Proposals for irrigated agriculture on the eastern shoreline of Lake Clifton, Waroona

Report and recommendations of the Environmental Protection Authority

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Summary and recommendations

In September 1990 the Water Authority of Western Australia referred to the Environmental Protection Authority four groundwater well licence applications for properties located on the eastern shoreline of Lake Clifton, which forms part of the Yalgorup National Park. Lake Clifton is subject to recommendations under the Darling System - System 6 Study (Red Book - C54) and is listed as a Wetland of International Importance Especially as Waterfowl Habitat, under the Ramsar Convention. It also supports one of the few known populations of a rare and ancient microbial community which produces stromatolites.

The groundwater well licences would support a number of intensive agricultural activities, all of which have a potential to contribute nutrients to Lake Clifton. Evidence suggests that the levels of nutrients entering the lake are critically high. Furthermore, researchers have reported the presence in Lake Clifton of the benthic macroalga, *Cladophora*. This reported growth of *Cladophora* is believed due to high levels of the nutrients nitrogen and phosphorus. It is therefore clear to the Authority that Lake Clifton has exceeded its assimilative capacity for these nutrients and if the growth of *Cladophora* is continued or increased it may threaten the integrity of Lake Clifton's stromatolites.

To protect Lake Clifton from land uses which conflict with the conservation of this wetland, the Environmental Protection Authority considers of fundamental importance the establishment of strict controls on agricultural or residential development within the catchment of that water body.

While the Authority can use assessments such as this present one to recommend against environmentally unacceptable land uses, such a reactive approach is not ideal. It is important that present and prospective landowners in the catchment do not develop unrealistic expectations of allowable land uses in the catchment. It is highly desirable that the environmental constraints on land use, due to the need to protect Lake Clifton and its stromatolites, are clearly conveyed to landowners through the planning process. The Authority has therefore drawn the matter to the attention of the Department of Planning and Urban Development, the Shire of Waroona and the City of Mandurah. Replies from these agencies are available for viewing upon request at the Head Office of this Authority.

The Environmental Protection Authority considers the control of agricultural development on the eastern shoreline of Lake Clifton critical to the conservation of this valued wetland. Consequently, the Authority recommends the following for these agricultural proposals.

Proposal 1 is for a domestic well licence and approximately 20 fruit trees. The Authority considers this proposal environmentally acceptable as long as water use is limited to that for normal domestic abstraction permitted for the Lake Clifton Aquifer.

Recommendation for proposal 1

The Environmental Protection Authority considers that the proposal for Lot 15 Old Coast Road, Waroona, is environmentally acceptable. The Authority therefore recommends that a well licence for domestic consumption only be issued.

Proposal 2 consists of approximately 0.3ha of fruit trees and vegetable garden, to be fertilised with both chemical and organic fertilisers. The Authority acknowledges that fertiliser use in proposal 2 is considerably less than that for many other horticultural proposals, however, the cumulative affect of numerous small horticultural proposals near Lake Clifton will exacerbate the already significant nutrient load in that lake. Consequently, this proposal is considered environmentally unacceptable.

Proposal 3 consists of a commercial market garden and orchard over an area of approximately 1ha. This proposal will require the application of considerable quantities of fertiliser within several hundred metres of Lake Clifton. As this proposal is likely to contribute a significant and unacceptable nutrient load to Lake Clifton, the Authority considers this proposal environmentally unacceptable.

Proposal 4, at Lot 7 Old Coast Road, Waroona, involves the irrigation of lucerne and strawberry clover for horse agistment. As with proposal 2, the irrigated land is within several hundred metres of the Lake Clifton shoreline, a small proportion of which is periodically inundated. Because of the area of property proposed for irrigation, fertiliser use, short distance to groundwater and the proposal's proximity to Lake Clifton, the Authority considers that this proposal may contribute to the nutrient enrichment of Lake Clifton. Therefore, the Authority considers this proposal environmentally unacceptable.

Recommendation for proposals 2, 3 and 4

The Environmental Protection Authority considers that the proposals at Lots 3, 6 and 7 Old Coast Road, Waroona, will result in an inevitable increase in the nutrient load of Lake Clifton. The Authority considers that any increase in the nutrient load of Lake Clifton is environmentally unacceptable and recommends that these proposals not proceed. The Authority therefore recommends the applications for these well licences be rejected.

