hardly be described as a significant competitor for the "limited mainland catchment".

1.42. With regard to the additional power requirements of this proposal:

- what are the effects of the proposed power station upgrading;
- does this mean installation of another generator;
- how much extra fuel will be transported by barge;
- does the $1.4m include capital costs of new electrical equipment and any station modifications required;
- what are the present noise and emission levels, how will they change, are they currently acceptable and will they remain so; and

- as the station is within the settlement, if a new generator is required is it feasible to relocate the station to either the treatment plant site or somewhere along the power route.

1.43. Why will Kingston not be included in the sewerage scheme, particularly when the sewer will run past it,

1.44. Would commercial users of water on the Island be required to pay for water on a 'user pays' basis, and would this charge represent a true economic return for supply costs.

1.45 The most dramatic reduction in demand for water would be effected by equipping all toilets on Rottnest with the composting variety. These would have the following advantages:

- will reduce demand for new fresh water by between 25 and 35 %;
- will reduce the size and nature of the wastewater treatment plant dramatically, and mean that the water produced will have much lower levels of nutrients and so pose less risk to groundwater when used to irrigate; and
- the electrical power for desalination and waste processing will be significantly reduced.

1.46 There are other methods of removing waste with far less water - vacuum systems, and black and brown waste water systems. All water demand management systems should be fully studied before any expansion of water supply and desalination is undertaken.

Groundwater Abstraction (Superficial Aquifer)

2.1. Although the PER points out the importance of the lake and swamps, especially Barker Swamp and the lakes supporting stromatolite growth, it does not address the potential impacts of groundwater abstraction resulting from decreased freshwater seepage or pollution from increased nutrient influx on these areas.

2.2. Based on the RIMP and the Progress Report on Implementation of the Recommendations (1990), there appears to be a slow increase in the salinity of the Wadjemup Hill fresh water lens.

2.3. It appears that the figure in the PER showing the extent of the groundwater resource is not the most up to date.

2.4. It is not clear whether the 96ML limit is short term, dictated by the current number of production wells, or whether the RIA is being conservative in adopting the estimated maximum safe yield referred to in the RIMP

2.5. The Water Authority recommends that the maximum draw from the surficial aquifer should be limited to 96,000m^3 for at least the first two years. The GSWA report (Smith 1985) noted that increased abstraction could significantly affect some seeps and the wetland most likely to be effected by increased drawdown is Barker Swamp. A more recent GSWA study (Hirschberg and Smith 1990) reassessed the groundwater resources of the Island and concluded that a total of 190,000m^3 per year may be abstracted safely from the shallow aquifer. This study, however, only considered the issue of saltwater upconing, not the potential impacts of this abstraction on the environment.

2.6. The complexity of the hydrology suggests that the wellfield should be developed in stages with adequate monitoring of production and observation wells, and the environment, between subsequent development to ensure that the aquifer and the environment are no adversely effected by the rate of abstraction.

2.7. No data to justify or substantiate the proposed increase of the sustainable abstraction level from 96,000 cubic metres to 120, 000 cubic metres is given in the PER.

2.8. The consequences of the increase in maximum abstraction from 96,000 cubic metres to 120, 000 cubic metres are not addressed in the PER, in particular the potential impacts on wellfield vegetation and nearby lakes and swamps as a result of increased drawdown.

2.9. If, as is stated in the PER, 190,000 m^3 of potable water can be drawn from the wellfield there is no need to look further for sources of water.

2.10. No information is provided on the existing groundwater treatment plant, its site, expansion requirements or need for relocation. Can the existing plant cater for the

projected total increase of groundwater (fresh and desalinated) supply and what additional chemical treatment and storage will be necessary.

2.11. Have any risks associated with increased water supply chemical treatment and storage been considered and does the present site meet EPA standards.

2.12. No mention is made of the potential effects of groundwater abstraction on phreatophytic vegetation through drawdown of the water table.

2.13. On a recent visit to Rottnest (March 1991) I noticed a lot of soil erosion in the area of the existing borefield. The erosion already seems to be significant and I don't see how the possibility of further damage in an expanded borefield can be dismissed in Section 7. Before the borefield is expanded the RIA must show that the existing associated problems can be solved.

2.14. The PER does not appear to consider abstraction of first class water from the Oliver Hill mound. Is this because of its proximity to the wastewater treatment and disposal site. Additional comments on this mound would be appreciated.

2.15. What are the "environmental and economic" reasons which lead to the reduction of estimated safe yield from 190ML to 120ML. Did this recommendation emerge from WAWA or a third party. If the 190ML were to apply there would be no need to consider any new sources at all.

2.16. Will pumping still be regulated to protect the freshwater lens, when accommodation needs water from somewhere.

2.17. Will the effluent disposal area contaminate the Oliver Hill freshwater mound and thus limit its future use.

2.18. A significant problem associated with the proposed increase in groundwater abstraction is that the principal demand period occurs over only approximately half of the year, at a time when the vegetation, lakes and swamps are under greatest stress.

2.19. What control system is intended to ensure that individual bores do not produce more than the defined sustainable capacity for that bore.

2.20. Recommendations 6.2 and 10.65 - 10.69 of the RIMP deal with water extraction issues but they do not appear to have been implemented. If they have, the PER makes no reference to the results and experience obtained.

Wastewater Treatment Plant and Infrastructure

3.1 According to Figure 1 in the PER, the treatment plant is 500 metres from Government House Lake and the closest reafforestation plot appears to be 650 metres - not 1500 metres as stated on page 38.

3.2 I presume that the emergency on-site soakage area is for effluent only as referred to in Clause 8.1. The proposed location of this soakage area is not shown on Figures 1 and/or 2. The estimated volume and quality of the effluent so discharged and the direction of the flow are important considerations in the selection of the soakage area.

3.3 If nutrients are found to be likely to enter the salt lakes, how will the alternatives mentioned (nutrient removal or ocean outfall) be funded and what guarantee is there of such funding.

3.4 In view of the peak loadings that will occur during summer, should not the wastewater treatment plant have sufficient pond storage capacity to provide a more even volume of effluent to the plantation area year round.

3.5 It is recommended that professional botanical and horticultural options be obtained concerning the trickle irrigation project and the effect of high level summer irrigation with nutrient rich water on native vegetation, more specifically *Melaleuca lanceolata*, *Callitris preissii* and *Acacia rostellifera*.

3.6 No mention is made in the PER that the Basin treatment pond/ discharge is acceptable at present with a brackish water mix.

3.7 Of the four potential sites, Site 2 has been wisely chosen and the extra cost is well worth expending in view of the other overwhelming advantages of this site.

3.8 On what basis is the suggestion made in the PER that leaks from the lining of the wastewater treatment ponds could be self-sealing.

3.9 Serious consideration should be given to treating wastewater to a point where it can be recycled for human use, through injection into the groundwater mound.

3.10 Tertiary treatment of the wastewater followed by injection into the groundwater for re-use would have the following advantages;

- the wastewater treatment plant could be placed in a more convenient and less expensive site;
- future increases in water demand could be met without greatly increased costs;
- it is consistent with the principles of recycling which will become increasingly important;
- excess water could be used for reticulation in areas such as the golf course without concern for the environmental impact; and
- there will be not need for environmental disturbance at Kingston with a bore and desalination plant.

