Water allocation and Perth's Water Future Strategy

Advice to the Minister for the Environment from the Environmental Protection Authority under Section 16(e) of the Environmental Protection Act, 1986

(This is not an assessment by the Environmental Protection Authority under Part IV of the Environmental Protection Act, 1986)

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Summary and Recommendations

A strategy for meeting public water supply demand in the Perth Metropolitan Region until 2021, the Perth's Water Future Strategy, was prepared by the Water Authority of Western Australia and referred to the Environmental Protection Authority (EPA) for consideration. Environmental approval is not being sought for any individual sources in the strategy at this time although a number of potential water supply sources are identified. The purpose of the referral was to obtain strategic direction on the strategy, identify environmental issues that will require further work and investigation and to establish an overall framework for future assessment of individual water sources. This report provides the EPA's advice to the Minister for the Environment on Perth's Water Future Strategy pursuant to Section 16(e) of the *Environmental Protection Act 1986*.

Since the document was published, there has been a major re-structure of the WA water industry in accordance with water policy reforms agreed by the Council of Australian Governments (COAG). As a result of the re-structure, carriage of the Perth's Water Future Strategy into the next phase was given to the Water Corporation (WC), although the Water and Rivers Commission (WRC) will have significant responsibilities relating to water resources management and protection elements of the Strategy. In reviewing the Strategy and preparing this advice, the EPA has therefore also had regard for the WRC's assessment of the Strategy, provided in its report Allocating Water for Perth's Future.

Provision of Water to the Environment

A fundamental matter arising from the Perth's Water Future Strategy is the need to ensure that adequate water is allocated to protect water-dependent ecological systems while meeting community water supply needs.

While consideration of environmental water requirements has been an integral part of water supply planning and environmental assessment of water source developments in WA for more than a decade, the need for formal and consistent processes to be adopted to ensure adequate water is allocated to the environment is now being given increased prominence at both a national and state level.

In February 1994, the Premiers and Prime Minister signed the COAG Agreement on Water Resources Policy. In relation to the environment, the agreement requires amongst other things:

- giving priority to formally determining allocations or entitlements to water, including allocations for the environment as a legitimate user of water;
- in cases where river systems are deemed to be stressed, establishing a better balance in water resources use including appropriate allocations to the environment to restore the health of river systems;
- undertaking assessments to satisfy environmental requirements of rivers systems before any harvesting of the water resource occurs;
- maximising water use in relation to its contributions to national income and welfare, within the social, physical and ecological constraints of catchments.

The WRC is coordinating implementation of programs to meet the requirements of the COAG Agreement. In particular the WRC is formalising a Water Allocation Planning System which will integrate with the environmental impact assessment process to ensure that adequate water is provided to protect the environment, ahead of decisions to extract or divert water for water supply purposes. The WRC is also developing principles and processes to be adopted in WA for determining environmental water requirements and managing environmental water provisions.

The EPA notes the policy directions of the COAG Agreement particularly in relation to environmental water allocations, and sees that the EPA, through the provisions of the *Environmental Protection Act*, has a key role in establishing environmental values and objectives which need to be met by environmental water allocations in WA. Amendments currently proposed to the *Environmental Protection Act* will support this by enabling Water

Allocation Plans to be formally assessed under the Act, and for legally binding conditions to be applied by the Minister for the Environment to ensure that environmental water allocations are sustained.

The EPA expects that water allocations plans submitted in the future in support of any water source development proposal included in the Perth's Water Future Strategy, would be in accord with the requirements of the COAG Agreement on Water Policy, and adopt the principles established by Agriculture and Resource Management Council of Australia and New Zealand/Australia and New Zealand Environment and Conservation Council (ARMCANZ/ANZECC) in the National Principles for the Provision of Water for Ecosystems.

The Perth's Water Future Strategy

The Strategy in broad terms consists of four components:

i) a set of seven strategy objectives;

ii) a water use efficiency programme which consists of a mixture of water regulation, education and market mechanisms;

iii) a preferred strategy to meet water supply demand from new groundwater and surface water sources which are proposed to be developed and which will be subject to detailed environmental impact assessment; and

iv) policy, research and development initiatives which include the protection of water supply quality, potential use of drainage water, reuse of wastewater and investigation of further sources that may be needed beyond 2021.

The EPA's advice on each of these components is provided in Sections 3 to 5 of this report.

Water use efficiency measures are a key element to minimising environmental impacts associated with water source development. The EPA supports the general approach of the water use efficiency program proposed in the Perth's Water Future Strategy to reduce consumption from the public water supply scheme. If reasonable reductions in water consumption are not achieved through the current proposed measures then increased use of regulatory measures may need to be considered.

The EPA supports the establishment of water use efficiency targets for all water use sectors (domestic, industrial, commercial etc) and the use of the water allocation system, as far is practicable to achieve these targets. This applies to both reticulated scheme supply and non-scheme use.

The preferred water sources identified in the Strategy to meet Perth's increasing water supply demand, rely heavily on groundwater, particularly from the Gnangara groundwater mound, with a new Harvey Dam, partial raising of Mundaring Weir, and Jane Brook and lower Serpentine River pumpback schemes being the only surface water sources proposed for development.