1. Introduction

In September 1990 the Water Authority of Western Australia referred to the Environmental Protection Authority four groundwater well licence applications for properties located on the eastern shoreline of Lake Clifton. At that time the Environmental Protection Authority decided not to assess the potential environmental impacts of those proposals. This decision was due to a considerable backlog of assessment work current at that time.

Subsequent to this decision, being not to assess the proposals, the Minister for the Environment received a number of appeals against the level of assessment set by the Authority. The appeals were upheld and the level of assessment set by the Minister, for each proposal, was Consultative Environmental Review (CER).

2. The proposals

The Environmental Protection Authority has received the following proposals for irrigated agriculture on the eastern shoreline of Lake Clifton. These lots, zoned rural, are located within the South West Coastal Groundwater Area. These proposals are outlined in Table 1 below, which includes the quantity of water allocated for domestic consumption. At this point the Water Authority's groundwater allocation for domestic consumption, over the Lake Clifton aquifer, is 1500 kL/annum.

Table 1: Summary of proponents, proposed land use and area subject to irrigation

Proposal number	Assessment number	Proponent	Location (Old Coast Road, Waroona)	Proposed use	Total groundwater allocation (kL/annum)	Area (ha)
1	547	Mr E A Scullie	Lot 15	Fruit trees	2000	0.05
2	548	Mr I L Grossman	Lot 3	Fruit trees	3900	0.3
3	546	Mrs F C Lewandowski	Lot 6	Vegetables Fruit, citrus trees	12,000	0.48 0.47
4	545	Mr N Kuhnberg	Lot 7	Lucerne/ clover	13,500	3.6

Proposal 1

This proposal involves the establishment of 20 fruit trees approximately 100-150 m from the shore of Lake Clifton. The proponent has initiated a native tree planting programme and has undertaken to establish further native species to the satisfaction of the Environmental Protection Authority. The tree planting is to provide erosion control and prohibit some movement of nutrients from the property.

Proposal 2

The proposal at Lot 3 Old Coast Road consists of predominantly almond, citrus and stone fruit trees covering a total area of approximately 0.3 ha. The proponent plans to recycle organic material produced on the property and to apply in the order of 30 kg/year Potato E fertiliser. The proponent has already undertaken a limited tree planting programme in order to provide erosion control and prohibit some movement of nutrients from the property.

Proposal 3

This proposal consists of approximately 130 fruit trees and a market garden of 0.48 ha. The area of market garden will be rotated yearly between two plots. The proponent wishes to grow at least two crops per year, with cabbages/cauliflowers as the winter crop and cucumbers as the summer crop. Fertiliser applications for vegetable production and fruit trees will be in line with Western Australian Department of Agriculture farmnotes. It is proposed to plant fruit trees around the area of market garden and native species along the lake boundary.

The Western Australian Department of Agriculture (WADA) recommends the following fertiliser applications for the proposed vegetable crops. This will result in the application of approximately 1540 kg nitrogen/ha/year and 520 kg phosphorus/ha/year in the first year of cultivation. Subsequent years will require 1300 and 250 kg of nitrogen and phosphorus respectively. The fertiliser applications for proposed fruit trees will be approximately 66 and 102 kg/ha/year of phosphorus and nitrogen respectively.

Table 2: Fertiliser recommendations for proposed market garden on Lot 6 Old Coast Road, Waroona. From: McPharlin & Luke (1989) and WADA Farmnotes 92/83 and 114/88

Crop	Status	Phosphorus applied (kg/ha/crop)			Nitrogen applied (kg/ha/crop)		
		Total	Organic	Inorganic	Total	Organic	Inorganic
Cabbage	Established	100	40	60	495	120	375
	New	260	200	60	975	600	375
Cucumber	Established	140	40	100	530	120	410
	New	250	200	50	530	600	410
Cauliflower	Established	120	40	80	570	120	450
	New	280	200	80	1050	600	450

Proposal 4

The proposed irrigation of lucerne and strawberry clover is for horse agistment. The proponent has given a commitment to the Environmental Protection Authority to limit fertiliser applications to 200 kg/ha/year 3:1 Super:potash. This represents phosphate applications of approximately 15 kg/ha/year. Furthermore, the proponent has previously carried out a limited tree planting programme.