3.11 The proposal to dispose of wastewater by minimum treatment and use for irrigation should be abandoned. At the very minimum it will be essential to remove nitrogen and phosphorus from the effluent.

3.12 When describing tertiary treatment it is stated "there would be considerable potential public health risks associated with this proposal". No reference is given.

3.13 Why could not the recent advances in membrane technology be adopted in development of a solution for the treatment of the effluent, with a possible view to reuse as first class water via, say, injection into or application over the potable groundwater aquifers.

3.14 The affected environment at the wastewater treatment plant and plantation area are well represented elsewhere on the Island.

3.15 The contour map in Playford 1988 indicates that groundwater flows from the effluent treatment and also the disposal site will be towards Government House and Serpentine Lakes.

3.16 The RIMP recommended no further encroachment on the natural environment. The proposed site requires destruction of some natural vegetation regrowth and may not be as unobtrusive as has been suggested.

3.17 While the wastewater treatment plant will be obscured from nearby roads part of it will be visible from the Oliver Hill lookout. Even more noticeable will be the tree plantations.

3.18 The Rottnest Society supports the RIA's determination to discontinue the pumping of untreated sewerage into the ocean and is therefore committed to the idea of a single class water system. We also support the idea of reafforestation provide that it does not conflict with the general considerations of RIMP Chapter 7, in particular Recommendation 7.1.

3.19 The site chosen seems the best option in the light of the other recommended proposal but the PER suggests a degree of uncertainty about the risk of offensive odours being blown over the settlement.

3.20 Under what conditions would odour from the wastewater treatment plant become evident in the Thomson Bay settlement, given that the prevailing afternoon breeze is toward the settlement, and what action would be taken to minimise the number and duration of occurrences.

3.21 There is an urgent need to upgrade the wastewater systems on the Island. The relocation of the Basin treatment plant and the cessation of disposal to sea of untreated sewage deserve the highest priorities. It would seem desirable to reuse any treated effluent where possible.

3.22 What is intended to happen with the existing wastewater treatment facilities at Fay's Bay and the Basin. What will the rehabilitation programmes include.

3.23 What is the basis for suggesting that a future expansion (Stage 2) of the wastewater treatment plant will be necessary.

3.24 Whichever wastewater treatment option is adopted, it appears that an increasing volume of stabilised sludge has to be disposed of to an approved landfill or soil conditioning site. No information is provide on the location, transport to or costs associated with such sites

3.25 Sludge from an evaporation pond should not be disposed of in an area that has conservation values.

Plantation and Wastewater Irrigation

4.1 Commitment 24 refers to a monitoring programme being established to ascertain whether the effluent re-use can be expanded, and yet the PER gives no basis for indicating the the existing proposal will be environmentally acceptable.

4.2 Given the significant variation in daily effluent loading between summer and winter and between holiday and non-holiday periods, have the predictions of performance of and impact on the plantation area and groundwater taken account of these variations.

4.3 Groundwater mounding is likely beneath the plantation area and the flow of groundwater will flow towards Government House and Serpentine Lakes.

4.4 Exclusion of the plantation area to Quokkas will reduce their habitat, increasing population pressures elsewhere on the Island.

4.5 How will *Salmonella* infections in Quokkas be managed. Will Quokkas in or near the disposal areas be tagged and swabbed. Will all disposal points be fenced.

4.6 How will the effluent be applied to the plantation area.

4.7 Problems with the trickle irrigation are likely due to suspended solids in the effluent and additional treatment to reduce them to low levels may well be necessary.

4.8 The costs of reticulation, installation and maintenance may be even greater than those quoted due to the enormous lengths of irrigation tubing (estimated at least 80km) required. More information is required about this part of the project is required before proceeding.

4.9 Such a disposal system appears feasible in the short term, however, in the long term it should be recognised that an alternative method will need to be employed given constraints such as the proximity to wetlands and the finite absorptive capacity of the soils.

4.10 If effluent were to be used in or near any of the settlements, this would have the potential to alter the existing landscape which still retains its ties with the Mediterranean climate but is based on scarcity of water.

4.11 If groundwater flows from the plantation area are to the south, away from the lakes, what investigations have been undertaken to ensure that effects will be minimal.

4.12 In view of the difficulty of modelling the nutrient flow "extensive monitoring" is indeed called for. Suggested changes to the proposed monitoring guidelines are:

- the five year time scale seems much too short. Perhaps a more appropriate time scale is the time taken for the trees to reach maturity. But even better, we would prefer a commitment to indefinite monitoring; and
- on the question of when monitoring should recommence once a perceived equilibrium had been reached, we would prefer monitoring to be linked to the initial rather than the final disposal volume.

4.13 Most of the shortcomings of the concentrated soakage disposal option that lead to its rejection also apply, albeit to a lesser degree, to the reafforestation option. The same volume of water, nutrients and other contaminants will be released in both cases and no logical explanation has been given for rejecting one option but accepting the other.

4.14 No information is provided on whether the indigenous flora to be used in the reafforestation programme can tolerate the predicted nutrient levels of 40 mg/L Nitrogen and 15 mg/L Phosphorus.

4.15 Nutrient levels applied to the plantation area without further treatment are estimated to be 7000 kg N and 2600 kg P each year, equivalent to applying 150 kg of standard fertiliser to each average domestic garden every year.

4.16 Potential movement of nutrient enriched groundwater from the plantation areas or the wastewater treatment plant site towards Government House Lake would be unacceptable even if monitoring detected the movements because of the short distance involved (no more than 500 metres). Immediate action would need to be taken and monitoring would only be effective if it were carefully located and comprehensively designed and managed. Therefore, reafforestation should not be undertaken in proximity to the lakes or swamps.

4.17 The proposed buffer between the plantation area and the salt lakes of 500 metres is not sufficient. Once the adsorption capacity of the soils of the plantation site has been reached, phosphorus will move freely to the lakes.

4.18 Silver gulls are known carriers of *Salmonella* and may be attracted to permanent ponds or temporary pools of wastewater in the plantation area. Transmission of the infection is more likely given the mobility of this vector and its habit for sharing eating places with people.

4.19 Some public may consider the plantations as intrusions into the rolling landscape while others will believe that to chop them down after they reach economic maturity would be tantamount to sacrilege.

4.20 The following points are raised concerning effluent disposal;

- will effluent be used in the settlement area;
- if so, will it be chlorinated;
- will grassed areas be established at Tentland as first priority of effluent re-use in the settlement; and
- can a commitment be given not to use effluent on the golf course unless extensive monitoring is done and published in the 'Islander'.

4.21 The effluent disposal issue raises the following:

- on what basis and where did the estimates of 50 - 70 ha required for effluent disposal originate;
- as most of the effluent disposal area is presently under reafforestation, does the 50 - 70 ha include these existing areas;
- where is the first area to be established;
- who will maintain the irrigation system; and
- will nutrient budgets for the system be researched.

4.22 The indigenous trees that it is proposed to plant and water are unlikely to need water as these species (using Recommendation 7.9 of the RIMP to identify what should be planted) are adapted to the low water availability/ high salt loads of Rottnest.

4.23 Will the significant availability of water and nutrients at the surface of the plantation sites tend to encourage shallow rooting of plantation species, leading to increased wind throw given the exposure to strong winds.