The EPA recognises that in the short to medium future, expansion of Perth's water supply system will rely principally on the development of groundwater sources. Methodology and criteria for determining environmental water requirements for ecological systems dependent on groundwater resources are reasonably well developed in WA, and their application to the Gnangara and Jandakot groundwater mounds has been largely effective in ensuring protection of wetlands and vegetation in these areas.

Methodology and criteria for determining environmental water requirements for ecological systems dependent on streamflows are relatively less developed. In addition, development of surface water sources generally has potential for greater social impacts, particularly if flooding of privately owned land is caused by dam construction. These issues have been raised in submissions made to the EPA on the Perth's Water Future Strategy, particularly in relation to the proposed new Harvey Dam.

The EPA has identified the environmental factors which need to be addressed by the WC and WRC in further planning and investigation to enable future environmental assessment of water

sources proposed for development in the strategy (Section 5 of this report). Approval for development of sources identified in the preferred source development strategy will be dependent on the preparation of water resources allocation plans which demonstrate that adequate environmental provisions are made to ensure water-dependent ecological systems are protected to meet EPA environmental values and objectives.

The EPA considers that the policy, research and development initiatives identified in the Perth's Water Future Strategy are comprehensive in identifying issues which need to be addressed in water allocation and source development planning for Perth's water supply, and generally endorses the management commitments made by the WC and WRC in respect of the Strategy.

In particular, the EPA supports the commitment to adopt the precautionary principle in catchment management plans prepared to protect the quality of water resources used, or planned to be used, for public water supplies.

The EPA also strongly supports the commitments related to reuse of wastewater and use of drainage water. The EPA considers that wastewater reuse and the use of drainage water, along with water use efficiency measures, have the greatest capacity to minimise, and where possible avoid, environmental impacts from water supply development. Where wastewater reuse and /or use of drainage water are shown to be technically feasible they should be considered in preference to sources with higher environmental impacts.

Conclusions

The EPA commends the former Water Authority of WA on its initiative to prepare a long term water supply strategy for Perth, and its involvement of the public in this process. The EPA considers that the Strategy provides a sound framework for future planning, investigations, and research and development of water sources to meet Perth's increasing demands.

Particular attention needs to be given to water use efficiency and to innovation, including research and development initiatives for wastewater reuse and use of drainage water, as these have the greatest potential to minimise and avoid environmental impacts from development of new dams and groundwater schemes.

The provision of adequate water to protect ecological systems dependent on water resources will be a fundamental component of the assessment by the EPA of any future water source proposed for development as part of the Strategy.

The EPA sees that through the provisions of the EP Act, it has a key role to establish environmental values and objectives which need to be met by environmental water allocations in WA. Amendments currently proposed to the Act will enable Water Allocation Plans to be formally assessed under the Act, and for the Minister for the Environment to set legally binding conditions to ensure that environmental water provisions are sustained.

Recommendations to the Minister for the Environment

Recommendation 1

That the Minister for the Environment notes that the EPA has provided advice in this report on the Perth's Water Future Strategy to assist the Water Corporation and Water and Rivers Commission in their future planning and investigations of water supply options for Perth.

Recommendation 2

That the Minister for the Environment notes that the EPA advice covers the key components of the Strategy, being the proposed water use efficiency program, specific groundwater and surface water sources proposed to be developed between now and 2021, and, policy and research and development initiatives.

Recommendation 3

That the Minister for the Environment notes the EPA principles for Water Allocation and Management that underpin the advice in this report.

Recommendation 4

That the Minister for the Environment notes that the Water and Rivers Commission is coordinating implementation of a program to meet the State's requirements in respect of the COAG Agreement on Water Resources Policy, and that this includes establishing a water allocation process which specifically recognises the need to maintain adequate water resources to protect environmental systems, in accordance with the EPA's environmental values and objectives.

Recommendation 5

That the Minister for the Environment notes that amendments currently proposed to the *Environmental Protection Act* will support the water allocation processes being developed as part of the COAG Agreement by enabling water allocation plans to be formally assessed under the Act, and for the Minister to set legally binding conditions to ensure that environmental water provisions to meet the EPA's environmental values and objectives are sustained.

Recommendation 6

That the Minister for the Environment notes that water resource allocation plans and individual source development proposals will need to be referred to the EPA for consideration under the *Environmental Protection Act*, prior to approval of any of the water sources proposed for development as part of the Strategy.

Recommendation 7

That the Minister for the Environment endorses the EPA advice contained in this report and in transmitting the advice to the Minister for Water Resources, advises him that the Strategy provides a sound framework for future planning and investigations for Perth's water supply, and that particular attention should be given to establishing appropriate water use efficiency targets for all water use sectors, and to innovation, including research and development initiatives for wastewater reuse and use of drainage water.

