NEXT MAJOR WATER SUPPLY SOURCE FOR PERTH (POST 1992)

WATER AUTHORITY OF WESTERN AUSTRALIA

Report and Recommendations
of the
Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 343 August 1988

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i SUMMARY AND RECOMMENDATIONS

The Water Authority of Western Australia has stated that following its currently proposed development of the Pinjar groundwater supply north of Perth there will be a need to develop a further water supply source for Perth after 1992 to meet the projected increase in water demands. Four options were considered suitable in terms of environmental, social and economic issues aspects.

This proposal was referred by the Water Authority of Western Australia to the Environmental Protection Authority, which determined that it should be assessed under Part IV of the Environmental Protection Act as an Environmental Review and Management Programme (ERMP). The Stage 1 ERMP prepared by the Water Authority of Western Australia evaluated the four options. This report (Stage 1 ERMP) was released for public comment over a ten week period which ended on the 27 April, 1988.

The Water Authority's preferred option is for a dam on the North Dandalup River with raising of either Mundaring or Canning Dam as equal next best options. The Stage 1 ERMP proposed a fourth option, South Canning Dam, however the Water Authority no longer considers a viable alternative.

There were 27 submissions on the Stage 1 ERMP received by the Environmental Protection Authority. These were from public groups and individuals, local government authorities and Government agencies. Most of the comments focussed on the likely impacts of the proposed North Dandalup dam both in the reservoir/dam area and downstream sections immediately below the dam as well as in the rural areas along the river on the coastal plain. There were also comments on general water use matters in relation to better management delaying the need to develop further water supply facilities in the future.

Apart from the Stage 1 ERMP and the public submissions, the Environmental Protection Authority also has taken into consideration its System 6 Report's recommendations to set aside conservation areas to ensure that there is adequate representation of the flora and fauna in the Darling Plateau/ escarpment areas. This proposal does not adversely impact upon these conservation areas.

The Environmental Protection Authority concluded that the North Dandalup dam is environmentally acceptable and also the raised Mundaring and raised Canning options are environmentally acceptable in principle. However, the Authority has recommended that details of environmental management of all three options be to the satisfaction of the Authority.

The recommendations on the Stage 1 ERMP are as follows:

RECOMMENDATION 1

The Environmental Protection Authority considers that the construction of a dam on the North Dandalup River as proposed in the Environmental Review and Management Programme is environmentally acceptable and recommends that the Water Authority of Western Australia proceed with the preparation of documentation describing specific management proposals for the project and in accordance with the Environmental Protection Authority's recommendations in this report.

RECOMMENDATION 2

The Environmental Protection Authority recommends that prior to construction, the Water Authority of Western Australia provide, to the satisfaction of the Environmental Protection Authority, an Environmental Management Programme for the North Dandalup dam to include details of the following:

(i) environmental consequences of road deviations;

(ii) source of construction materials; and

(iii) the management of the proposal in terms of its environmental impacts in the reservoir, dam and immediate downstream sections of the river and valley during and following the construction phase. This includes the mitigation of potential impacts upon the habitats in the affected areas.

RECOMMENDATION 3

The Environmental Protection Authority recommends that prior to construction, the Water Authority of Western Australia provide to the satisfaction of the Environmental Protection Authority, a management plan, prepared in consultation with the Department of Conservation and Land Management, for Reserve C21038. This management plan should include the following:

(i) proposals for the excision of the dam wall and spillway areas from Reserve C21038;

(ii) management of public access to the Reserve;

(iii) impact of spillway waters on the stream zone;

(iv) impact of the pipeline and maintenance road; and

(v) rehabilitation of the pipehead dam site.

RECOMMENDATION 4

The Environmental Protection Authority concludes that the raised Mundaring and raised Canning options are environmentally acceptable in principle and recommends that before any final decisions are made, the Water Authority of Western Australia refer detailed proposals on these options to the Environmental Protection Authority for assessment.

1. INTRODUCTION

The Water Authority of Western Australia has submitted to the Environmental Protection Authority an Environmental Review and Management Programme (ERMP) on the next major public water supply source (post 1992) for Perth. This Stage 1 ERMP outlines the need for additional water supply sources and lists those options the Water Authority considers are environmentally, socially and economically acceptable. The main purpose of Stage 1 is to seek the Eenvironmental Protection Authority's acceptance in principle of its options selected prior to further detailing of environmental requirements which would be done in Stage 2.

The Stage 1 ERMP concluded that there are four suitable options that could be developed by 1992. These are:

. raising the wall at Mundaring Weir;

. raising the wall at Canning Dam;

. construction of a new storage dam in the South Canning area; and

. construction of a new storage dam to replace the existing pipehead dam on the North Dandalup River.

Of these options, the Water Authority prefers the North Dandalup dam.

A public submission period of 10 weeks ending on 27 April, 1988 on the Stage 1 ERMP resulted in 27 submissions being received. Most of these focussed on the likely impact from the North Dandalup option.

This assessment report was prepared following consideration of both the ERMP and public and Government department submissions during the public review period. A copy of the proponents response to these issues is included in Appendix 4.

2. BACKGROUND

The Water Authority has stated that following the completion of the Pinjar groundwater development, a new major water supply source will be required by 1992. This reasoning is based on current and predicted water consumption demand even in view of the Water Authority's public water conservation programme.

Because of the extent, magnitude and likely environmental implications of developing a new water supply source, the EPA required the Water Authority to prepare an ERMP for this project. It was agreed that it would be a staged assessment, with Stage 1 evaluating the available alternatives and seeking the EPA agreement in principle to the Water Authority's basis for selection of options, then Stage 2 discussing those details the EPA required for any of the options selected in Stage 1.

The framework from which the options were selected by the Water Authority is illustrated in its Source Development Plan as shown in Table 1. The selection of the options from the Plan which were listed in the ERMP was based on three criteria:

1. It must be a "major" source, that is, provide a system yield benefit of more than ten million cubic metres of water per annum.

Table 1: Most Likely Source Development Timetable (includes G & AWS System)

All units millions of cubic metres per annum

D.A.W.=Deep Artesian Well G.W.=Groundwater Scheme P.H.=pipehead P.B.=pumpback St=stage