4.24 The PER also fails to provide detail of the preliminary hydrological model which predicts the possible movement of nutrient rich ground water in the direction of the unique salt lake communities.

4.25 The PER completely fails to consider the possible effects of nutrient toxicity on may of the native heath species despite a very large scientific literature being available.

4.26 The PER does not clearly state that all of the effluent from the wastewater treatment plant will be directed to the plantation area, although Figure 2 suggests that this is the case. A commitment should be given to this effect.

4.27 The plantation area includes flora conservation areas such as *Acacia rostellifera* and *Melaleuca* sp. (Figure 3 ii) but no mention has been made of the future preservation and management of these sites.

4.28 The time lag between the pumping of effluent and the commencement of the effluent is important to ensure that the vegetation is able to take up both the water and nutrients supplied in the effluent.

4.29 The Rottnest Society believes that land disposal of treated wastewater is superior to marine disposal.

4.30 The WAWA should be interested in an article about irrigation of secondary treated effluent onto vegetation areas entitled "To Treat Wastewater, Hire Mother Nature" in Compressed Air Magazine, July 1990 (p 14 - 20).

4.31 There is no discussion of the potential of the plantation trees to absorb the nutrient loading from the treatment plant in perpetuity, and especially after the trees have reached maturity.

4.32 This proposal is very seductive given the present degradation of the Island environment. However;

- the potential hazards to groundwater and the lake system are unknown and unpredictable, given that usage will so dramatically and suddenly change;
- Changes are to be monitored by the RIA and not WAWA; and
- this method of sewerage disposal is still in its infancy. WAWA itself does not have the expertise to manage and project the effect on a small delicate ecosystem.

4.33 What soil testing has been and will be done to estimate the soil's performance and to monitor changes in the soil characteristics within the selected plantation area.

4.34 What species will be grown and will they be harvested for firewood or other purposes.

4.35 What will be the criteria used to determine the species selection for the wastewater effluent disposal site, what trialling will be undertaken to ensure compatibility with those criteria and what contingency planning will be established if species do not perform adequately after planting.

Monitoring

5.1 Assurance is sought that monitoring is carried out to ensure that there is no possibility of groundwater contamination from the effluent systems on Wadjemup Hill which sits on top of the the main freshwater lens. Assurances are also sought that accommodation in this area would be vacated immediately signs of contamination were detected.

5.2 Baseline monitoring in relation to the proposal is essential as little has yet been undertaken. Such monitoring should include the following:

- lake water levels, especially those close to the wellfield;
- lake water quality - nutrients, bacteria and salinity - for lakes in proximity to the reafforestation areas, wastewater treatment plant and wellfield.;
- the groundwater seeps to lakes and swamps closest to the wellfield;
- invertebrate monitoring;
- quantity and quality of groundwater currently moving towards Government House and Serpentine Lakes from the wastewater treatment and disposal sites; and
- vegetation studies to establish the potential sensitivity of the existing vegetation in and adjacent to the wellfield and especially that associated with the wetlands.

5.3 Commitment 22 will need to be complied with prior to the disposal of any effluent from the wastewater treatment plant to ensure that Commitment 21 can be considered environmentally acceptable.

5.4 Monitoring prior to development should determine the presence and importance of fresh and brackish groundwater (< 5000 mg/L) near lakes and swamps close to the wellfield;

5.5 In relation to the proposed investigatory and monitoring programme:

- what is the scope of work to be given to the "competent geological consultant";
- what is to be monitored and how often;
- is the lake system to be studied or just water chemistry;
- the algal mats will be the first affected by nutrient inputs so how will they be monitored; and
- who will prepare the consultant's brief and evaluate the contractor's findings and performance.

5.6 It is recommended that strict monitoring of bores strategically located in relation to the wastewater treatment plant and wastewater disposal site. A management programme should be initiated to ensure restriction on nutrient increases into the lakes and swamps.

5.7 It is recommended that the results of monitoring should be reviewed by the WAWA or the EPA (or both).

5.8 The installation of monitoring bores in and around Barker Swamp and between the wellfield and the larger lakes to the east would be useful in monitoring the effect of increased abstraction on both the quantity and quality of groundwater flow to the wetlands.

5.9 No data is available on the nutrient status of the lakes and swamps but it is expected that they have extremely low levels. Prior to final design of the scheme, the nutrient levels in Government House and Serpentine Lakes should be undertaken and reported to the EPA, to establish a baseline level for future monitoring.

5.10 The effluent disposal is to be monitored by the RIA and not WAWA; can the RIA competently undertake this task.

5.11 The PER states that re-introduction of monitoring would occur if disposal volume exceeded 150% of the last monitoring period. The duration of the monitoring period is not defined. I would suggest that long term monitoring should continue at intervals of six months to assess seasonal variations.

5.12 To whom does the existing groundwater monitoring information go to and what evaluation is undertaken of this wellfield performance.

5.13 Why is no data given for the lakes existing nutrient status, and if not available, why was it not examined during preparation of the PER. Has nutrient data been obtained for the freshwater seeps.

Desalination and Yarragadee Bore

6.1 Any alternative to desalination is likely to be preferable in terms of lesser costs and energy expenditure. It is recommended that deep drilling be postponed until all other options have been fully explored.

6.2 Based on 1994/95 population numbers, should not the water demand be something like 180ML rather than 150ML. It would seem therefore that the desalination plant has to provide 84ML rather than 54ML.

6.3 Based on the 1984 Binnie and Partners report, which showed that maintenance costs could be one sixth of the capital cost each year, if the PER estimated cost of $3m proves to be accurate the running costs could therefore be as high as $500,000 per year.

6.4 Before desalination is embarked upon, a more detailed costing and environmental impact statement needs to be provided. It is understood that the current estimate of desalination costs is $4.50 per cubic metre.

6.5 Drilling into the Yarragadee fossil water raises a number of questions about costs, depth, purity and quantity of water, and the environmental impact of drilling at Kingston, and depleting this fossil water.

6.6 If desalination were to be considered, the existing shallow wells in the Settlement could provide the necessary water without the cost of drilling.

6.7 It is our opinion that treated effluent should be used as the source of feedwater if a reverse osmosis plant is to be set up. The treated wastewater would be much more economical to process than highly saline water and would be part of the recycling process.

6.8 Much more accurate costings of desalinated water with varying degrees of mineral load are needed before plumbing for the option of drilling a bore into the unknown and unplumbed depths of Yarragadee.

6.9 No mention is made of the Rottnest Lodge's desalination plant; its bore monitoring, usage monitoring, effluent disposal and impacts.

6.10 Ocean discharge of the desalination effluent is supported and we urge the RIA to re-route waste effluent from the Lodge desalination plant away from Garden Lake.

6.11 The environmental acceptability of the proposed desalination plant has not been addressed in any manner.

6.12 What is the efficiency of the proposed desalination plant. Is the 54,000 cubic metres fresh water and, if so, how much water would need to be processed to supply that volume.

6.13 What process options would be considered for the desalination plant, what chemicals would be required and where would the effluent from such a plant be disposed of.