Contents

1. Introduction

1.1 Purpose of Report

A strategy for meeting public water supply demand in the Perth Metropolitan Region until 2021, the Perth's Water Future Strategy, was prepared by the Water Authority of Western Australia and referred to the Environmental Protection Authority (EPA) for consideration. Environmental approval is not being sought for any individual sources in the strategy at this time. The purpose of the referral was to obtain strategic direction on the strategy, identify environmental issues that will require further work and investigation and to establish an overall framework for future assessment of individual water sources. This report provides the EPA's advice to the Minister for the Environment on Perth's Water Future Strategy pursuant to Section 16(e) of the *Environmental Protection Act , 1986* (the Act).[1]

1.2 The Strategy Document

Perth's Water Future Strategy (here after referred to as the Strategy), was prepared by the WA Water Authority (WAWA) and published in 1995 (WAWA, 1995a). It sets out a water supply development and water use efficiency strategy and provides a framework for consideration of water use and water supply development over the next 25 years. The report was the culmination of three years work involving active consultation with the community, consultants and specific community/industry associations. The Strategy was designed to fit within the context of the "Perth's Water Future - A Vision for Water Supply for Perth and Mandurah to 2050" (WAWA, 1995b) which looked at water supply scenarios for the next 50 years.

The Strategy foreword describes the approach taken in the report as being one that enables individual developments to be seen in the wider context of water resource availability and cumulative environmental considerations, as well as balancing economic, social and environmental considerations within a context of technical feasibility.

The Strategy was developed from the evaluation of these aspects and outlines the strategy preferred by the then Water Authority for development of various water supply options.

Since 1995 when the document was published, there has been a major re-structure of the WA water industry in accordance with water policy reforms agreed by the Council of Australian Governments (COAG). One of these reforms removed the perceived conflict of interest within the Water Authority between the responsibility for management of water resources and the responsibility for water resource exploitation. The Water Authority was disbanded on 1 January 1996 and was replaced by three organisations, the Water Corporation (a water supply, drainage, irrigation and wastewater treatment utility); the Water and Rivers Commission (which has responsibility for management of water resources); and the Office of Water Regulation (which has responsibility for regulation of water service providers to ensure appropriate standards of service are met). The roles of these three agencies are outlined further in Section 2.1 of this report.

As a result of the re-structure, carriage of the Perth's Water Future Strategy into the next phase was given to the Water Corporation, although the Water and Rivers Commission will have significant responsibilities relating to water resources management and protection elements of the Strategy.

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[1] Section 16(e) of the *Environmental Protection Act, 1986* relates to the functions of the Environmental Protection Authority (EPA) and enables the EPA to "advise the Minister on environmental matters generally and on any matter which he may refer to it for advice, including the environmental aspects of any proposal or scheme, and on the evaluation of information relating thereto".

1.3 Key Strategic Considerations Outlined in the Strategy Document

The Strategy document identified a number of key strategic issues which emerged during consultation with the community and which were central to the development of the proposed strategy. These issues were:

- "The relationship between population growth and the demand for water.
- The need to make best use of our existing resources through water efficiency, drainage water and wastewater reuse, and the use of private groundwater wells.
- The need to develop and manage water resources in an ecologically sustainable manner.
- The importance of protecting our existing and future ground and surface water sources from contamination.
- The implications of climate change." (WAWA, 1995a, p. ii).

1.4 Water and Rivers Commission Assessment of the Strategy Document

The EPA has delayed its advice on the Perth's Water Future Strategy in part to enable it to consider the Water and Rivers Commission's assessment of the Strategy which was provided in Allocating Water For Perth's Future (WRC, 1997a). As the State's agency responsible for management and protection of water resources the EPA considered it necessary to receive and consider the Water and Rivers Commission's assessment prior to preparing its advice on the Strategy.

1.5 Limitation of the Report

Perth's Water Future Strategy cannot be considered a 'proposal' within the meaning of Section 38 of the Act and therefore cannot be formally assessed under Part IV of the Act.

The advice to the Minister for the Environment provided in this report is prepared pursuant to Section 16(e) of the Act. This advice should not be considered as a formal assessment of a proposal under Part IV of the Act. The EPA reserves the right to formally assess under Part IV, any specific source development proposal, including those associated with the Strategy. The EPA may also decide at a later date to provide further advice pursuant to Section 16(e) if further guidance is required.

Information gathered from the public review of the Strategy, Government agency submissions, Water Corporation's response to submissions and the Water and Rivers Commission's assessment of the Perth's Water Future Strategy has been considered in this advice.

2. Background

2.1 1996 WA Water Industry Restructure

The Perth's Water Future Strategy report was prepared by the WAWA, which, at the time, was both the manager of water resources for the State as well as the major water supply authority. In 1996 the following three separate water agencies were created to replace the Water Authority:

- the Water Corporation (WC) provides commercial water, sewerage, irrigation bulkwater and drainage services to customers. To operate, the WC needs bulk water licences which are issued by the Water and Rivers Commission (WRC) and operating licences which are issued by the Office of Water Regulation (OWR). The WC also has to meet the requirements of other regulators including requirements of the EP Act.
- recognising the primacy of the EP Act in terms of the protection of Western Australia's environment, including the setting of environmental objectives for water (both quality and quantity), the WRC is responsible for the protection and management of the State's water resources. This involves the assessment of water resources in accordance with EPA's

environmental objectives (determining how much water is available for a range of uses, including the environment), preparation of water resource allocation plans (which are assessed by the EPA to ensure that adequate amounts of water are allocated to protecting the environment), and the assessment of applications for water allocation licences.