Year	Forecast unrestricted demand	Sources commissioned (operational)	Groundwater interim quota Scheme	Groundwater interim quota Total	System yield benefit	System yield	Surplus yield
1984/85	210.8	STORAGE RESERVOIRS: Canning,Serpentine, South Dandalup,Wungong (restricted outlet)*, Churchmans,Victoria, Mundaring					
		PIPEHEADS/PUMPBACKS: North Dandalup P.H. Lower Helena P.B.					
		GROUNDWATER SCHEMES: Gwelup	10.5				
		Mirrabooka	16.8				
		East Mirrabooka St 1&2	4.6				
		Wanneroo	21.2				
		Jandakot St 1	4.0				
		Deep Artesian	12.0	69.1		276.2	+65.4
1987/88	239.8	Wanneroo D.A.W.	1.5	70.6	1.5	277.7	+37.9
1988/89	249.4					277.7	+28.3
1989/90	259.9	Pinjar St 1 G.W.	10.2	80.8	11.9	289.6	+29.7
1990/91	269.7	Mundaring Integration			0.0		
		Wungong Outlet Main Amp.			1.1	290.7	+21.0
1991/92	279.7	Deletion of North Dandalup P.H.			-11.5		
		Cockleshell Gully D.A.W. (north)	1.1	81.9	1.1	280.3	+ 0.6
1992/93	290.3	Conjurunup Creek P.H.			5.2		
		Cockleshell Gully D.A.W. (south)	1.3		1.3		
		Jandakot St 2 G.W.	4.0	87.2	4.2	291.1	+ 0.7
1993/94	300.7	North Dandalup Dam (part)			11.0	302.0	+ 1.3
1994/95	311.2	North Dandalup Dam (add)			7.0		
		Pinjar St 2 G.W.	10.9	98.1	11.9	320.9	+ 9.7
1995/96	321.7	North Dandalup Dam (add)			4.0	324.9	+ 3.2
1996/97	332.6	Gooralong P.B.			3.2		
		North Dandalup Main Amp			3.0		
		North Dandalup Dam (add)			4.1	335.2	+ 2.6
1997/98	342.3	Cockleshell Gully D.A.W. (central)	1.3		1.3		
		Whitfords D.A.W.	1.5		2.0		
		Tamworth D.A.W.	1.5	102.4	2.0		
		Raise Mundaring Weir (enlarged Helena Reservoir)			0.0		
		Lower Serpentine P.B. St 2			3.0	343.5	+ 1.2
1998/99	348.7	Pinjar St 3 G.W.	10.9	113.3	12.0		
		Raised Mundaring (part)			3.0	358.5	+ 9.8
1999/2000	355.1	Raised Mundaring (add)			1.0	359.5	+ 4.4
2000/01	361.7	Dirk Brook P.B.			3.0	362.5	+ 0.8
2001/02	368.3	Lexia G.W.	6.5	119.8	7.0	369.5	+ 1.2
2002/03	374.9	South Canning Dam			0.0		
		Araluen P.B.			1.8		
		Raised Mundaring (add)			3.0		
		Hamilton Hill D.A.W.	1.5	121.3	2.0	376.3	+ 1.4
2003/04	381.6	Marrinup Brook P.B.			5.3		
		Lake Thompson D.A.W.	1.5	122.8	2.0	383.6	+ 2.0
2004/05	388.4	Lower South Dandalup P.B.			4.4		
		East Mirrabooka St 3 G.W.	2.0	124.8	2.0	390.0	+ 1.6
2005/06	395.2	Yeal St 1 G.W.	7.8	132.6	9.0	399.0	+ 3.8
2006/07	402.0	Raised Mundaring (add)			3.0		
		South Canning Dam (part)			2.0	404.0	+ 2.0
2007/08	408.9	Jane Brook P.B.			6.1	410.1	+ 1.2
2008/09	415.9	Yeal St 2 G.W.	7.8	140.4	9.0	419.1	+ 3.2
2009/10	423.1	South Canning Dam (add)			4.0	423.1	+ 0.2

* Assumes Wungong Tunnel and outlet pipes completed to South West Highway.

Source: Water Authority, Stage 1 ERMP.

2. It must be able to be developed and commissioned by 1993 if required.

3. It must be financially feasible in the current political and economic climate.

The evaluation of alternative source development options included:

. groundwater aquifers;

. deep artesian sources;

. desalination of sea water;

. forest thinning to improve efficiency of surface water catchments;

. developments of existing and new dam sites; and

. transportation of ice-bergs (see Table 2).

This evaluation process resulted in the selection of four possible source development options:

. raising of Mundaring Weir (raised Mundaring);

. raising of Canning Dam (raised Canning);

. construction of a dam at South Canning; and

. construction of a new dam at North Dandalup (North Dandalup).

However, in July 1988, the Water Authority advised the EPA that from further investigations of water quantity and quality, the South Canning dam option is now no longer considered a feasible option (see Appendix 1). Thus, it should be noted that the Environmental Protection Authority's assessment of the Stage 1 ERMP only refers to the three remaining options.

3. DESCRIPTION OF PROPOSAL

This proposal encompasses the three options, each of which represents the economic optimum size. The details of each option are listed in Appendix 2 and a summary is shown in Table 3.

Of these options, the Water Authority has selected North Dandalup as the best option to undertake first, with the remaining two to be possibly constructed at a later date beyond 1992.

3.1 NORTH DANDALUP DAM

The North Dandalup dam would replace the existing pipehead dam, although its location would be about 200 m further upstream. It is intended that the existing pipehead dam would be demolished. The new dam would be an earth wall about 224 m AHD or about 54m above stream level. It would also include two small earth dams located north of the new site in the low valley feature between two hills (see Figure 1). The total catchment upstream from the site is about 153 km^2 of which 505 ha would be within the Full Supply Level of the reservoir. The maximum storage capacity would be about 75 million cubic metres.

Table 2. Water supply development options considered for the Next Major Source

Category	Source Name	System yield Benefit (Mm3/yr)	Able to be developed by 1993	Approx. cost (c/kL)	Reasons for rejection or acceptance as a viable alternative for the next major source
1. Non-feasible options	• Ord River	>10	No	1020	
	• Icebergs	>10	No	very expensive	
	• Solar distillation	>10	No	very expensive	
2. Long-term options	• Desalination of sea water	>10	No	>150	Too expensive
	• Swan-Avon Trib. (Wooroloo, Brockman, Jullimar, Red Swamp)	2 - 34	Yes	67 - 91	Too expensive
	• Murray River - Outside Lane-Poole - Tributary Devel.	150 21	No No	83 32	Too expensive Precluded by vesting of Lane-Poole Reserve
	• Forest thinning	>10	No	<10	Feasibility studies in progress but not able to be developed by 1993.
3. Medium term surface water options	• Helena River redevel. (Upper Helena, Darkin or Lower Helena)	9 - 13+	Yes	35 - 60	A number of alternative schemes were considered but found to be considerably more expensive and have greater engineering problems than the option of raising Mundaring Weir.
	• Victoria/Bickley redevelopment	3	Yes	51	Yield small and too expensive
	• Conjurunup Dam	3.3	No	40	Yield small and too expensive.
	• Lower Sth Dandalup Pumpback	4	Yes	30	Yield small (a full dam proposal was considered but was still small and was more expensive than the pumpback proposal).
	• Martinup (Pumpback or Dam)	5 - 7	Yes	31 - 32	Pumpback and dam yield are small and the dam would flood a section of the Hotham Valley Railway
	• Swan-Avon Trib. (Jane & Susannah pumpbacks)	1 - 6+	No	25 - 31	Yield small and could not be developed in time
	• Pumpback developmnts (Dirk, Gooralong, Lower Serp. St. 2)	3+	Yes	20 - 36	Individually too small. Yields depend on a new major storage dam and hence the three as a package would still be too small.
	• Harvey River	30	No	36	Expensive source timed to meet the expected growth in Mandurah demand post 2010. Resolution of water resource allocation issues prevent development by 1993.
4. Medium term groundwater	• Pinjar Stages 2 & 3	12+	Yes	>35	Development timed to meet local demand growth in the adjacent North-West Corridor. Additional cost involved in developing earlier would make them too expensive.
	• Barragoon, Yeal, Loxia	7 - 9+	No	40 - 50	As with Pinjar, these sources are timed to meet local demand growth in the North West Corridor and hence not able to be developed by 1993.
	• East Mirrabooka St 3	2	Yes	26	Yield small.
	• Jandakot South Stages 1 & 2	3+	Yes	45	Yield small and expensive
	• Dandalup	10	Yes	39	Too expensive.
	• Karnup	7	Yes	38	Yield small and expensive.
	• Deep Artesian Wells (7)	2+	No	12	The seven wells are individually small, and their development timing is dependent on an increased demand on adjacent service reservoirs to allow mixing. Hence theycould not be developed as a package by 1993.
5. Viable alternatives	• Raised Mundaring Dam	11	Yes	18	Large, can be developed in time and financially realistic.
	• Raised Canning Dam	10	Yes	28	Large, can be developed in time and financially realistic.
	• South Canning Dam	12	Yes	20	Large, can be developed in time and financially realistic.
	• North Dandalup Dam	14	Yes	19	Large, can be developed in time and financially realistic.

Notes
Mm³/yr = million cubic metres per year
c/kL = cents per kilolitre
+ Yield for each source

Source: Water Authority Stage 1 ERMP.