6.14 Where would the desalination plant be established and what infrastructure would be necessary.

Additional Issues

7.1 Contrary to the guidelines, the PER fails to address many of the identified potential impacts listed, such as impact on the salt lake system and remnant vegetation as a result of abstraction and long term recharge on the reafforestation area.

7.2 Does the capital cost of the project include the expenditures associated with compliance with Commitment 7 and if not, how will this programme be funded and what timetable will apply to its implementation.

7.3 Everything is to come to a full stop until the ground probing radar has gone through the whole of the area looking for the human remains of Aboriginal ancestors. We are calling on the EPA to stop all work on the Island until this is cleared up.

7.4 Will the archaeologist be present during all excavations. What is the procedure if Aboriginal artifacts are encountered.

7.5 I agree with the earliest possible implementation of the programme but feel that the timetable is somewhat ambitious.

7.6 In relation to the water conservation programme;

- will both the residents and visitors be subject to water conservation measures
- will conservation measures such as duo-flush cisterns, low volume shower roses, and spring loaded taps at all public facilities be installed according to the timetable by 1995
- shouldn't all residents be restricted to keeping a maximum area of lawn, say $100m^2$.
- will residents be supplied rainwater tanks for garden watering, and at what installation rate per annum

7.7 Is there data available from other communities which would allow an estimate of the likely efficacy of the proposed water conservation measures. It is estimated that water use per person would increase by approximately 20 per cent.

7.8 It is suggested that when all water supplies are fresh a system of education with regard to conserving water use be promulgated on the Island in addition to actual control measures.

7.9 No mention is made in the PER of how the contents of the septic tanks from remote areas are disposed of.

7.10 No mention of Garden Lake's raised nitrogen levels from golf course runoff and effects of heavy watering and fertiliser use from the Lodge grounds.

7.11 The comment in the RIMP that " it may be appropriate to meter water use in individual units and charge for water on a 'user-pays' principle' is supported.

7.12 The water conservation programme appears to be orientated to visitors rather than residents. What particular water conservation controls are proposed to minimise in-house and outside house consumption by residents.

7.13 Will water meters be installed at certain points to monitor water use of different areas such as Geordie/Longreach, Kingston, Thomson Bay, the Lodge, Rottnest Hotel and Tentland.

7.14 Is it possible to have economic incentives for visitors to conserve water. What are the economics of installing individual metres against a percentage reduction (or no real increase when converting from salt showers) in water use.

7.15 While the field day was quite well attended, there was considerable delay in arranging transport for the advertised site inspection on the day.

7.16 While the PER refers to the proposal being affected by many of the recommendations in the Rottnest Island Management Plan (page 35 and Table 4), no information is provided as to how and which of the recommendations can have an 'affect'.

7.17 Why doesn't the RIA install rainwater tanks with each dwelling unit as an additional water collection system.

7.18 Will all contractors or agencies involved with the construction of facilities for the scheme be required to return all building rubble to the mainland rather than use up the very limited landfill disposal space on the Island.

7.19 The assessment of power upgrade (about 300kW) should also have been part of the PER, as it will have a significant effect on the environment. We understand that all assessments are supposed to document the impact the project will have on the Greenhouse Effect. This is not mentioned in the PER.

7.20 As with the water supply, demand management of electricity is also extremely important , and has not been covered in the PER. Electrical demand management is of course much more cost effective when diesel is the fuel source.

7.21 The Renewable Energy Advisory Council strongly recommends that if future expansion of electrical power at Rottnest is required, it be via wind turbines. Apart from being cost-effective when compared to diesel fuel used on Rottnest, the intermittent nature of wind is ideal for processes such as desalination, since fresh water may be stored during times of excess wind power. The location of a 200kW wind turbine at Rottnest should cause no operational problems with the diesel plant. New reverse osmosis membranes would require about half the output of a 200kW wind turbine.

7.22 Tanks for storing water pumped during off-peak times, and preferably during times of strong winds, will be far more economical and more environmentally acceptable than an increase in power supply capacity.

Appendix 3

Response by the proponent to issues

RESPONSE TO POINTS RAISED
DURING THE PUBLIC REVIEW PERIOD
FOR THE
WATER RELATED SERVICES PROJECT

A REPORT TO THE

ENVIRONMENTAL PROTECTION AUTHORITY

JUNE 1991

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1 PROJECT OBJECTIVES AND OPTIONS

1.1 Location of the wastewater treatment plant outside the settlement. (1.1, 1.35, 3.16, 3.17, 4.10)

It is not the objective of the Authority to increase the size of the settlement areas for residential or commercial development. The preferred location for the wastewater treatment plant has been selected as the environmentally most acceptable site taking into account the relative proximity to the settlement and minimal disturbance of the ground in the laying of service-lines to the location.

The site is one which has been the subject of significant environmental change, it is not visually obtrusive and is adjacent to an area of the Island which will benefit from reafforestation.

1.2 Annual visitor numbers to Rottnest Island. (1.2, 1.3, 1.4, 1.5, 1.6, 1.15)

The pressure on Rottnest Island does not come from numbers of visitors annually but number of peak demand visitors. Through the autumn, winter and spring periods, the Island could obviously support a very much greater number of visitors. The ecosystem of Rottnest is under pressure during the summer months and this of course coincides with the peak demand school holiday period.

It is interesting to note that the peak demand in the mid 1970s was five to six thousand people on a busy long weekend. Despite predictions at that time that visitor numbers might grow to exceed 20,000 on long weekends, the reality is that we still host some 5-6,000 people on busy long weekends in 1991.

There are some built-in barriers to increased visitor traffic. The size of the jetty in Thomson Bay determines the number and frequency of ferry arrivals and departures. Furthermore, visitors themselves will determine the amount of time they want on Rottnest. There is very little demand for visitors to arrive much after 11.00am or leave much before 4.00pm. The practicalities of ferry movements will of themselves limit the actual number of visitors.

The demand on the Island by daytrippers is substantially different to that of overnight visitors. The Authority's policy is to encourage people to move out onto the Island either through pedestrian or cycle transport or the new Bayseeker bus service. This has had the effect of substantially reducing the number of people gathered in the Thomson Bay settlement. Following two summers, there is no evidence to suggest that the remote bays have deteriorated as a result of this increased visitor movement. Fencing and board-walks have been constructed at bays such as Ricey Beach, Parakeet and Little Parakeet and Longreach Bays. The experience is that people will observe the signage and utilise access ways thus avoiding free access to bays and beaches over dunes and through vegetated areas. Parakeet bay is an example where an area can recover successfully and relatively quickly once organised facilities are in place to regulate movement patterns.

The Authority has adopted a very firm policy in recent years to actively encourage a clientele which has a respect for and an enjoyment of the Island. Conversely there continues to be active discouragement of the vandal element who have been the source of so much destruction in both settled and non-settled areas in the past.

In summary, the Authority believes, supported by evidence, that numbers of visitors per se are secondary when considering environmental rehabilitation or destruction. A limited number of destructive people will cause vastly greater damage than vast numbers of responsible visitors.

It is meaningless to speak of ceilings on numbers of visitors through the autumn to spring period. Visitor numbers might only average some 200 per day at this time of year and the Island is obviously capable of handling more people. To this end, the Authority together with strong support from the business community, is embarking on marketing programmes together with the scheduling of key events during this off-peak period to encourage visitors at times other than the summer period. Such examples include the highly successful West Australian triathalons which occur in May each year, the Cottesloe Crabs Swim Thru Rottnest in November and the March Festival which was held over the March long weekend in 1991. The positive comment that comes from the majority of visitors to these events supports their continued existence.