- the Office of Water Regulation (OWR) is responsible for regulating the providers of water services (eg WC and others) and for ensuring that users of water services receive an appropriate level of service. It is also responsible for stimulating competition in the water industry and advising on charges for services.

Although most water in the State is provided by the WC at this time, the restructure has opened up the opportunity for competition by allowing other service providers to enter the market.

2.2 Water Allocation Planning and Environmental Assessment

Public submissions received by the EPA on the Perth's Water Future Strategy supported environmental assessment by the EPA of water allocation plans and source development proposals.

The WRC has proposed a framework for water allocation and source development planning in Western Australia which incorporates consideration and assessment by the EPA of the environmental acceptability of these plans (WRC 1997a) (Figure 1).

The EPA recognises that the framework will continue to be refined as national and state water policy reform programs are implemented. These reform programs are addressed further in Section 2.3 of this report.

An outline of the WRC's allocation process and its integration with the environmental assessment process is discussed below. The process consists of three phases:

Phase 1 - Regional water allocation plan or water supply strategy phase

This phase would cover the preparation of regional water allocation plans or strategic water supply strategies such as the Perth - Bunbury Draft Regional Allocation Plan (Western Australian Water Resources Council, 1988) and the Perth's Water Future Strategy.

Regional water allocation plans provide a process for determining a priority for environmental values and beneficial uses of water resources. This level of planning enables identification of water resources that may have substantial environmental constraints and provides a preliminary estimate of the water that might be available for consumptive uses. The potential cumulative impacts of water allocation on a regional basis are also considered.

Regional water supply strategies generally follow on from regional water allocation plans and identify the sources preferred for water supply development for the region. This includes a "filtering of those sources which have greater environmental constraint and therefore might not be acceptable for water supply development".

Regional water allocation plans and water supply strategies are broad and may embrace more than one water resource system. They would be prepared following an extensive community consultation process which would include a strategic review of environmental issues.

During this phase the EPA would normally provide strategic advice relating to the water allocation plans and water supply strategies. This advice would include but not be limited to the following:

- identification of appropriate environmental values and objectives;
- environmental factors that may be relevant to the direct or indirect potential impacts arising from the diversion, potential uses, abstraction or storage of a water resource;
- matters that should be considered by proponents of source developments;
- further investigations that may be required for better definition of environmental impacts and assessment of the acceptability of these impacts; and

- other issues including inter-basin transfers, water use efficiency, alternative sources and timing of development of water sources in water supply strategies.

Phase 2 - Subregional water resource allocation plan or source investigation phase

This stage would normally focus on a particular water resource system (for example, a particular river basin or groundwater aquifer or part thereof) and would determine the limits for potential water resource development that would enable sustainable use whilst ensuring ongoing protection of water-dependent and other ecosystems.

Subregional water allocation plans normally involve the determination of Environmental Water Requirements (EWRs) and propose Environmental Water Provisions (EWPs). EWRs are "descriptions of the water regimes needed to sustain the ecological values of aquatic ecosystems at a low level of risk" (ARMCANZ/ANZECC, 1996). EWPs are "that part of the environmental water requirements that can be met".

EWPs may refer to:

- "unregulated flows in rivers and water in wetlands and aquifers;
- specific volumetric allocations and/or releases from storages;
- water levels maintained in wetlands; and
- water in transit for other uses, the pattern of flow of which may be defined to meet environmental need." (ARMCANZ/ANZECC, 1996).

Ideally EWPs should be identified to be equal or greater than EWRs to ensure protection of water-dependent ecological systems. However, they may be less if there is a limited amount of water available and, following assessment by the EPA, other demands for consumptive use are deemed to be more beneficial in the interests of a particular subregion. In principle, any allocation of water should be:

- sustainable, taking account of long term requirements;
- consistent with the National Principles for the Provision of Water for Ecosystems (ARMCANZ/ANZECC, 1996); and
- consistent with the environmental values and objectives identified by the EPA.

The draft allocation plan would be prepared by the WRC following an extensive community consultation process and would be issued in draft form for public review. An environmental review would be prepared addressing environmental values, objectives and environmental factors, as well as any other matters, in accordance with EPA guidelines.

Subregional water resources allocation plans are unlikely to constitute a 'proposal' and therefore would not currently be assessable under Part IV of EP Act. However, the EPA can provide advice to the Minister for the Environment under section 16(e) of the EP Act.