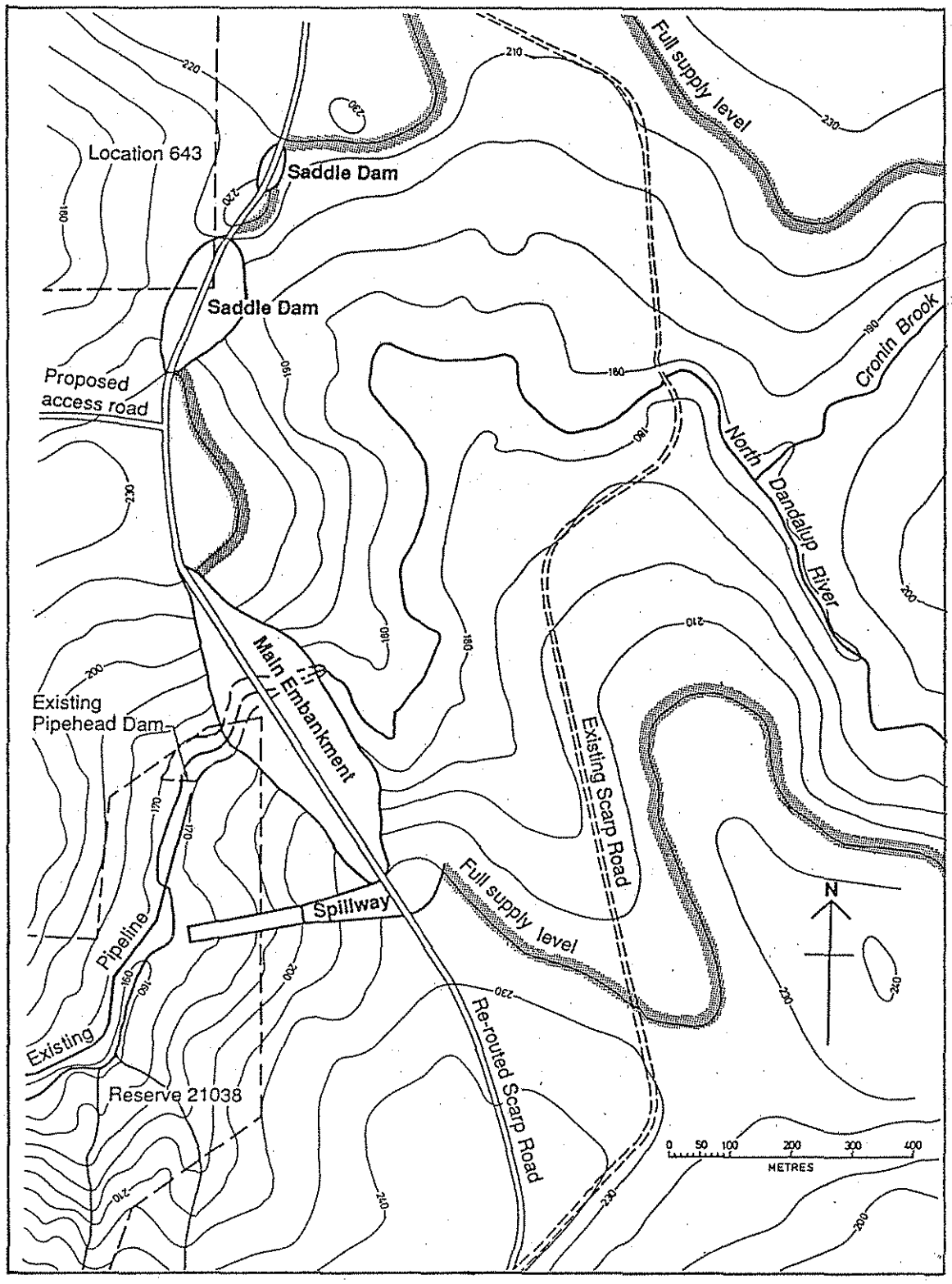

Figure 1: North Dandalup Dam; Plan of Works

Source: Water Authority Stage 1 ERMP.

Table 3. Some basic physicals dimensions of the three options.

	PROPOSED WALL HEIGHT (m)	STORAGE CAPACITY INCREASE (x $10^6 m^3$)	SURFACE AREA (ha)	ADDITIONAL SYSTEM YIELD BENEFIT (x $10^6 m^3$ per year)
Raised Mundaring	154 (AHD) (increase of 11.5)	200 (increase of 123)	1400 (increase of 640)	11.0
Raised Canning	217 (AHD) (increase of 11.5)	170 (increase of 80)	850 (increase of 350)	9.9
North Dandalup	224 (AHD) (54 above stream level)	75	505	13.8

Source: Water Authority Stage 1 ERMP.

The Water Authority has described North Dandalup as the best source available for development in terms of meeting the nominated objectives for water supply, economics, natural and social environment. The Water Authority also considers that the North Dandalup dam has the least significant impact on the natural environment.

3.2 RAISED MUNDARING

The existing wall would be increased by 11.5 m to 154 m AHD, which would increase storage capacity by 77 million cubic metres to 200 million cubic metres and result in a maximum reservoir surface area of 1400 ha, an increase of 640 ha.

3.3 RAISED CANNING

This would, like Raised Mundaring, have its wall increased in height by 11.5 m, to 217.5 m AHD. This would result in a new storage capacity of 170 million cubic metres and an addition of 350 ha of its reservoir's surface area to a total of 850 ha.

4. REVIEW OF PUBLIC SUBMISSIONS

The Stage 1 ERMP was open for public comment by the EPA for a period of 10 weeks and closed on the 27 April 1988.

The EPA received a total of 27 submissions, of which there were 5 from local governments and 7 from State government departments, and 15 from members of the public. A list of the issues raised in the submissions appears in Appendix 3.

4.1 NORTH DANDALUP

The majority of submissions focussed on the proposed construction of the North Dandalup dam rather than on the other development options. In brief, there were 5 submissions which directly opposed the proposed construction of

the North Dandalup Dam and 6 could accept the proposal subject to sufficient water being released to maintain natural water flow in the downstream section. Of the remaining submissions on North Dandalup, 13 made general comments, most of which showed concern about future management requirements.

The main environmental concerns raised in the submissions included:

- loss of access to river water throughout the year by farmers downstream of the proposed dam site;
- impact of dam on indigenous flora and fauna;
- loss of aesthetic value of North Dandalup valley;
- loss of valuable social and recreational resource; and
- detrimental impact of the reduced downstream flow on the coastal environment, especially the Peel/Harvey Estuary.

4.2 RAISED MUNDARING AND RAISED CANNING

Some of the submissions suggested that the assessment of the environmental impacts of these two options is relatively brief compared to the North Dandalup dam. In particular, it was suggested that there are only brief statements on the general aspects of the environmental impact of these options.

5. ENVIRONMENTAL ASSESSMENT AND MANAGEMENT OF PROPOSAL

The EPA has considered public comments received during the public submission period. It was found that the submissions have supplied information that assists in the assessment of the proposal and the preparation of future directions.

It is clear from the Stage 1 ERMP and public submissions that the North Dandalup dam proposal has received the main focus of discussion. However, some detail has also been provided on the raised Mundaring and raised Canning options.

A system of conservation reserves has been established following the Environmental Protection Authority's System 6 Report and subsequent detailed examination of these areas by the Reserves Review Committee. These reserves properly conserve representative examples of the ecotypes found in the northern jarrah forest. As well, this system of Reserves identified catchments which should be protected. The three options proposed by the Water Authority of Western Australia would not adversely affect any of the conservation areas, except for a possible small area of inundation in the Monadnocks Reserve should the raised Canning option proceed.

The Environmental Protection Authority has concluded that because this reserves system is in place and that these proposals would not adversely affect it then all three are environmentally acceptable in principle.

However, the Environmental Protection Authority recognises that in all three options some specific areas of conservation value would be destroyed or degraded, if they were constructed. For example, in both the raised

Mundaring and raised Canning options some unusual site vegetation types which have limited distribution, several species of rare or restricted plants and some bird habitats would be affected by inundation.