1.3 Necessity for the Water Related Services upgrade.
(1.8, 1.9, 1.13, 1.14, 1.15, 1,21, 1.26, 1.27, 1.28, 1.31, 1.37, 1.38, 3.6, 3.21)

The need to upgrade the water services on Rottnest is demand driven. Outfall of untreated mascerated sewage to the ocean at Point Clune is unacceptable and must be stopped.

The present facility using an Imhoff Tank adjacent to the Basin at Pinkys Beach must also be discontinued as quickly as possible. The Imhoff Tank operates most efficiently treating fresh wastewater and, due to the dual class system currently in use, is processing saline water. This is highly inefficient, inadequate for the Island's needs and leads to much of the odour which is currently the subject of so much adverse criticism from visitors and residents alike.

Salt water in the tourist dwellings leads not only to very high maintenance costs but substantial deterioration to the buildings themselves. Photographic evidence supporting this report indicates the types of deterioration to walls and wet area appliances. It is difficult to place a dollar value on the increased cost of maintenance caused by saline water in showers and toilets but this, together with the cost of deterioration to buildings must inevitably be passed onto visitors using the Authority's accommodation.

The added costs of running a dual water over a one class water system can be summarised as follows although it is difficult to put actual dollar values on these points raised:

a) Materials. There is a more rapid breakdown and therefore need for replacement of plumbing materials contingent on the second class water. Such examples would be plumbing parts such as taps, fittings, copper tubing.

b) Labour. There is not only the added labour cost associated with the plumbing work but also associated with gaining access to the areas. This very often requires follow up by tilers or other tradesman to repair the work undertaken.

c) Damage to structural walls and wet areas. It is often necessary (refer to attached photographs) to substantially damage the walls and floors to gain access to the burst or broken piping. Similarly damage occurs to the wet areas especially in showers, laundries and toilets.

d) Accelerated breakdown. There is undoubtedly a much higher attrition rate of appliances such as hot water systems, taps, floor and wall tiles caused by the dual system.

e) Inconvenience to Visitors. Visitors complain frequently of the inconvenience caused through broken fittings and piping but also the loss of goods stored on floors when subjected to flooding from leaking pipes.

f) Other costs which are not so obvious are the accelerated corrosion of pumps and related equipment, quite often causing such rapid deterioration that new pumps have to be replaced or substantially overhauled as little as **ONE MONTH** after installation. A similar situation occurs with reticulation mains and other associated facilities.

There is no question that a new wastewater facility must be developed. The present facility could not handle the added burden of sewage from the Geordie Longreach settlement. In its present location and using existing technology, it cannot adequately process saline wastewater.

NEITHER THE ENVIRONMENTAL PROTECTION AUTHORITY NOR THE HEALTH DEPARTMENT OF WESTERN AUSTRALIA ARE SATISFIED WITH CONTINUED OCEAN OUTFALL OF EFFLUENT FOLLOWING PRIMARY TREATMENT. (1.33, 3.6)

1.4 Water Conservation. (1.7, 1.10, 1.27)

The Authority proposes a number of measures to limit the water consumption by visitors and residents. Limited water shower roses are to be introduced into the units south of the Hotel in Thomson Bay as part of major maintenance programme undertaken between July and October of this year. Spring loaded taps are to be installed progressively so that use of water is limited by people having to stand at the outlet point whilst water is collected.

A range of water conservation devices, including energy and water efficient hot water systems are being reviewed and implemented on a continuing basis by the Authority.

An education programme is in the final stages of development, based around the statement "there's no excuse, we must reduce". This will be thematic including messages related to conserving water usage, electricity, encouraging recycling and encouraging more intelligent use of rubbish disposal receptacles. It is proposed that the water usage signs will be placed beside all taps on the Island. This will complement other signage and brochure material to heighten the awareness of both visitors and residents that Rottnest is in a water deprived climate.

1.5 Treatment of effluent for re-use for human consumption or injection into the ground water system.
(1.33, 2.11, 3.4, 6.7)

The National Health and Medical Research Council will not approve treatment of effluent for human consumption purposes. It is deemed highly undesirable to have a large chlorination plant adjacent to the wastewater treatment facility given the inherent dangers of such a plant and the extensive exclusions zones which would be necessary around this area. Though it is difficult to quantify, it is estimated the costs of development and maintenance of such a chlorination plant would be prohibitive. Reference has been made to recycling of water in the Thames Estuary in the United Kingdom. Proponents have overlooked the fact that such wastewater is pumped back into the Thames following treatment from which it is subsequently taken up and subjected to further treatment before made available through potable water sources. Such a facility does not exist on Rottnest Island.

1.6 Power.
(1.42, 7.19)

Questions have been raised about the need to provide additional power for the water services project. The Authority currently has three new Cummins high speed diesels and three older Blackstone Lister diesels engines. The introduction of the new diesels has substantially improved the efficiency of power generation and it is the Authority's intention to gradually replace the Blackstones as their useful life concludes. No decision has been taken on the relocation of the power house to a more suitable venue. The modern diesels are designed and installed in such a way that they can be relocated should the demand arise or it be perceived to be desirable to relocate the power house away from the settlement area.

1.7 Kingstown Environmental Education Centre. (1.43)

Questions have been raised about linking the Kingstown Environmental Education Centre to the main sewerage system. The Kingstown wastewater treatment plant was substantially upgraded during 1989/90. It is anticipated that this plant will be more than adequate to cater for Kingstown's needs into the future. However, quite deliberately, the service lines for the proposed wastewater treatment plant pass adjacent to the entrance to Kingstown. This has been so designed that Kingstown could be readily linked into the central system should the existing wastewater facility at Kingstown fail and a decision taken to not repair it.

1.8 Composting Toilets. (1.45, 1,46)

The Authority has agreed to the purchase of composting toilets to be placed at Narrow Neck, servicing Marjorie, Rocky and Stark bays and at Oliver Hill. They will be studied in these locations over a period of time to determine their effectiveness on Rottnest Island. Composting toilets could not be introduced into the majority of existing tourist dwellings as the storage tank must be located beneath the pan. This would require substantial excavation and structural modification to the majority of dwellings and would not be deemed suitable at this time.

1.9 Net Present Value Estimates (1.24, 1.25)

The calculations have been undertaken to enable comparison, in net present value terms, of the various options for provision of fresh water on the Island. The authors contend that the figures presented using the formula outlined is a valid basis for comparison.

The mainland pipeline option is between 10 and 13 times more expensive than the preferred options for the provision of water.

2 GROUND-WATER ABSTRACTION - SUPERFICIAL AQUIFER

Reference is made to the following responses from Dr P E Playford, Director Geological Survey of Western Australia in relation to ground-water abstraction from the Wadjemup Hill fresh water lens. (2.1-2.9, 2.12, 2.14, 2.15, 2.17)

In general terms, hydraulic equations underestimate the actual ground-water storage. It is therefore stated that the figures presented in the PER are very conservative and in fact the fresh-water lens has greater capacity than that shown.