Amendments are currently proposed to the Act to enable 'strategies' to be assessed under Part IV. If these amendments are enacted the EPA will in the future, be able to formally assess subregional allocation plans and ensure that EWPs being proposed to protect water-dependent ecosystems are in accordance with EPA environmental values and objectives. Conditions may then be set by the Minister for the Environment which would bind the WRC in the subsequent issuing of water allocation licences. Where EWPs for the resource are consistent with EPA environmental values and objectives, the allocation of water available to consumptive uses may be considered to be sustainable.

Phase 3 - Source development or water supply project planning

Water supply project planning involves preparation of specific purpose plans to develop a particular source, typically several years ahead of expected water needs. A proponent for development of a source (the service provider eg the WC or some other water user) would develop a detailed source development proposal in accordance with a subregional allocation plan. The proposal would be referred to the EPA for possible assessment under Part IV of the Act. If a formal assessment is required by the EPA, an environmental review would be prepared by the proponent in accordance with EPA guidelines and the EPA would conduct its assessment in accordance with its procedures for environmental impact assessment under Part IV of the Act.

In some instances particularly large projects may require additional, more detailed Section 16 (e) guidance before referral of a proposal under Section 38

The EPA considers that the process outlined above has merit and that procedures for the integration of the environmental impact assessment and the water allocation planning process should be further developed through implementation of the COAG Agreement on Water Resources Policy discussed in section 2.3 below, for consideration by the EPA.

The EPA's advice on the Perth's Water Future Strategy contained in this report should be viewed in the context of this three phase water allocation process recognising that considerable further work will be undertaken by the WRC and water service providers, and detailed environment impact assessment carried out, prior to approval of any individual source development proposed in the Strategy.

2.3 Council of Australian Governments (COAG) Agreement on Water Resources Policy

On February 25, 1994 the Premiers and Prime Minister signed the COAG Agreement on Water Resources Policy. Specifically in relation to the environment, the agreement requires:

- giving priority to formally determining allocations or entitlements to water, including allocations for the environment as a legitimate user of water;
- determining environmental requirements on the best scientific information available;
- in cases where river systems are deemed to be stressed, achieving a better balance in water resources use including appropriate allocations to the environment to restore the health of river systems;
- considering the establishment of environmental contingency allocations which provide for a review of the allocations five years after they have been determined;
- undertaking assessments to satisfy environmental requirements of river systems before any harvesting of the water resource occurs;
- maximising the contributions of water use to national income and welfare, within the social, physical and ecological constraints of catchments.

The WRC is coordinating implementation of programs to meet the requirements of the COAG Agreement. The WRC has already released two reports relating to implementation of the water reforms in WA (WRC, 1997 b & c).

The EPA understands that the WRC shortly intends to release a third report which will be a discussion paper on "A Water Allocation Planning System and Tradeable Water Entitlement Structure for Western Australia". This report will provide further refinement and details on the water allocation process discussed in Section 2.2 above, and its integration with the environmental assessment process. A fourth paper, also to be released shortly, will outline how environmental water allocations will be established and protected.

Through the provisions of the EP Act, the EPA has a key role in establishing environmental values and objectives which need to be met by environmental water allocations in WA.

Subject to amendments to the EP Act being adopted enabling strategies to be formally assessed under part IV of the Act, the EPA will be able to formally assess the WRC's allocation plans and provide advice to the Minister for the Environment on the adequacy of proposed environmental water allocations. The Minister for the Environment may then set conditions which would bind the WRC in subsequent issuing of water allocation licences.

Until the amendments occur, the EPA will continue to advise the Minister through S16 of the EP Act.

The EPA will provide advice to the WRC on the water policy reform proposals following release of the further proposed reports.

The EPA expects that water allocation plans submitted in the future in support of any water source development proposal included in the Perth's Water Future Strategy, would be in accord with the requirements of the COAG Agreement on Water Resources Policy, and adopt the principles established by ARMCANZ/ANZECC in the National Principles for the Provision of Water for Ecosystems (ARMCANZ/ANZECC, 1996).

The ARMCANZ/ANZECC principles are presented in Appendix 3.

3. The Perth's Water Future Strategy

The Perth's Water Future Strategy is a plan to meet the public water supply demand of Perth, Mandurah and the Goldfields and Agricultural areas to the year 2021 with emphasis on the period to 2010.

The demand for public water supply has grown as a result of population growth and increasing water consumption. In addition, the domestic use of scheme water is still growing at a rate of about 1-2% per person per year.

The Strategy proposes that under the most likely population and water use scenario an additional 120 GL of scheme water supply may be required by 2011 and a further 110 GL by 2021 without programs to modify water use (269 GL/year in 1997/98 to 498 GL/year in 2020/21 (WAWA, 1995 a, page 1-3). The existing supply capacity is expected to be fully utilised by about 1997/98, beyond which additional water sources and water-use efficiency measures will be needed.

The former Water Authority prepared the Strategy following an extensive process of public consultation and evaluation of alternative water supply and water-use efficiency measures. The strategy formulation process is described in Figure 2.

The Strategy in broad terms consists of four components:

i) a set of seven strategy objectives;

ii) a water use efficiency program which consists of a mixture of regulation, education and market mechanisms;

iii) a combination of new groundwater and surface water sources which will be subject to detailed environmental impact assessment; and

iv) policy and research and development initiatives which include the protection of water supply quality, potential use of drainage water, reuse of wastewater and investigation of further sources that may be needed beyond 2021.