3. Assessment of the proposals

These proposals for intensive agriculture are similar in nature and have been assessed concurrently, that is, they have undergone a class assessment. This process is followed when a number of substantially similar proposals are referred for assessment around the same time.

This report is the Authority's report to the Minister for the Environment on the proposals as a class. However, for the purposes of the Environmental Protection Act it should be regarded as the Authority's report for each of the proposals.

The Authority has assessed the proposals on the basis of:

- the information provided in the well licence applications;
- information provided by the proponents;
- issues and information raised in appeals to the Minister;
- site visits by officers of the Environmental Protection Authority;
- discussions with other state government departments and researchers; and

- Lake Clifton, the nature of the Lake Clifton environment and the Authority's knowledge of current irrigated agricultural practice and its environmental effects elsewhere on the Swan Coastal Plain.

4. The existing environment

Lake Clifton is located on the western edge of the Swan Coastal Plain approximately 100 km south of metropolitan Perth. This lake is one of 11 that form the Clifton-Preston lakeland system, which in turn is part of the Yalgorup National Park. However, the Yalgorup National Park does not include much of the area surrounding the lake system. This is also the case with Lake Clifton, where only the lake basin and the immediate foreshore are protected through National Park status. Lake Clifton is subject to recommendations under the Darling System - System 6 Study (Red Book - C54) and is listed as a Wetland of International Importance Especially as Waterfowl Habitat, under the Ramsar Convention. It is recognised by the international scientific community for its living stromatolites.

The lake and groundwater systems in the vicinity of Lake Clifton are closely related (Moore and Turner, 1988). Groundwater flow is in a south-west direction with flows into the lake, whilst water loss is mostly through evaporation. In addition, the lake is not directly connected to the sea and consequently acts as a concentrating basin for inflowing nutrients and salts. This circumstance has created a body of hypersaline groundwater under the lake (Commander, 1988) which enhances the accumulation of mineral nutrients, such as nitrogen and phosphorus.

The stromatolites of Lake Clifton are located predominantly along the lake's north-eastern shoreline. This is thought due to a continuous flow of alkaline groundwaters of low salinity, along the eastern edge of the lake (Moore, 1987). This groundwater flow provides the calcium and bicarbonate necessary for the formation of the mineralised stromatolite structures, whilst protecting the microbial community from desiccation during summer. Groundwater flow into Lake Clifton is summarised in Figure 1 (from Commander, 1988).

An increase of nutrient levels in the lake has been recently reported (Moore and Turner, 1988) and is thought to have precipitated an increase in the population of *Cladophora*, a benthic (bottom dwelling) macroalga. *Cladophora* has been noted to cover the stromatolites in late spring and summer, which may inhibit the growth of these structures during this time. At present this covering is sufficiently light to be largely removed during autumn and winter due to wind-generated wave action.

The alga, *Cladophora*, has proliferated in other large wetland systems, such as the Peel-Harvey Estuary. Its growth and decay has considerably reduced the biological integrity of these systems.

The proposals for intensive agriculture are located on the Yoongarillup soil which forms part of the Spearwood Dune System. The soils adjacent to the shores of Lake Clifton are shallow (0-1 m) and underlain by Tamala Limestone.

5. Environmental impacts

The growth of stromatolites, or thrombolitic microbiolites (Burne and Moore, 1987), appears closely linked to several aspects of the local environment, particularly those of the inflowing groundwater. The Lake Clifton Superficial Aquifer, from which the proposed groundwater abstraction will take place, is a relatively shallow lense of fresh water perched above saline water. Intensive agriculture, which requires large amounts of water and fertiliser, may result in one or more of the following:

- unacceptable nutrient loads to the lake;
- salt water upconing into the fresh water lense;
- reducing the flow of groundwater to the eastern regions of the lake; and
- through evaporation, concentrate the salts in the groundwater.

Any one of the above represents a serious threat to the integrity of the microbial community in Lake Clifton.