2.1 a) Groundwater flow to Barker Swamp will be reduced by increasing abstraction from the Rottnest borefield (HR 2623), near the swamp. However the effects are not expected to be significantly deleterious, and the situation should be monitored.

b) Some nutrients from the proposed effluent disposal site south of the airport may eventually seep into Serpentine and Government House lakes. However it is proposed to carefully monitor such movement of nutrients. (3.1, 4.9)

2.2 The salinity of the Wadjemup Hill fresh-water lens varies seasonally. If abstraction is kept to less then half the estimate of annual recharge then salinities should stabilize and not continue to rise. If the aquifer is properly developed there need not be any significant increase. Experience indicates that careful management leads to improved water quality in these circumstances.

2.3 The extent of the Wadjemup Hill fresh-water lens is larger than that shown in the PER based on more recent work (Hydrogeology Report 1990/91).

2.4 Refer to 2.5 below.

2.5 The GSWA safe yield of 190 000 m^3/year only refers to the ability of continually abstracting this quantity of fresh-water but makes no reference as to the effects of this abstraction on the environment. However, the GSWA believes that the planned abstraction need have no significant effect on the environment, provided the well field is properly managed.

2.6 The GSWA endorses this statement and points out that adequate monitoring facilities have been installed.

2.7 The increase from 96 000 m^3/year is based on the GSWA estimate of 190 000 m^3/year but because of the number of bores required and the difficulty in adequately spacing the bores, the Water Authority put the upper limit at 120 000 m^3/year.

2.8 The effects of abstraction on the environment have not been considered in estimating the available groundwater resource. The effects on vegetation are expected to be essentially nil. The only wetland that may be affected by the abstraction is Barker Swamp, as previously discussed. To date there is no evidence to suggest any adverse effect.

2.9 Refer to 2.5 and 2.7 above.

Reference is made (2.10) to the existing ground-water treatment plant. The Authority is unsure of a response since there is not an existing ground-water treatment plant on the Island. If reference is being made to the Imhoff wastewater treatment plant at the Basin, then the answer is quite simply that it is proposed to be relocated to a site south of the airstrip. The existing plant cannot cater for sewage from the Geordie Longreach settlement (3.6), thus creating the current necessity to dishcarge primarily treated material to sea.

2.12 See 2.8.

2.13 Soil erosion in the existing borefield area was caused by movement of drilling equipment. Once completed, this area is the subject of rehabilitation. The size of vehicles required for regular surveillance and maintenance are very much smaller and do not have the same impact that larger drilling trucks had. Some of these tracks form part of the fire fighting access ways on the West end of Rottnest.

2.14 The Oliver Hill fresh-water lens is much smaller than the Wadjemup Hill lens and as a fresh-water resource would be too difficult to develop because of the generally shallow depth to saline groundwater.

2.15 See 2.7.

2.16, 2.18 The whole concept of an integrated supply utilising catchment water, fresh-water from the borefields and the added facility of "topping up" with desalinated water addresses the demand for a single class water system on Rottnest. This latter facility ensures that the fresh water lens need not be the subject of threatened extra abstraction should the supply from catchment water be diminished in any year due to poor rainfall. The question emphasises the need to have access to each of these three water supplies to ensure the integrity of the fresh water lens on an annual basis.

2.17 Effluent disposal in the area recommended will not contaminate the groundwater of the Oliver Hill fresh-water lens.

2.20 The question raised a number of issues relating to recommendations of the Rottnest Island Management Plan (1985). The following information is provided in response:

Rec 6.2: Implementation is in progress, due for completion in 1992/93.

Rec 10.64: The monitoring, as described, has been implemented and is confirmed in the Mid-Term Review (MTR).

Rec 10.65: The Lighthouse well is infrequently pumped to supply ground-water to the Lighthouse cottage currently occupied by two staff. It is proposed that an off-shoot delivery from the borefield be installed as the supply for the Lighthouse area and Research Station at which time the well in question will be de-commissioned.

Rec 10.66: This has been implemented and measurements of delivery, drawdown and TDS are taken every second day throughout the production season. In past seasons, no bore has been permitted to exceed 1100mg/l where the limit has been set of 1500mg/l. This has resulted in an improved "conditioning" of the aquifer.

Rec 10.67: All bores have been sited, drilled, developed and commissioned on the advice and action of the Water Authority of WA or their predecessor, the Public Works Department.

Rec 10.68 & 10.69: These have been addressed elsewhere in this report.

3 WASTEWATER TREATMENT PLANT AND INFRASTRUCTURE

3.1 Ground-water mound and movement of nutrient rich ground-water. (1.11, 1.12, 1.15, 1.22, 3.1, 3.3, 4.3, 5.8)

The Authority has taken cognizance of the points raised by members of the public in response to the Public Environment Report. As mentioned previously there will be bores in place to monitor movement of ground-water following commencement of reticulation to areas to be reafforested.

It is accepted that this monitoring process can be undertaken by personnel other than those employed by the Rottnest Island Authority as is the practice currently with other monitoring bores. In any event, the laboratory analysis and interpretation is conducted by accredited laboratories on the mainland. The Authority would rely on the input of such accredited laboratories and personnel to both undertake the analysis and interpretation of results. (1.11, 1.12, 5.1, 5.10)

The WAWA have committed resources to training and technical backup for Rottnest Island Authority personnel as required for the management of the facilites. It has been further determined that, when the service-lines are laid, a further pipeline will be laid between the proposed wastewater treatment plant and the most easterly point of the service trench, being adjacent to the Kingstown Environmental Education Centre entrance. This will be undertaken at the time the service trenches are excavated. (1.15, 1.22, 3.3) The treatment plant is approximately 700 metres from Government House Lake (3.1). The Authority undertakes to establish afforestation areas and therefore disposal of effluent <u>at least</u> 800 metres from the saltlakes until comprehensive monitoring and an environmental impact assessment confirms that it is safe to proceed within this boundary (4.3, 4.16, 4.17).

Should the results of ground-water monitoring suggest a flow towards the salt lakes in excess of that predicted or deemed to adversely affect the salt lakes, then the pipe will already be in position for linkage to an ocean outfall probably at Bickley Point. (4.16)

Should such event be likely, then this will become the matter of a separate environmental review in consultation with the Environmental Protection Authority, the Water Authority of WA and interested members of the public.

3.2 Wastewater Afforestation Project evaluation. (1.35, 3.5, 3.7, 3.17, 4.10)

As part of its planning for the water related services project, the Rottnest Island Authority commissioned the consulting firm McArthur & Associates to prepare a wastewater afforestation evaluation for the area in question. This report addresses many of the questions raised in Section Three with particular reference to nutrient usage by plants, soil and vegetation profiles in the area in question and matters pertaining to the water table in this locality.

The report addresses the range of appropriate species and recommends those that are indigenous to Rottnest Island. (3.17)

This report is available for scrutiny at the office of the Environment Protection Authority and the Rottnest Island Authority's Perth offices. (4.21, 4.22, 4.25, 4.27)

3.3 Wastewater Facility Capacity

It is agreed that there may be some advantages in evening out the January flow. However the benefits are likely to be intangible to the reafforestation area providing this area is designed around the likely monthly flow patterns. (eg. design on February flows and over-water during January). (3.4)

A future expansion may never be necessary, but it is WAWA practice to at least keep the expansion option open. The site has been selected with this flexibility in mind. (3.23)

3.4 National Health & Medical Research Council Requirements (1.16, 3.9, 3.10, 3.12, 3.13)

Reference is made to tertiary treatment of wastewater followed by injection into the ground water system. The National Health & Medical Research Council will not approve such a process. Earlier reference in this summary records the Authority's concern at the likely hazards of an expensive chlorination plant with the associated exclusion zone which must be observed around such a plant.