An outline of each of the Strategy components is presented below, and the EPA's advice on these provided in Sections 4, 5, and 6 of the report.

The EPA's position in respect of particular Water Allocation and Management issues which underpins the advice in this report is set out in Appendix 1 and this should be referred to Appendix 2 provides definitions for specific terms related to water allocation, management and consumption, used in the report.

3.1 Objectives Proposed in Perth's Water Future Strategy

The Strategy report proposes seven objectives developed in consultation with the community. It should be noted that in developing the Strategy, tradeoffs were made among the objectives by the Water Authority. The objectives are as follows:

- "reduce overall per capita water consumption through appropriate water use efficiency measures.
- ensure that availability of acceptable water quality and quantity to the years 2010 and 2021 by means of a strategy which is technically viable and socially acceptable.
- achieve an equitable distribution of the strategy's costs and benefits.
- minimise negative impacts on the social environment and maximise opportunities for benefits.
- minimise the risk to human health and safety.
- minimise negative impacts on the natural environment and maximise options that enhance the environment.
- minimise financial costs to WAWA consumers and economic costs to the community" (WAWA, 1995a, p.3-3).

The EPA's assessment focuses on consideration of the environmental aspects of the Strategy and generally does not consider economic or financial aspects as these are mostly beyond the scope of the EPA.

The EPA strongly supports the objectives to reduce overall per capita water consumption, and to ensure the availability of acceptable water quality and quantity by means which are technically viable and socially acceptable.

The EPA also generally supports the objective to minimise negative impacts on the natural and social environment and to maximise opportunities for benefits. It is not always acceptable, however, to simply minimise impacts. Impacts must be contained to acceptable levels.

3.1.1 Ecologically Sustainable Development and Water Supply Planning

The Perth's Water Future Strategy report makes reference to the Draft National Strategy for Ecologically Sustainable Development prepared by the Ecologically Sustainable Development Steering Committee (ESDSC, 1992) and states that ESD is "development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends". The Strategy report also states the three main objectives as being:

- "to enhance individual and community well-being and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain ecological processes and systems" (WAWA, 1995a, p.2-5).

In addition, the Strategy report states that the ESDSC recommended to the national government that to achieve sound water resource management the government should:

- "promote an awareness of the interdependence of the components that comprise natural ecosystems and the need to develop a commitment to an integrated approach to the development and management of water resources.
- manage water and related resources in such a way as to maintain their essential biophysical functions and to achieve a balanced response to the economic, social and environmental aspirations of the community" (WAWA, 1995a, p. 2-6).

3.1.2 Water Supply Planning in WA as Proposed in the Perth's Water Future Strategy

The Strategy report proposes the following principles in applying the principles of ecologically sustainable development to water supply planning in WA:

- "existing developed water sources are used as efficiently as practical, thereby minimising the need for the development of new supply sources.
- development of new sources of water supply recognising the full range of benefits and costs which accrue to the community and the environment, and establishes that the benefit outweighs the cost.
- essential human and environmental values are protected.
- the benefits and costs of water supply enhancement are equitably borne by individuals, sectors off the community, and the environment, now and in the future. This includes the concept of indefinite sustainable use of the water resource and maintenance of environmental values.
- supply system management minimises adverse impacts and maximises benefits to the community and the environment within practical limits. Effective environmental planning, including formal Environmental Impact Assessment, a process of adaptive environmental management, and public participation all contribute to optimising management.
- provision be made for genuine public participation in resource planning and management" (WAWA, 1995a, p.2-6).

The EPA supports these principles which are generally compatible with the ARMCANZ/ANZECC principles for provision of water to ecosystems, and other principles the EPA considers should be applied to water resources management and protection, as outlined in Appendix 2.

3.2 Water Use Efficiency

The Perth's Water Future Strategy includes a water use efficiency program which consists of a mixture of regulation, education and market mechanisms.

The Strategy report indicates development of the water use efficiency program was guided by the following principles:

- reductions in water use should be gradual and permanent rather than immediate but short lived.
- priority should be given to target areas and measures with the greatest potential for achieving significant reductions in water use.
- measures should be cost effective (ie. the economic benefits should outweigh the costs).
- measures should not result in loss of either amenity or end use benefits (ie. they should provide the same or equivalent benefit but with less water).
- the means of implementation should be socially acceptable and built on community support.
- the program should include a balanced package of elements rather than reliance on only a few elements" (WAWA, 1995a p5-1).

The EPA supports the inclusion of a water use efficiency program as an essential component of the Strategy. However, the principles for the program should not be restricted to measures which are cost effective in terms of financial benefit only. The program must recognise that water use efficiency measures are a key element to reducing environmental impacts associated with water source development. Reducing and, where possible, avoiding environmental impacts should be included as an explicit principle of the program.