While these in themselves are not sufficient to recommend against the options proceeding, nevertheless, specific details in the form of an Environmental Management Plan should be submitted to the Environmental Protection Authority in order to demonstrate to the Authority's satisfaction that these impacts have been minimised and managed.

The following is an assessment of the environmental impacts of all three source options.

5.1 NORTH DANDALUP

There are both environmental and social aspects which require consideration in the assessment of this option.

5.1.1 NATURAL ENVIRONMENT

Four main areas of impact arise from the proposed construction of this dam, namely: the reservoir area; the dam wall (including the two saddle dams) area; the immediate downstream area; and, the outflow area in the escarpment and Swan Coastal Plain. Minor aspects, although of importance, include such things as road deviations.

The reservoir area is the area which would be subject to the greatest disturbance. A total of 505 ha would be inundated including sections of the river fringe, and mid to lower valley ecosystem and habitats.

The plant and animal surveys described in the Stage 1 ERMP have been comprehensive in terms of the species present. However, there has been limited indication of whether the ecosystems in this area are significantly different from those in other parts of the catchment. This is particularly relevant in the upstream area of the escarpment.

The Authority considers that the flora and fauna surveys detailed in the Stage 1 ERMP provides a suitable basis for the interpretation of the reservoir ecosystem. The significance of the loss of the reservoir area through inundation should be addressed in the Stage 2 ERMP.

The effect on the dam wall area is similar to that on the reservoir area outlined in the preceding section.

The downstream section's ecosystem aspects require further attention in terms of stream flow during construction and operation of the dam. This is of particular concern to the EPA in terms of its System 6 Report as recommendation area C49 (Reserve 21038) includes part of the dam wall, the stream zone and the pipeline/access road zones. Although the Reserve is currently for the purpose of Parkland and Recreation, not vested, the System 6 Report recommends that the purpose be amended for Conservation of Flora and Fauna and Water and to be vested in the National Parks and Nature Conservation Authority.

The Stage 1 ERMP discusses the water quantity and quality aspects, the latter having been mainly based on EPA data (see Appendix 5 of ERMP), in terms of the dam's impact on the Peel Harvey Estuary System. The EPA has produced further information in relation to drainage nitrate-nitrogen concentrations emanating from various "hills" catchments. This information

indicates that at both the North Dandalup tributary and North Dandalup pipehead dam, water concentrations are below 0.1 mg nitrate-nitrogen per litre.

Another matter of concern is the impact of spillway water on the immediate discharge point in the stream and the stream zone downstream especially in relation to possible threats to the integrity and purpose of the System 6 recommendations.

5.1.2 OTHER ASPECTS

Other aspects which should be considered by the Water Authority in its preparation of further details include:

- the impact on the environment from the proposed road deviations and (this should be addressed in terms of ecosystems as well as individual plant and animal species and habitats);

- source of construction materials;

- management of recreation aspects, particularly in terms of public access to the System 6 recommendation area C49. The Environmental Protection Authority would not encourage any access other than via managed routes and this would require consultation with Conservation and Land Management; and

- provision for the excision of the dam wall and spillway area from Reserve 21038. This should be discussed more fully in consultation with Conservation and Land Management and the Environmental Protection Authority.

5.2 RAISED MUNDARING AND RAISED CANNING

It is clearly shown in the Stage 1 ERMP that there are matters of environmental concern which would result if either Mundaring or Canning Dam were raised. In fact, the environmental aspects listed appear to be of greater significance than those occurring at North Dandalup. In view of this, the Water Authority should prepare further detailed information on these environmental issues for consideration by the EPA when these options are proposed to be constructed.

5.3 COMMENTS AND RECOMMENDATIONS

The purpose of the Stage 1 ERMP report was to seek from the Environmental Protection Authority:

(i) approval in principle to North Dandalup as the preferred option for the next major water supply source for Perth; and

(ii) agreement to the preparation of a Stage 2 report, which would address the detailed planning of the proposed dam.

The EPA notes that the Source Development Plan referred to in the Stage 1 ERMP reflects the current position of catchment development outside those which have been identified and/or set aside for conservation purposes, as earlier stated in Section 5 of this report. However, it is noted that each location contains specific conservation aspects especially for the raised Mundaring and Canning options, and these should be referred to the EPA.

The EPA considers the North Dandalup option to be environmentally acceptable but various aspects require further reference in the detailed planning of the proposed dam.

RECOMMENDATION 1

The Environmental Protection Authority considers that the construction of a dam on the North Dandalup River as proposed in the Environmental Review and Management Programme is environmentally acceptable and recommends that the Water Authority of Western Australia proceed with the preparation of documentation describing specific management proposals for the project and in accordance with the Environmental Protection Authority's recommendations in this report.

RECOMMENDATION 2

The Environmental Protection Authority recommends that prior to construction, the Water Authority of Western Australia provide, to the satisfaction of the Environmental Protection Authority, an Environmental Management Programme for the North Dandalup dam to include details of the following:

(i) environmental consequences of road deviations;

(ii) source of construction materials; and

(iii) the management of the proposal in terms of its environmental impacts in the reservoir, dam and immediate downstream sections of the river and valley during and following the construction phase. This includes the mitigation of potential impacts upon the habitats in the affected areas.

The Environmental Protection Authority has noted that its System 6 Report's recommendation area C49, Reserve C21038 has an existing Water Authority of Western Australia pipehead dam, pipeline and access road located within the Reserve at present.

The proposed construction of the North Dandalup dam on the north east boundary of the Reserve would allow the removal of the pipehead dam and rehabilitation of the site.

However, to ensure potential environmental impacts on the Reserve from the North Dandalup dam are minimised, the Environmental Protection Authority makes the following recommendation.

RECOMMENDATION 3

The Environmental Protection Authority recommends that prior to construction, the Water Authority of Western Australia provide to the satisfaction of the Environmental Protection Authority, a management plan, prepared in consultation with the Department of Conservation and Land Management, for Reserve C21038. This management plan should include the following:

(i) proposals for the excision of the dam wall and spillway areas from Reserve C21038;

(ii) management of public access to the Reserve;

(iii) **impact of spillway waters on the stream zone;**

(iv) **impact of the pipeline and maintenance road; and**

(v) **rehabilitation of the pipehead dam site.**

The EPA also considers that the raised Mundaring and raised Canning options are environmentally acceptable in principle in terms of the information so far supplied by the Water Authority in its Stage 1 report. However, before any final decisions are made on these two options the EPA would require further information.

RECOMMENDATION 4

The Environmental Protection Authority concludes that the raised Mundaring and raised Canning options are environmentally acceptable in principle and recommends that before any final decisions are made, the Water Authority of Western Australia refer detailed proposals on these options to the Environmental Protection Authority for assessment.

APPENDIX 1

WATER AUTHORITY LETTER REGARDING SOUTH CANNING

APPENDIX 1

WATER AUTHORITY of Western Australia

629 NEWCASTLE STREET
LEEDERVILLE W.A.
Postal Address: P.O. Box 100 Leederville
Western Australia 6007
Telephone: (09) 420 2420 Telex: AA 95140
Facsimile: (09) 328 2078

Your Ref
Our Ref A20303
Enquiries R Stone
Tele Direct 420 2733

Mr B Carbon
Chairman
Environmental Protection Auth.
1 Mount Street
PERTH WA 6000

(Attention: Mr C Murray)

NEXT MAJOR PUBLIC WATER SUPPLY SOURCE FOR PERTH (post 1992)
ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME - STAGE 1

The Water Authority is presently completing a major review of the Sources Development Plan to accommodate a number of significant changes in assumptions basic to the plan:

- new population projections provided by the State Planning Commission ("Planning for the Future of the Perth Metropolitan Region");
- current trends in the rate of increase of per capita water demand;
- expected reduced demands due to the Water Conservation Strategy;
- adjusted streamflow records reflecting a drier rainfall period since 1947 than the full record previously used;
- recognition of the scientific opinion expressed at the Greenhouse 87 Conference that the Greenhouse Effect will result in a further reduction in rainfall in the south-west of Australia;
- reduced yield potential from the Yarragadee Formation artesian aquifer.