Nitrogen and phosphorus in the effluent will be taken up by:

* plant growth in the afforestation programme, especially when the plants have become established;

* phosphorus will be partially taken up in the limestone of the soil profile;

* nitrification and denitrof within the soil profile. (3.11).

3.5 Environmental Impact at the Wastewater Treatment Site. (3.14)

It must be emphasised that there have been substantial changes to the ecology of the proposed wastewater treatment site. It has been the subject of fires on several occasions causing a substantial change to the mix and intensity of vegetation in the area. Reafforestation will occur with species indigenous to Rottnest Island and any visual impact of revegetated areas will more closely align the landscape to its appearance prior to human settlement and reverse the destructive effects of early events. Such reafforestation will not occur on areas underlain by exploitable ground-water. (3.18, 3.19, 3.21, 4.10)

The existing wastewater treatment plant at the Basin will be rehabilitated through removal of the Imhoff tank, filling in of the ponds and subsequent stabilisation of the area. The outfall at Point Clune will be discontinued and the pipe to the ocean removed. (3.22)

Future expansion of the wastewater treatment plant may never be necessary. It is WAWA practice to select locations and design facilities in such a way that this option remains viable. (3.23) Reference has been made to the sludge from the evaporation ponds. The volume estimated is very low on an annual basis. Sludge will digest on the bottom of the lagoons and should only require removal every few years. As is currently practiced, the material would be trucked to a landfill site at the rubbish tip where it is stored and used over time for soil enhancement as required. This highly nutrient material will not be disposed of in any areas having conservation value. (3.24, 3.25, 7.9)

3.6 Odour from the Wastewater Treatment Facility (3.19, 3.20)

Reference is made to the likely odour from the wastewater treatment plant: the odour from the Imhoff tank is due to the fact that the system, designed for fresh water, is treating saline wastewater. The experience of all visitors and residents is that the present system almost guarantees a daily dose of an offensive odour over the Thomson Bay and/or Geordie Longreach settlements. This is also endured by personnel on craft travelling passed Bathurst Point under most prevailing conditions.

Secondly, the production of odour is directly related to detention time within the sewer itself. There will be no significant odour from the new plant because it is designed as an aerobic system. Whilst the treatment plant is located south-south west of the Thomson Bay settlement, it is some 2km distant from the centre of the settlement. An odour which is not dispersed over this distance under Rottnest wind conditions will be infinitely less offensive than that suffered from the Imhoff tank currently.

4 PLANTATION & WASTEWATER IRRIGATION

(The numbers indicated relate directly to the questions raised in this section)

4.1 Should the need arise to expand the area required for effluent reuse, the matter would be referred by the Rottnest Island Authority to the EPA for environmental assessment.

4.2 Reference is made to the McArthur Report in which the impact of variable effluent loadings on the plantation area is addressed.

4.3 This point is noted and response presented (4.9, 4.11) in this report.

4.4 Regarding quokka grazing pressure, the total area of Rottnest exceeds 1900 hectares. The area in question is very small and will have minimal impact on grazing pressure per hectare over the land mass of the Island.

4.5 Some reference is made to salmonella infections. The wastewater treatment facility will be fenced and covered to ensure that neither quokkas nor birds come into contact with the wastewater at this location. The Health Department of WA records that all aspects of salmonellosis risk are now being well addressed by the management of the Rottnest Island Authority. The Health Department continues monitoring to ensure these high standards are continued.

4.6 Generally, the effluent will be applied in accordance with the National Health and Medical Research Council and Australian Water Resources Council "Guidelines for Use of Reclaimed Water in Australia". Design of the irrigation system is likely to be a combination of "coarse" trickle and spray irrigation to prevent drift to public areas. As there is likely to be some algae in the effluent, the irrigation system must be sufficiently "coarse" to prevent continual blockage.

4.7 Only low levels of suspended solids are expected in the effluent. It is agreed that the algae content has the potential to block trickle irrigation systems and this will be taken into consideration in the final design.

4.8 It should be noted that there is insufficient effluent to fully irrigate the 50-70 ha quoted in the PER (pg 42). A likely approach will be to irrigate a number of discrete zones within the larger area until growth is established, then move on to other areas. These smaller areas will need to be adequately separated to keep groundwater mounding to a minimum.

4.9 The point made is endorsed, but depends on many factors which can only be confirmed by extensive monitoring of the groundwater. The monitoring will be designed to identify early any migration of nutrients to sensitive areas. If this occurs then clearly Rottnest Island Authority will have to modify its effluent disposal practice. (eg ocean outfall) or remove nutrients at the treatment plant.

4.10 Refer to 4.20 over page.

4.11 Groundwater flow will be towards the lakes and the ocean. As previously mentioned it will be necessary to carefully monitor the movement of any nutrients into the lakes.

4.12 Monitoring will continue until it is confirmed that there is no risk to the saltlake ecology from the effluent disposal system.

4.13 Refer to 4.8 above.

4.14 This is addressed in the McArthur Report, available for scrutiny in the offices of the EPA and RIA in Perth.

4.15 Noted.

4.16 Answered with the placement of an extra pipe in the service trench.

4.17 The distance proposed between the plantation area and the salt lakes more closely approximates 1500 metres than 500 metres. (see 3.1)

4.18 Seagulls will be denied access to the effluent ponds by the fact that nets will cover the wastewater treatment plant.

.../17

4.19 The landscape has been modified substantially due to fires and gathering of wood. Garden Island presents a model for the appearance of Rottnest Island vegetation prior to settlement. Thinning of vegetation will occur to provide brush for erosion control and stabilisation in other locations on the Island. This is seen as a highly desirable outcome of the project being implemented.

4.20 The question has been raised concerning effluent disposal. It is not proposed that effluent will be used in the settlement area. Should this be contemplated in the future, then it would be the subject of environmental and health assessment by the EPA and the Health Department of WA. Such a process would involve public consultation before any decision was taken. It is not intended to use treated effluent on the Golf Course.

4.21, 4.22 Addressed by reference to the McArthur Report referring to an area of 50-70 hectares if indigenous species are used.

4.24 Refer to 4.11 above.

4.25 Addressed in McArthur Report.

4.26 Answered in 4.20 above.

4.27 Addressed in the McArthur Report.

4.28 Noted.

4.29 Noted.

4.30 Noted.

4.31 Addressed in McArthur Report and refer to 4.19 above.

4.32 Addressed in various responses above.

4.33 Refer to McArthur Report (4.3 pg 14).

4.34 The species to be grown are those indigenous to Rottnest, being Melaleuca species, Acacia species and Callitris. It is intended that trees be harvested for firewood and the brush used for dune stabilisation and erosion control.