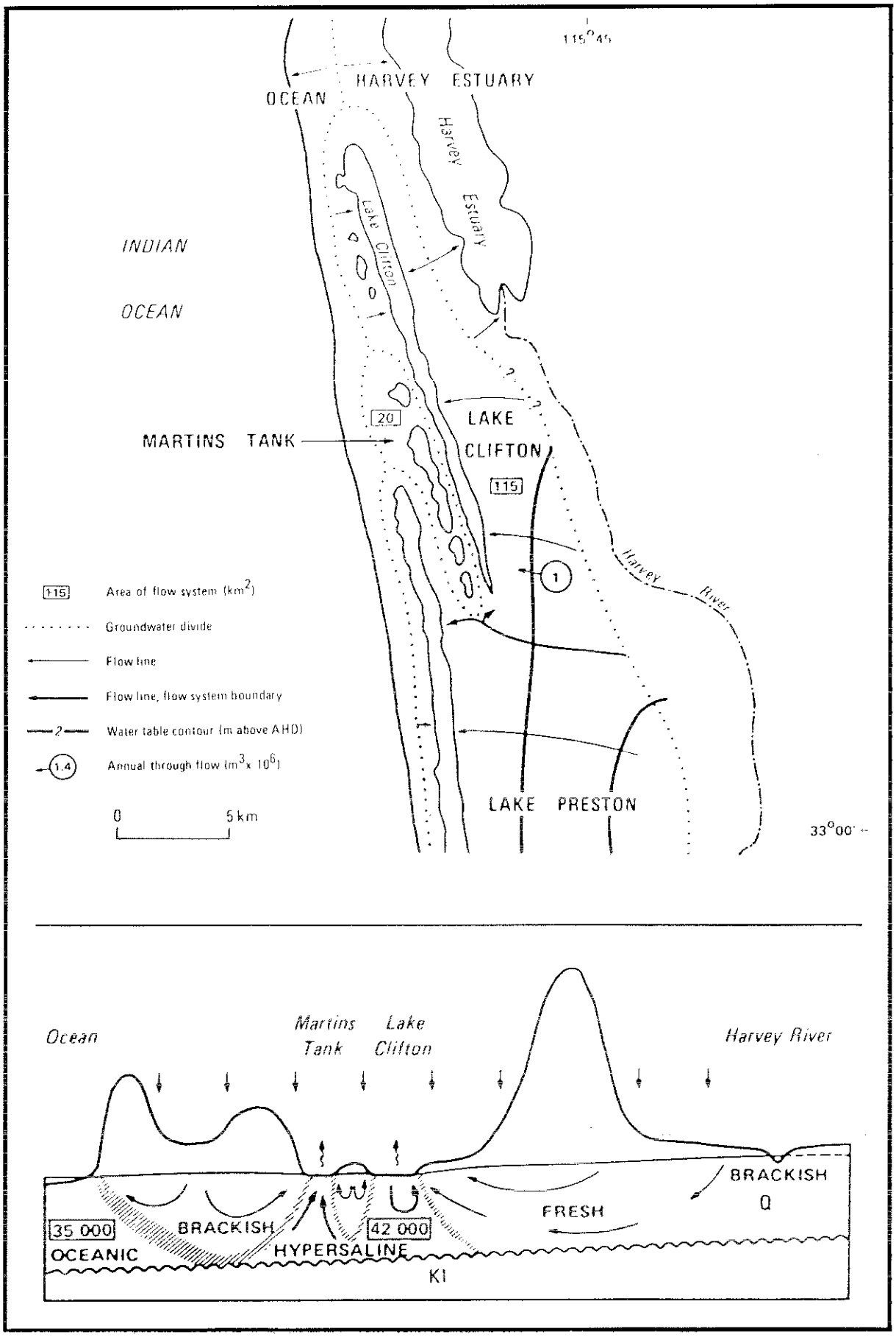

Figure 1: Groundwater flows in the Lake Clifton area

The four proposals for intensive agriculture are located on Yoongarillup soil of the Spearwood Dune System. Land capability studies by the Western Australian Department of Agriculture (Wells, 1989) state that the soils in these properties have only a moderate capacity to support commercial market gardening in a manner which is environmentally sustainable, and that this does not account for proximity to wetlands or shallow groundwater.

Recent increases in the growth of *Cladophora* in Lake Clifton have coincided with an increase in lake phosphate levels, the subdivision of land for "hobby farms", intensification of land use nearby and the establishment of septic sewerage systems. The groundwater catchment of Lake Clifton is extremely localised, with recharge to that system through local rainfall. It is therefore most likely that land use along the eastern shoreline of Lake Clifton has contributed to the proliferation of *Cladophora*. However, the extent of nutrient movement from these properties is variable and may be influenced by the following:

- shallow sands;
- depth to groundwater (1-2 m);
- groundwater movement in limestone is often channelled and therefore rapid; and
- Spearwood soils and Tamala limestone have some capacity to bind and demobilise phosphate.