The effects of reduced demand projections and reduced yield estimates substantially cancel each other when deciding the need for new sources. However, some of the resulting changes in the recommended timetables for source development are quite significant in their impact on planning activities. Those changes with most significant effects on short-term planning activities are:

- The date for commencement of construction of North Dandalup Dam has been deferred to September 1993 and the commissioning date to June 1996 in the 'most likely' timetable. However, the 'maximum' timetable would require the present design and construction schedule to be maintained, with construction starting in September 1991 and commissioning in June 1993. North Dandalup

dam's yield benefit has been estimated to be achieved over a 4 year period instead of 2 years.

- South Canning dam has been dropped from the list of possible sources on the present Plan due to the uncertainty with estimated yield benefits and possible salinity problems.

- Preliminary figures of total consumption for 1987/88 indicate a Gross Output of 223 million cubic metres (including supply to G&AWS). This is above the projected 'most likely' demand and should be taken as a warning that the 'maximum' timetable may yet have to be implemented unless the Water Conservation Strategy can be demonstrated to be achieving its objectives.

Therefore, if the 'maximum' timetable does need to be implemented the timing of North Dandalup would remain as proposed in the Stage 1 ERMP, 1993. If demand can be moderated in accordance with the objectives of the Water Conservation Strategy the commissioning date could be deferred to 1996. In either event the timing is such that the Water Authority believes it is appropriate to continue the engineering and environmental planning process commenced in 1986.

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A/MANAGER
WATER RESOURCES PLANNING

July 13, 1988

(WR-M173) BC

APPENDIX 2

KEY PARAMETERS OF ALTERNATIVES FOR THE NEXT MAJOR SOURCE

Appendix 2 Key Parameters of the Alternatives for the Next Major Source (Economic optimum size if developed as the next major source)

Details	Raised Mundaring Weir	Raised Canning Dam	South Canning Dam	North Dandalup Dam
STRUCTURE				
Site	Present dam site	Present dam site	Approx 1.5 km NE of Eagle Hill, U/S of Scenic Drive Gauging Station	Approx 200 m U/S of Pipehead
Type of Structure	Concrete	Concrete	Embankment	Embankment
Dam Crest Level (m A.H.D.)	154	217.5	271	224
Dam Crest Length (m)	460	1250	580	660
Height of dam or Raising (m)	11.5	11.5	37	54
CATCHMENT				
Area (km^2)	1482	727	495	153
Mean rainfall (mm p.a.)	800	950	880	1300
Mean streamflow ($m^3 \times 10^6$)	48.6	57.5	23.1	29.9
RESERVOIR				
Full supply level (m A.H.D.)	150	216	267	219
Storage capacity ($m^3 \times 10^6$)	200	170	215	75
Additional storage ($m^3 \times 10^6$)	123	80	215	75
Surface area (ha)	1400	850	2450	505
Additional area (ha)	640	350	2450	505
System yield benefit ($m^3 \times 10^6$ p.a.)	11.0	9.9	11.6	Total 25.0[1] Net 13.8[1]
Mean system annual draw ($m^3 \times 10^6$ p.a.)	11.7	7.9	10.0	13.1
Mean annual draw of the source ($m^3 \times 10^6$ p.a.)	5.9	2.5	11.1[2]	12.9
Time to develop full yield (years)	10	7	16	4
STREAMFLOW UTILISATION[3]				
Draw/Inflow	62% (54%)	77% (73%)	51% (0%)[2]	81% (40%)
Overflow/Inflow	27% (39%)	19% (25%)	17% (0%)	11% (60%)
Net Evaporation/Inflow	11% (7%)	4% (2%)	32% (0%)	8% (Minimal)
COSTS[4]				
Capital Cost (Millions $)	22.4	36.4	23.2[5]	34.8
Operating Cost (Thousands $ p.a.)	200	130	174	222
Present Value Total (PVT) (Millions $)	25.6	38.5	26.0	38.4
PVT/Yield ($/$m^3$ p.a.)	2.33	3.89	2.24	2.78[1]
Cost (Cents/m^3)	18.2	29.1	20.3	18.6
PVT of development timetable (Millions $)	397.6	412.3	392.6	363.8
Sequence of major sources	RM > ND > SC	RC > ND > RM	SC > ND > RM	ND > RM > SC

1. The net system yield benefit of 13.8 for North Dandalup Dam is made up of a total yield benefit of 25.0 minus 11.2 for the deletion of the existing North Dandalup Pipehead, which must be demolished to make way for the construction of the dam. The quoted PVT/Yield for North Dandalup is based on the net yield benefit.
2. The draw for South Canning are releases, not releases plus overflow.
3. The streamflow utilisation shows the potential utilisation due to the proposed project and in brackets the existing utilisation. The inflow includes pumpback flows from the Lower Helena P/B. The P/B flow increases as the capacity of Mundaring is increased.
4. All costs are given in December 1986 dollars. Present value totals are calculated for a discount rate of 6%.
5. The capital cost of South Canning includes $650 000 for the realignment of an SEC power transmission line.

Note: The South Canning option has been deleted from the Source Development Plan by the Water Authority

Source: Water Authority Stage 1 ERMP.

APPENDIX 3

SUMMARY OF ISSUES RAISED IN PUBLIC SUBMISSIONS

SUMMARY OF ISSUES RAISED IN PUBLIC SUBMISSIONS

GENERAL WATER USE

- Water is currently wasted in the Perth metropolitan area. There should be no more dams constructed, but more economical use made of the water resources already available to us. The expected water demand is exceeding the existing water supply.

- A water conservation option through water restrictions is viable and should be implemented immediately. Disagree with the ERMP assumption that water restriction policies are not viable alternatives.

- Perth's water problems need to be addressed in a broader sense, and the proposed dam will only defer water supply problems.

- The Water Authority's role should change from that of being 'water provider' to 'water manager'

- More research is required regarding the long term water demand management of the Perth water supply.

- The Water Authority of Western Australia had already predetermined that the proposed North Dandalup dam was its preferred source long before the ERMP was prepared, and other options such as raising the Canning Dam or Mundaring Weir were inserted into the assessment process as token or straw options.

- Therefore as research was oriented towards the North Dandalup option, the Water Authority did not adopt a scientific approach and the ERMP is flawed.

- There are also shortcomings in water supply considerations and the selection of feasible alternatives included the two 'raising the dam wall options'. These are unrealistic as they are dependant on a sequence of very wet years for them to have any real affect on the water supply.

IMPACT ON WATER QUALITY

- Proposed dam may have an adverse effect on the local water quality of both groundwater and stream water. Groundwater in the area is already becoming increasingly saline and the dam may contribute to this problem.

- Construction of the proposed dam will exacerbate already existing problems created as a result of other dam construction in the hills. This will have an indirect impact on the coastal environment ie contribute to nutrient enrichment problems in the Peel - Harvey system and reduce fresh water flushing in the river system.

IMPACT ON THE NATURAL ENVIRONMENT

- There is inadequate justification in the ERMP for the conclusion that North Dandalup is the least environmentally significant option. Differences on the effect of a new development on relatively undisturbed land as compared to enlarging an existing 'landscape scar' have been ignored.

SUMMARY OF ISSUES RAISED IN PUBLIC SUBMISSIONS (Cont'd)

. Access to nearby bauxite mining areas should be retained.

SUGGESTIONS

. A sound environmental management programme should be established which would protect and conserve rare and endangered species of flora and flora.

. Further information should sought from local south west Aboriginal groups before ethnographic merits of the development are discussed.

. Water charges should be introduced for all water used so per capita use is reduced, and bores monitored.

. Population growth and industrial development should be restricted to be within the constraints available through available supply and quantity of water.

. Water Authority should research possibilities of inducing rain.

. A continual flow of water should be maintained throughout the year in the North Dandalup valley.