4.35 Addressed in McArthur Report (Section 9 pg31).

5 MONITORING

5.1 The septic tanks on Wadjemup Hill are emptied on a regular basis. Composting toilets may be an option in this location in the future, should they prove successful and should any risk be perceived from the current septic system.

5.2 Base line monitoring has been undertaken. The Authority has commissioned Amdel Environmental Consultants to assess water quality on a twice yearly basis and their reports are available in both the offices of the Rottnest Island Authority in Perth and the EPA in Perth.

5.3 Noted. **5.4** Completed.

5.5 The GSWA is preparing a report on the groundwater-abstraction and water-quality monitoring requirements. The EPA will be asked to prepare a monitoring programme for the lake system. Alternatively the Authority is prepared to develop a monitoring programme to the EPA's satisfaction.

5.6 Dr Playford has advised that the Geological Survey of WA is preparing a report on the ground-water abstraction and water quality monitoring requirements. The Authority, acting on Dr Playford's advice, also requests that the EPA prepares a monitoring programme for the lake system. A commitment is given that such monitoring will be undertaken in accordance with the recommendation presented. Such monitoring, processing of samples and interpretation of results will be reviewed by WAWA and the EPA.

5.7 This information is already being circulated to the EPA, WAWA, Geological Survey of WA and the Environmental Committee of the Rottnest Island Authority.

5.7, 5.9, 5.13 Data is collected biannually for determination of the nutrient status of Garden, Herschel & Government House lakes. The results have been publicly available and are on file in the offices of the Rottnest Island Authority in Perth. They are circulated to the WAWA, EPA, GSWA and members of the RIA Environmental Standing Committee.

5.8 Noted. This is already programmed to be undertaken.

5.11 Noted.

6 DESALINATION AND THE YARRAGADEE BORE

6.1 After the full exploitation of the shallow bores and the existing bitumen catchment, the most economical alternative related to the provision of 54kl p.a. is desalination.

6.2 1994/95 demand is estimated at 180,000kl. Note that the bitumen catchment provides 26,000kl, leaving a shortfall of 54,000kl for the desalinator plant.

6.3 The figure of $3,000,000 referred to relates to the net present value. The figure referred to by Binnies relates to the capital cost of installing the unit.

6.4 It is confirmed that the current cost of desalination is $\$4.50/m^3$.

6.5 Costs/depth - agreed; it is now thought that depth may be up to 2000m and if contract prices are too high, then alternatives will be reassessed.
Purity - this is addressed on page 13 of the PER. Expectations are 5000mg/L TDS.
Quantity/depletion - as quantity to be extracted is small, depletion is not expected.
Environmental impacts - construction impacts are expected to be localised and temporary.

6.6 Salinity needs to be consistent to the desalination plant. Existing shallow wells will not provide this - see 4.3.3 (a) in PER.

6.7 It is agreed that this is a possibility if we can resolve all health related issues with the Health Department. This was raised in the PER (page 19), but will take many years of research to resolve.

6.8 The mineral load of the Yarragadee bore is unknown without drilling.

6.9, 6.10 Monitoring is undertaken on a twice yearly basis of the feedstock water, the outfall water and the desalinated product. The chemical composition of the outfall is similar to that of the second class borewater from which it is drawn; the desalination process changes the concentration of chemicals but does not alter the actual chemical components therein. The outfall from the Lodge desalinator may be discharged to the ocean with hypersaline wastewater from the larger desalination units when they are installed, if it is deemed to be having an adverse effect on the lake ecology.

6.11 Agreed.

6.12 Assumed worst condition - seawater 3:1. 50% increase in salinity (50,000mg/L).

6.13 Reverse Osmosis/anti-scalents or mineral acids for maintenance/discharge to sea.

6.14 It is proposed that the desalination plant will be located approximate to the Yarragadee Bore site if this proceeds. Underground power will be supplied to the site and the saline water will be discharged to the sea at Bickley Bay.

Should a decision be taken that feedstock water for the desalination plant be sourced from existing second class borefields, then it is likely the plant would be located within the water catchment area. In this event, saline water would be discharged through the existing Point Clune outfall pipe.

7 ADDITIONAL ISSUES

7.1 This question has been addressed in earlier responses.

7.2 The commitments presented in Commitment Seven of the PER have already been commenced. The items mentioned are being introduced into the tourist units as part of the next five year major maintenance programme commencing in July 1991 with units south of the Hotel. These costs are not debited to the Water Related Services project but are met from within the Rottnest Island Authority's revenue budget on an annual basis.

7.3, 7.4 An archaeologist will be present for all excavations in areas which could have sensitivity from an Aboriginal point of view or have not previously been disturbed. Reference to figure 1 of the PER indicates that the chosen site for service trenches are along roadways and adjacent to the railway line from Kingstown to Oliver Hill. This route has been deliberately chosen as it is known to be areas in which have been previously disturbed and from which there has been no recorded material of an Aboriginal artifactual or skeletal nature.

If artifacts are encountered, there is a strictly laid down procedure for advising the Aboriginal Sites Department of the WA Museum. At this time, all work comes to a halt until the area is fully examined. There is already in place a stringent set of guide-lines for disturbance of the ground in different areas of Rottnest Island. This has been in operation since 1989 and has proved effective in addressing this very sensitive question.

7.5 Noted.

7.6, 7.11, 7.12, 7.13, 7.14 A water conservation programme, directed at residents and visitors, has already been commenced. It is not proposed to monitor usage in different locations.

7.9, 7.10 Reference is made to increased nitrogen levels at Garden Lake compared with others in the system. Recent analyses confirm seasonal variability in the relative chemistry of the lakes. The possible reasons for nitrogen levels in Garden Lake include:

* To the east of the lake, the area now occupied by the lakeside units was located a vegetable garden and piggery over a very long period. It is probable that nutrients may have moved into the lake system from this area.

The most recent (April 1991) lake chemistry analyses indicate that Garden Lake nitrate and ammoniacal nitrogen levels are slightly lower than Herschel and Government House lakes..

7.17 Reference is made to rain water tanks. The water collected in such tanks is likely to be contaminated from bird droppings and the Health Department of WA does not encourage use of this water for human consumption.

7.18 Building rubble which can later be used on the Island is stockpiled at the rubbish tip. Items which have no future value are required to be moved back to the mainland at contractors' expense.

7.19, 7.20 Reference has been made earlier in this report of the Authority's gradual upgrade of the power generation capacity. There have been substantial economies effected by an improved conversion ratio of fuel to power through the agency of new equipment and fuel additives. Naturally, the Authority is always examining ways of increasing the efficiency of power generation and distribution. Undergrounding the power lines has been a major factor.

7.21 The wind turbine is of value as an ancillary power source only. The Authority must still maintain its baseload generating requirement from sources other than wind power. There being no economically effective ways of storing generated power from wind sources at the present time, a move to substantial wind generation would be determinant totally on prevailing wind conditions. Following financial commitments by the Authority during 1989/90, the switchboard at the power house was upgraded to allow power generated from the wind turbine to be added to the grid in concert with that generated by the diesels.

Significant expense is incurred and time lost from the frequent breakdowns of the wind turbine. Practical experience suggests that this is not yet an economic alternative on Rottnest Island. However the Authority continues to monitor this situation closely and is not averse to future consideration of this as an option.

Dr C J Back
CHIEF EXECUTIVE OFFICER

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