It is well established that septic tanks and the application of fertilisers on many sandy soils of the Swan Coastal Plain can lead to the nutrient enrichment of surface and groundwater bodies and the subsequent eutrophication of downstream wetlands.

6. Conclusions and recommendations

The Authority has assessed the proposals on the basis of:

- the information provided in the well licence applications;
- information provided by the proponents;
- issues and information raised in appeals to the Minister;
- site visits by officers of the Environmental Protection Authority;
- discussions with other state government departments and researchers; and
- Lake Clifton, the nature of the Lake Clifton environment and the Authority's knowledge of current irrigated agricultural practice and its environmental effects elsewhere on the Swan Coastal Plain.

The Environmental Protection Authority is aware of the considerable land use pressures current in the developing rural areas south of Perth. The increase in "hobby farms", septic tank sewerage disposal and intensification of land use requires a planned approach to land use management, particularly in localities that include sensitive and valued elements of the environment.

While the Authority can use assessments such as this present one to recommend against environmentally unacceptable land uses, such a reactive approach is not ideal. It is important that present and prospective landowners in the catchment do not develop unrealistic expectations of allowable land uses therein. It is highly desirable that the environmental constraints on land use, due to the need to protect Lake Clifton and its stromatolites, are clearly conveyed to landowners through the planning process. The Authority has therefore drawn the matter to the attention of the Department of Planning and Urban Development, the Shire of Waroona and the City of Mandurah. Replies from these agencies are available for viewing upon request at the Head Office of this Authority.

The Environmental Protection Authority considers the control of agricultural development on the eastern shoreline of Lake Clifton critical to the conservation of this valued wetland. Consequently, the Authority recommends the following for these agricultural proposals.

Proposal 1, at Lot 15 Old Coast Road, is for a domestic well licence and approximately 20 fruit trees. The Authority considers this proposal environmentally acceptable as long as water allocation is limited to that for normal domestic abstraction permitted for the Lake Clifton Aquifer.

Recommendation for proposal 1

The Environmental Protection Authority considers that the proposal for Lot 15 Old Coast Road, Waroona, is environmentally acceptable, as long as a well licence for domestic consumption only is issued. The Authority therefore recommends that a well licence for domestic consumption only be issued.

Proposal 2 consists of approximately 0.3ha of fruit trees and vegetable garden, to be fertilised with both chemical and organic fertilisers. The Authority acknowledges that fertiliser use in proposal 2 is considerably less than that for many other horticultural proposals, however, the cumulative affect of numerous small horticultural proposals near Lake Clifton will exacerbate the already significant nutrient load in that lake. Consequently, this proposal is considered environmentally unacceptable.

Proposal 3 consists of a commercial market garden and orchard over an area of approximately 1ha. This proposal will require the application of considerable quantities of fertiliser within several hundred metres of Lake Clifton. As this proposal is likely to contribute a significant and unacceptable nutrient load to Lake Clifton, the Authority considers this proposal environmentally unacceptable.

Proposal 4, at Lot 7 Old Coast Road, Waroona, involves the irrigation of lucerne and strawberry clover for horse agistment. As with proposal 2, the irrigated land is within several hundred metres of the Lake Clifton shoreline, a small proportion of which is periodically inundated. Because of the area of property proposed for irrigation, fertiliser use, short distance to groundwater and the proposal's proximity to Lake Clifton, the Authority considers that this proposal may contribute to the nutrient enrichment of Lake Clifton. Therefore, the Authority considers this proposal environmentally unacceptable.

Recommendation for proposals 2, 3 and 4

The Environmental Protection Authority considers that the proposals at Lots 3, 6 and 7 Old Coast Road, Waroona, will result in an inevitable increase in the nutrient load of Lake Clifton. The Authority considers that any increase in the nutrient load of Lake Clifton is environmentally unacceptable and recommends that these proposals not proceed. The Authority therefore recommends the applications for these well licences be rejected.

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

The Authority's experience is that it is common for details of a proposal to alter as it is established or implemented. In many cases alterations are not environmentally significant or have a positive effect on the environmental performance of the project. The Authority believes that such non-substantial changes, and especially those which improve environmental performance and protection, should be provided for.

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