. More ecologically sound water alternatives should be addressed by the Water Authority eg desalinisation techniques, water recycling, rehabilitation of degraded areas.

. If the proposed dam is constructed, reafforestation programmes should be undertaken in other areas where timber has been cleared to make up for the timber loss.

. Water monitoring programmes in the Perth metropolitan area should be increased.

APPENDIX 4

WATER AUTHORITY RESPONSE TO ISSUES RAISED IN PUBLIC SUBMISSIONS

NEXT MAJOR PUBLIC WATER SUPPLY SOURCE FOR PERTH (post 1992)

Environmental Review and Management Programme
Stage 1: Evaluation of Alternatives

Water Authority Response to Public Comments
Submitted to Environmental Protection Authority

WATER SUPPLY PLANNING PROCESS

As described in the ERMP and detailed in the Water Authority publication "Planning Future Sources for Perth's Water Supply" (Mauger, 1987), the Water Authority uses a Sources Development Plan (SDP) as the basis for planning the development of the Perth region's water supply. The SDP ranks potential sources according to their cost effectiveness, and unless constrained by other factors, the most economic sources are scheduled to be developed first. The timing of when sources are developed is a function of the increase in demand for water. However, the SDP is only a planning base and nominated sources are modified, re-scheduled or deleted to satisfy environmental, social or technical constraints.

The evaluation investigation which culminated in the preparation of the Next Major Source (post 1992) Stage 1 ERMP commenced by establishing the need for a major increment in supply capacity and the essential characteristics (criteria) for the next major supply source (see ERMP Section 4.1). The characteristics were checked against the sources appearing on the SDP at that time and some additional sources which appeared worthy of consideration. Only four sources satisfied all three requirements and were thereafter considered as the feasible alternatives.

One submission received by the Environmental Protection Authority (EPA) during the public review period suggested that the Water Authority's role should change from being a "water provider" to that of "water manager". The Authority performs both these functions as illustrated in Figure 1 of the ERMP.

A current example of the management role is the Water Authority's involvement with the Western Australian Water Resources Council in the release in December 1987 of the "Discussion Paper" and subsequent "Working Paper" entitled "A Strategy for Water Allocation in the Perth/Bunbury Region". These documents solicit public input to determining the difficult water allocation questions of the Perth/Bunbury region by identifying the finite nature of the available water resource, the conflicting demands for its use and the need to as a community determine how we should best distribute the resource amongst legitimate users, including the environment. Above all, the thrust of this document is to develop a beneficial use basis for water management in the South-West.

Other examples of action as a water manager include the thrust into demand management, action to control salinity, setting of licensing levels for groundwater use in Wanneroo to protect wetlands, and the programme for environmental water management at Millstream.

As a 'water provider' and 'water manager', the Authority must plan in accordance with its statutory responsiblities and within its stated corporate objectives. The Authority's two primary corporate objectives reflect these twin responsibilities (Water Authority 1987a). The Authority believes that this evaluation of feasible alternatives for providing for Perth's anticipated growth in demand has been conducted in accordance with those objectives.

The Water Authority provides the following response to comments received by the EPA during the public comment period.

CONSIDERATION OF ALTERNATIVES

Limiting population growth

Several government agencies and conservation interests raised the question of limiting Perth's population growth as a means of reducing the need for new sources of supply. This is an option open to the people and government of Western Australia in the mid to long-term but is not part of the Water Authority's responsibilities. However, it does not fit into the criteria for this study which was to find the best means of supplying a forecast shortfall in supply which will most likely eventuate some time in the next decade.

The larger question of Perth region's available water supply, the implications of developing various sources under alternative water demand scenarios and how we as a State wish to resolve these issues is more the subject of the Western Australian Water Resources Council report "A Strategy for Water Allocation in the Perth-Bunbury Region" and a further report anticipated for the latter part of this year on water alternatives for the 21st century. Public discussion at that level of planning is the more appropriate means for addressing the larger water planning questions.

Water Conservation

The Water Authority agrees that better use of our existing water resources is the most desirable and economical means of deferring the need for additional sources of supply. To that end, the Authority has reviewed its own activities in this regard and as an example, has increased its efforts to reduce water losses in the trunk main and distribution pipeline system. At the community level, the Authority is pursuing an active conservation programme which also appears to be having a very satisfying effect on water demand. However, no matter how low per capita water consumption falls, if the number of consumers continues to increase, eventually the volume of supply must be increased.

Whilst the Water Authority and the community are making progress in reducing per capita consumption, a new supply will ultimately be required and it is the Water Authority's statutory responsibility to be well prepared to provide such supply when it is required. To that end the Authority is acting prudently by planning for the best source to meet such shortfall in supply when it eventuates.

Water restriction

As stated in Section 3.4 of the ERMP, the Water Authority believes there is merit in reviewing the design level for restrictions, however, any significant increase in the present probability of restrictions is believed to be unacceptable currently to the general community and government. If the general public view was that the community was best served by a reduction in access to, and personal discretion in, the way we use water, then the Water Authority could implement such a proposal. It would in fact be an economy for the Authority establishing and maintaining a system required to cope with less extreme conditions. However, unless such an attitude is the majority view or the Authority is directed by government to so act, it cannot operate in a strongly regulatory manner. The Authority can not set itself above public opinion.

The Authority's approach is to seek water use efficiency through a mix of educative, pricing and regulatory mechanisms. Generally the strategy is based on educational, social and price incentives with regulation more effective if confined to drought, plumbing codes, etc., rather than as a general tool where it would tend to alienate education and moral persuasion if over-used.

Controls on groundwater abstraction

The recently completed "Perth Urban Water Balance Study" (Water Authority 1987b) has recommended that the Perth area be proclaimed under provisions of the Rights in Water and Irrigation Act. Proclamation, if proceeded with, would require licensing of all non-domestic bores and wells. Licensing when combined with an ongoing monitoring programme and expert appraisal will provide management of Perth's valuable underground water resources. Domestic groundwater well licensing, because of the large number of wells (more than 77,000) and the associated workload and cost, is not considered justified on either economic or water resource management grounds. The Water Authority will rely on increasing public awareness of the need for responsible use of domestic bores as an important part of its water conservation programme.

Reuse of water

To the extent that water can be "reused" there are opportunities for minimising pressure on new water sources.

In Australia we commonly classify reuse in terms of recycled water and reclaimed water.

Recycling is a common practice in industry where water is cycled through processing, washing or cooling circuits and only "make-up" water is added. These efficiencies are commonly unrecognised by the community but are one of the primary reasons why industry accounts for only 11% of water consumption in W.A.

Reclamation of water is the practice of taking up waste water rejected by some user, treating it as necessary, and putting it to further use. The prime opportunity for reclamation of waste water is in the reuse of sewerage effluent. At the present time the reuse of waste water is not widespread in Australia and only a very small percentage is reused. The prime barriers are health limitations and economics. In Western Australia, with approval of public health authorities, some 30 country towns economically reclaim wastewater for irrigation of parks and gardens.

In Perth it has been more difficult to develop waste water resources as economically attractive sources for the potential users. The Water Authority does, however, recognise the fact that Perth's urban wastewater flow is a significant resource and it is likely that it will be exploited to a greater degree in the future as a source of supply, particularly as total urban water demand increases and alternative sources become committed. It will of course be necessary to carefully research the viability of the various reuse options prior to their introduction in Perth. In line with this, the Water Authority has been conducting research since 1981 into the possibility of recharging groundwater aquifers with secondary treated effluent produced at some existing wastewater treatment plants.

There are two main problems with reclamation for potable purposes (as has been proposed). These are the cost and public acceptance. For lower grade uses the minimum treatment requirement recommended is secondary standard plus disinfection, but for potable use additional advanced wastewater treatment is necessary. This tertiary level treatment is expensive and costs two to three times the cost of secondary treatment making the end product of potable water prohibitively expensive compared to other alternative sources. Perth's wastewater at present is treated to only primary or secondary standard prior to ocean discharge.