The Strategy report indicates that in developing the water use efficiency program priority has been given to reducing the use of scheme water, however, attention has also been given to self supplied groundwater. The EPA encourages the WRC and WC to work cooperatively to promote water use efficiency by all sectors in WA, whether they be scheme or self supply. This joint role is recognised by the WRC in its response on the Perth's Water Future Strategy (WRC, 1997a).

The EPA's advice on the water use efficiency program proposed in the Perth's Water Future Strategy is presented in Section 4 of this report.

3.3 Proposed New Source Development Strategy and Previous Environmental Assessments

Table 1 shows the results of the preliminary screening carried out by the Water Authority on all the options considered in the Strategy.

Table 1. Screening of water source options in the Strategy

Category Description	Water Source Type/Location
Category 1: Medium term: likely to be viable to the year 2010	Gnangara Mound groundwater North West Corridor groundwater Jandakot Mound (south) groundwater Serpentine (Karnup & Dandalup) groundwater Jane & Susannah Brook pipeheads Serpentine-Dandalup pumpbacks New Harvey Dam & Wellesley pumpback Raise Mundaring Weir & Canning Dams Water from Waroona-Harvey irrigation dams
Category 2: Research & development: appear promising but require investigation to prove technical, and/or financial feasibility, at which time they may substitute for sources in the medium term	Forest management to increase runoff Drainage water (irrigation only) Wastewater reuse (industrial, irrigation, recharge)
Category 3: Long-term: too expensive now, but may be acceptable in the long term (2010 to 2050)	Moore River region groundwater Bunbury region dams Yarragadee (Southern Perth Basin) groundwater Lower south west dams Brackish groundwater desalinisation
Category 4: Very long-term: very expensive, may be acceptable in the very long term (beyond 2050)	Arrowsmith-Jurien region groundwater Brackish dams desalinisation (Wooroloo & Brockman) Seawater desalinisation (reverse osmosis)
Category 5: Non-feasible: prohibitively expensive, or unacceptable environmental or technical risks	Kimberley pipeline (Dimond Gorge on Fitzroy) Kimberley tankers (Dimond Gorge on Fitzroy) Icebergs from Antarctica Cloud seeding
Category 6: Private supply: sources of supply outside the control of the public supply system	Rainwater tanks (400 000 houses with 20 kL tanks) Private groundwater wells

(From page 3-7 of "Perth's Water Future Strategy" (WAWA, 1995a)

Further assessment of alternate candidate strategies determined that the preferred approach to source development over the time horizon of the Strategy (before 2021)was a combination of new groundwater schemes particularly near Perth, and the diversion of surface water including from the Harvey-Waroona area. Future water supply needs in the North West and North East Corridors would be met by new North West Corridor and Gnangara Mound groundwater schemes. Population growth south of Perth would be supplied from surface water schemes with some groundwater from the Serpentine groundwater area.

The Strategy states that to the year 2010 and without the benefits of water use efficiency, near-Perth groundwater schemes in the North West Corridor and Gnangara Mound would be central in meeting public water supply requirements with about 86% of the additional supply capacity to 2010 being met by groundwater from these areas. Beyond this time, to 2021, demand would be met by further development of the Gnangara Mound and the development of surface water from the Harvey-Waroona area, including a proposed new dam on the Harvey River and pumpback on Wellesley Brook, as well as development of the groundwater resource near Serpentine. By 2021 about 50% of supply would come from groundwater sources.

The future water needs of the Goldfields and Agricultural Water Supply System would be met by raising the height of the Mundaring Weir dam wall to increase the capacity of the Helena Reservoir, with additional water being supplied from a pumpback diversion on Jane Brook

The water sources proposed for development are development are derived from eight major water resource systems as identified in Table 2, and illustrated in Figure 3. The estimated yield and indicative timing of development are also shown in Table 2.

The EPA has previously considered the Quinns Groundwater Scheme and determined that it did not require formal assessment due to its limited potential environmental impacts (WAWA, 1992).

The Pinjar Groundwater Scheme has previously been formally assessed by the EPA as part of the Gnangara Mound Water Resources Allocation Plan (EPA, Bulletin 295) and subsequent Section 46 changes to conditions (EPA, Bulletin 1997). The Ministerial Conditions of approval for this scheme set EWPs (in the form of groundwater levels) which must be maintained to ensure protection of wetlands and phreatophytic vegetation in the region.

The EPA is currently formally assessing the East Gnangara Environmental Water Provisions Plan (WRC, 1997d), and will recommend conditions on EWPs which must be maintained in this region to protect water-dependent ecological systems. The Lexia Groundwater Scheme (within the East Gnangara region) has been formally assessed on the basis that its water allocation licence will ensure that environmental conditions applying to the region are complied with.

The EPA has also previously undertaken assessment in respect of raising of Mundaring Weir (EPA, 1988). The assessment was part of the consideration of a number of water source options and no formal approval was provided for raising of the weir at that time.

The EPA is currently considering a subregional water allocation plan for the Harvey Basin (WRC, 1998) and will provide advice on the plan to the Minister for the Environment under Section 16e of the Act.