Apart from the cost of potable water derived from wastewater, there is the need to gain public acceptance of it in the water supply. Overseas experience has shown that, despite it meeting all chemical and health requirements, public resistance to its introduction has remained high. For this reason and the high cost, reuse schemes for potable purposes are extremely rare throughout the world and their introduction in Australia is certainly not considered warranted at present.

As an alternative to the production of potable water, the most likely approach to exploitation of the wastewater resource will be the encouragement of lower grade uses if research shows them to be viable. This will allow conservation of high quality potable supplies from dams and groundwater for uses which require high quality water.

More distant sources

Suggestions have been made that the study should have considered bringing water from farther afield such as Harvey. It has been argued that, even if the construction cost of such an option is high, the benefit of retaining valley systems near Perth in their natural state may well offset these costs.

At this stage in its published forward planning for the next 25 years, the Water Authority has anticipated that source development for Perth will remain between the Moore River and Harvey. The primary reasons for this strategy have been economic ones. The Water Authority is expected to maintain restraint in growth of water charges. However, there is also a consciousness that there are value questions and equity questions in inter-basin transfer that are likely to take considerable time for the community to resolve.

In conjunction with the Western Australian Water Resources Council, the Water Authority is actively addressing water supply options for the South-West in the 21st century and it is hoped that this work will help the community to fix future priorities and principles for such decisions.

If as a result of such future discussion of planning options, the community prefers the costs of more distant sources or desalination to continued intensification of local water use, the Water Authority can respond to such direction. It needs to be understood, however, that such radical changes of direction are not likely to be decided easily or quickly and they therefore could not be seriously viewed as an alternative in this study.

POLICY AND TECHNICAL QUESTIONS

Compensation for loss of conservation lands

The implementation of the proposal by CALM to compensate for the loss of conservation lands (including sustained yield timber production) is currently being examined jointly by CALM and the Water Authority. A number of alternative schemes are being considered but have not yet been resolved. The Water Authority has already entered into arrangements to transfer control of some land to CALM for conservation purposes, e.g. in the Lane-Poole Reserve.

Transferable water entitlements

The Western Australian Water Resources Council (WAWRC) has established a Working Party which will shortly report on the matter of 'transferable water entitlements' (TWE). Once reviewed by the WAWRC, recommendations on TWE will be made to the Minister and the Water Authority.

Riparian rights in proclaimed stream areas

People who own or occupy land which has direct access to a watercourse may take water for watering stock and for domestic use. This entitlement is known as a Riparian Right.

Direct access means that the watercourse is not in a reserve and passes through the property or forms part of the property boundary.

On proclaimed streams water may only be taken for other purposes, including any commercial purpose, where a licence is issued by the Water Authority.

The Water Authority has the power to manage stream flow to protect the rights of riparian users. Where the stream flow ceases naturally, those who have stored winter flow have no obligation to supplement stream flow.

Once the Water Authority constructs a dam on a stream it is entitled to take and store all water available in any stream (Metropolitan Water Supply, Sewerage and Drainage Act Section 14 and Country Areas Water Supply Act Section 11).

The Water Authority is only liable for compensation for physical damage to property (Water Authority Act Section 62) and hence need not pay for "Riparian Rights". However, they are required to cause as little detriment as possible (Water Authority Act Section 83).

As stated in Section 6.3.1 of the ERMP, in view of the possible adverse impact on riparian users of the North Dandalup River, the Authority has reviewed present use of the river flow and will determine, in consultation with existing riparian landowners, a satisfactory arrangement for meeting the genuine and reasonable domestic, stock and garden watering requirements of the landowners. If the arrangement arrived at is to release prescribed flows, the amount released would not exceed the natural streamflow that would have occurred at the dam site at the time and no water would be released in periods when the natural streamflow would have ceased altogether.

Net evaporation errors

Discussion of "net evaporation errors" used as a project characteristic and differential factor in Table 5 of the ERMP appears in Section 5.2.4(iv), page 19 of the ERMP.

Salinity damage costs

Inclusion of salinity damage costs in the economic account was an attempt to recognise that financial costs were borne directly by householders in addition to those carried by the Water Authority and other government agencies. The cost function (Section 5.3.4(ii)) is based on research in Adelaide and is believed to reasonably reflect the Perth situation. It only considers in-house use of water and therefore is directly related to life of appliances and use of soaps and detergents. Whilst it is not claimed that the figures arrived at for the damage cost are precise, they are good indicative estimates and the proportional costs between alternatives would remain the same whether real costs were higher or lower.

Vegetation

The comment was made that the evaluation of vegetation complexes was deficient in not addressing the representation within reserves of those complexes most threatened by surface water development; Murray (H), Murray (M/M) and Murray/Bindoon.

The vegetation complexes used in this evaluation follow those of the Atlas of Natural Resources for the Darling System (Department of Conservation and Environment, 1980). No Murray (H) unit was recognised by this system nor any subsequent study of which the Water Authority is aware. Murray (M/M) is presumed to be Murray (M/H) which is addressed along with Murray (L/M) (Murray/Bindoon) in Sections 6.6.2 and 6.6.3 in the ERMP supporting document prepared by Havel Land Consultants (1987). That report sets out the representation of all the Darling System vegetation complexes in reserves (Table 6b).

Rare flora

The Water Authority acknowledges that *Verticordia fimbrilepsis* listed in Table 1, Appendix 4 of the ERMP is a gazetted rare species. The error appears to have arisen in report typesetting but is not of consequence to this evaluation as the species was not found at any of the four alternative sites studied.

Fauna

Several comments were made in relation to the fauna surveys and the interpretation of the available data. The first questioned the use of the bird density estimates as "importance" values in comparing sites, suggesting that sampling at different seasons could reverse the rankings. Whilst the data used were gathered in a single season, as the decision-making timetable would not permit longer sampling, the bird fauna was sampled at a time when the majority of species were breeding and territorial. It could therefore be argued that the results reflect the "obligate" ecological values of the project areas to bird communities. In other seasons the relationships between additional (e.g. wintering flocks) bird species and these specific areas would tend to be "facilitative".

Addressing other specific comments; Chapman & Dell (1985) was cited in connection with the intrusion of wheatbelt and coastal plain reptile species and the Discussion section of Chapman & Dell does set the wheatbelt reptile fauna in a broader south-western context. The discussion on page 11 of the supporting document on fauna (Dunlop et al., 1987) deals with jarrah forest herpetofauna not the broader 'Bassian' fauna as implied by the comment received.

Dell's Skink was not recorded at Mundaring nor reported as having been found at that site, but was at least as common as *Ctenotus labillardieri* at the other three locations. Voucher specimens were not collected as a matter of course, in part due to the species classification as rare, as such collection would have constituted a breach of the consultants licence. One specimen found dead in a trap was accessed to the Western Australian Museum collection (R96280 - South Canning).

NORTH DANDALUP DAM PROPOSAL

Although a large part of this ERMP dealt with an account of the planning and decision-making process pursued in arriving at the conclusion that North Dandalup Dam was the best choice available from the range of options and alternative sources, a large number of comments received by the EPA were focused on the North Dandalup alternative, its impacts and their management. The following statements are provided in response to those comments specific to North Dandalup.

Water flow in the North Dandalup River

Winter flow in the North Dandalup River will be reduced in all years, except those in which the dam overflows continuously. The efficient nature of the water catchment downstream of the dam generates a substantial runoff, rapidly ameliorating the dam's dramatic effect on river flow (see ERMP section 5.2.4).

Summer flows in the North Dandalup River are highly variable, depending on prevailing climate and weather phenomena. During 9 of the last 10 summers, flow at the gauging weir above the pipehead dam has ceased altogether. As stated in the ERMP section 6.3.1, the pipehead is taken out of operation when streamflow falls below 30 000 cubic metres per day, generally towards the end of November, and does not recommence operation until late May or June. With the establishment and filling of a storage dam, the streamflow immediately downstream of the dam would decrease during the low river flow months.

Coastal plain groundwater recharge

Damming of the North Dandalup River will probably have little effect on recharge to the coastal plain aquifer systems according to advice given to the Water Authority by Geological Survey of Western Australia (unpublished Hydrogeology Report 2458). The report states that "Regional water table and potentiometric maps show that most of the recharge is due to direct rainfall infiltration over a large area". It goes on to infer that the majority of the length of the North Dandalup River on the Coastal plain receives groundwater discharging from the Superficial Formations and "because of the clay content and low hydraulic conductivities of the sediments associated with the river, little recharge is likely to occur from river flow".

Effect on Peel Inlet

In years of average streamflow North Dandalup dam would reduce mean river flows to Peel Inlet by about 14×10^6 m^3/yr. This represents a 3.3% reduction in 'hills' streamflows and a 2.6% reduction in total flows (including the coastal plain) to the Inlet.

In 'dry' years the proportioned reduction due to North Dandalup would be less than in average years. The reduction in the 90% flow exceedance streamflows to the Inlet would be 2×10^6 m^3/yr. This represents a 1.6% reduction in the 'hills' streamflows and probably even less in the total flows.

In 'wet' years the proportional reduction due to North Dandalup would be more than for average years. The reduction in the 10% flow exceedance streamflows to the Inlet would be 36 x 10^6 m^3/yr. This represents a 4.3% reduction in 'hills' streamflows and probably less in the total flows.

Evaporation losses

North Dandalup Dam would be a deep dam with relatively small surface area and relatively low proportion of shallow reservoir. Consequently, annual net evaporation as a proportion of mean reservoir storage volume would be less than 5% and not the 20-30% claimed by the Shire of Serpentine-Jarrahdale.

Bauxite mining

Development of North Dandalup Dam would directly sterilize a small quantity of bauxite beneath the reservoir and within the buffer zone. Alcoa would still have access to deposits within the catchment area on the same terms and conditions as successfully apply to mining in other catchments. Development of a storage dam in place of the existing pipehead facility at North Dandalup would in fact reduce the likelihood of contamination of the public water supply system due to the buffering capacity of the storage reservoir. The Water Authority will continue to liaise closely with Alcoa in relation to its mining and exploration activities.

Resource recovery from reservoir basin

As has been the Water Authority's practice during construction of Harris and Harding dams, consideration would be given to facilitating recovery of resources (e.g. gravel) within the reservoir basin at North Dandalup, consistent with legal constraints and the construction schedule for the project.

Recreation and tourist facilities

Consistent with Water Authority practice, passive recreation and tourist facilities would be established as an integral part of the development of the proposed North Dandalup dam. The nature of these facilities would be determined following investigation and in consultation with the Shire of Murray and Department of Conservation and Land Management.

One submission suggested that the existing North Dandalup catchment is a valuable natural social and recreational resource and should not be destroyed. As stated in the ERMP, whilst the catchment services a pipehead dam, public use of the area is severely restricted. Establishment of a storage dam would permit a catchment plan allowing greater freedom of access to the extensive area of catchment remaining untouched around the reservoir.

Closure, rerouting and construction of roads

A number of roads in the vicinity of the North Dandalup dam and reservoir would be closed or rerouted and some new sections of road would need to be constructed in association with development of a dam.

As set out in the ERMP, it is envisaged that Hines Road would be redeveloped to a standard satisfactory for construction traffic and long-term access to and egress from the dam. A new section of Hines Road would be constructed through the Scarp to the dam and all upgrading work would be at the Water Authority's expense. The Authority is aware of the school on the corner of Hines Road and South West Highway and will ensure that traffic safety is a priority in planning for this location. The Authority will liaise closely with the school and the Local Government Authority on this matter.

Scarp Road between Sharp road and the Dam would be rerouted and constructed equivalent to its present standard or better following consultation with the Shire of Murray and the Department of Conservation and Land Management (CALM). This cost would be carried by the Water Authority.

Re-construction of other affected forest tracks would be determined in consultation with CALM. The Water Authority's contribution to the cost of this work would be established in consultation with CALM.

The Water Authority would give consideration to contributing to spending on surrounding roads where it could be demonstrated that the Water Authority's activities have had or will have a significant detrimental effect on public roads.

Aboriginal material and consultation

The Water Authority is not aware of any significant unresolved concern specific to Aboriginal people in relation to the project proposed at North Dandalup. As acknowledged in the ERMP the Water Authority is aware of the requirements of the Aboriginal Heritage Act 1972-80 and will act accordingly. Aboriginal people holding a traditional association with the area will be further consulted during the Stage 2 environmental review process.

Fauna

One submission suggested that creation of a reservoir at North Dandalup would threaten the "only known populations of the stonefly *Riekoperla occidentalis*". Not only is there no evidence to suggest that creation of the reservoir would eliminate this invertebrate from the North Dandalup system, it is also known to occur in at least two other river systems currently being studied in the area; Dirk Brook and the Serpentine River and its tributory the Gooralong.

Suggestions in the same submission that "The existing pipehead dam is already having a detrimental impact on the migration of native aquatic fauna" has been the subject of studies conducted for the Water Authority over the past three years. The report on this subject should be submitted to the Water Authority in July following which it should be possible to better assess the validity of such a claim. The results of the work will provide a valuable input to the development of appropriate management strategies to be reported upon in the Stage 2 ERMP.

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APPENDIX 1

WATER AUTHORITY of Western Australia

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ENVIRONMENT

14 JUL 1989

File No 139/86 Initials EB

Mr B Carbon
Chairman
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(Attention: Mr C Murray)

NEXT MAJOR PUBLIC WATER SUPPLY SOURCE FOR PERTH (post 1992)
ENVIRONMENTAL REVIEW AND MANAGEMENT PROGRAMME - STAGE 1

The Water Authority is presently completing a major review of the Sources Development Plan to accommodate a number of significant changes in assumptions basic to the plan:

- new population projections provided by the State Planning Commission ("Planning for the Future of the Perth Metropolitan Region");
- current trends in the rate of increase of per capita water demand;
- expected reduced demands due to the Water Conservation Strategy;
- adjusted streamflow records reflecting a drier rainfall period since 1947 than the full record previously used;
- recognition of the scientific opinion expressed at the Greenhouse 87 Conference that the Greenhouse Effect will result in a further reduction in rainfall in the south-west of Australia;
- reduced yield potential from the Yarragadee Formation artesian aquifer.

The effects of reduced demand projections and reduced yield estimates substantially cancel each other when deciding the need for new sources. However, some of the resulting changes in the recommended timetables for source development are quite significant in their impact on planning activities. Those changes with most significant effects on short-term planning activities are:

- The date for commencement of construction of North Dandalup Dam has been deferred to September 1993 and the commissioning date to June 1996 in the 'most likely' timetable. However, the 'maximum' timetable would require the present design and construction schedule to be maintained, with construction starting in September 1991 and commissioning in June 1993. North Dandalup

dam's yield benefit has been estimated to be achieved over a 4 year period instead of 2 years.

- South Canning dam has been dropped from the list of possible sources on the present Plan due to the uncertainty with estimated yield benefits and possible salinity problems.

- Preliminary figures of total consumption for 1987/88 indicate a Gross Output of 223 million cubic metres (including supply to G&AWS). This is above the projected 'most likely' demand and should be taken as a warning that the 'maximum' timetable may yet have to be implemented unless the Water Conservation Strategy can be demonstrated to be achieving its objectives.

Therefore, if the 'maximum' timetable does need to be implemented the timing of North Dandalup would remain as proposed in the Stage 1 ERMP, 1993. If demand can be moderated in accordance with the objectives of the Water Conservation Strategy the commissioning date could be deferred to 1996. In either event the timing is such that the Water Authority believes it is appropriate to continue the engineering and environmental planning process commenced in 1986.

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WATER RESOURCES PLANNING

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(WR-M173) BC