Where there is potential for significant environmental impacts, the EPA will require formal assessment and recommend Ministerial Conditions setting appropriate EWPs to protect water-dependent ecological systems, before approval is granted for development of any of the sources included in the Perth's Water Future Strategy. This includes the new Harvey Dam.

On the basis of current information, the EPA's advice in respect of environmental factors which will need to be considered for water sources proposed in the Strategy is presented in Section 5 of this report.

Table 2. Water sources nominated for development in the preferred Strategy

WATER RESOURCE SYSTEM/SOURCE	YIELD (GL/yr)	INDICATIVE TIMING (With Water Use Efficiency)
1. Metropolitan Coastal Groundwater	**59**	
a) Quinns	19	before 2010
b) Whitfords	12	before 2010
c) Eglinton	17	before 2010
d) Yanchep/Two Rocks	11	before 2010
2. Central Gnangara Groundwater	**15.8**	
a) Pinjar Stage 2 part 2	6.4	2010-2021
b) Pinjar Stage 3	9.4	2010-2021
3. East Gnangara Groundwater	**13.5**	
a) Lexia	11.1	prior to 2010
b) Mirrabooka Stage 3	2.4	beyond 2021
4. North Gnangara Groundwater	**39.1**	
a) Barragoon Stage 1	8.7	2010-2021
b) Barragoon Stage 2	9.1	2010-2021
c) Barragoon Stage 3	3.9	2010-2021
d) Yeal Stage 1	4.5	beyond 2021
e) Yeal Stage 2	5.4	beyond 2021
f) Muchea	7.5	beyond 2021
5. Swan-Canning Surface Water	**9.7**	
a) Partial raising Mundaring Weir	3	2010-2021
b) Jane Brook Pumpback (to raised Mundaring Weir)	6.7	2010-2021
6. Karnup-Dandalup Groundwater	**23.5**	
a) Karnup	10.5	beyond 2021
b) Dandalup	13	beyond 2021
7. Serpentine-Murray Surface Water	**7**	
a) Lower Serpentine (below falls) pumpback	7	before 2010
8. Harvey Surface Water	**58.9**	
a) New Harvey Dam	40	2010-2021
b) Wellesley Creek pumpback (to Harvey Dam)	11	2010-2021
c) Waroona Dam	7.9	beyond 2021

(From Page 6-2 of "Perth's Water Future Strategy" (WAWA, 1995a)

3.4 Policy and Research and Development Initiatives

The Perth's Water Future Strategy includes a program of policy and research and development initiatives addressing a number of matters, including:

- water quality protection;
- private groundwater wells;
- wastewater reuse;

- use of drainage water; and
- investigations of sources proposed for development beyond 2021.

The EPA supports the inclusion of this program in the Strategy and sees it, along with the water use efficiency program, as a key element to minimising and, where possible, avoiding environmental impacts from water source development.

The EPA's advice on the policy and research and development initiatives proposed in the Perth's Water Future Strategy is presented in Section 6 of this report.

4. Water Demand and Water Use Efficiency

4.1 Water Use Efficiency Targets

Information

A number of public submissions were concerned about the environmental impacts arising from source developments and the justification for those source developments.

Growth of Perth's population and the water demand of users of the public water supply system are the factors which control the rate and timing of the development of new sources. The rate of increased water demand therefore has a considerable influence on the extent and type of environmental impacts that may result from new source development. If development of new sources can be slowed through improved water use efficiency, then water may be supplied at a later time from a sources with lower environmental impacts due to improved technology and/or community willingness to pay more for water. Thus the environmental impacts in this delayed scenario would be different.

The Perth's Water Future Strategy forecasts that annual demand from the Perth public water supply system will increase by about 230 GL/year (269 GL/year in 1997/98) to 498 GL/year in 2020/21 (WAWA, 1995a, p. 1-3) without programs to modify water use. This forecast was based on the following assumptions:

- growth in the population served by the system from the present 1.2 million to a forecast of 2 million by 2021; and
- growth in per capita water consumption from the reticulated water supply scheme will increase from 170 to about 240 kL/person/year by 2021. This includes all water use from the reticulated water supply scheme including domestic, industrial, commercial, institutional, etc (Figure 4).

The Strategy indicates that with the successful implementation of the water use efficiency program proposed in the Strategy the increase in annual water demand to 2020/21 will reduce from 230 GL/year to about 170 GL/year, which represents a per capita water use of around 210 kL/person/year. Demand management means the introduction of a package of water use efficiency measures that would be generally regarded as being acceptable by consumers.

Although the WRC has indicated that an allocation licence will not be issued to service providers that are not using water efficiently from existing sources, the WRC considers it wise to plan using generous demand forecasts. The advantage of this is that it ensures that investigation of potential new sources occurs well in advance of actual demand, even though some of these sources may never be utilised if demand management achieves target reductions.

Consideration

There are significant potential environmental benefits from reducing rates of demand and growth of demand as this can lead to short-term deferral, even postponement in the long-term, of some source developments proposed in the Strategy and may allow substitution of alternative sources with lesser environmental impact in the future, through improved technology and increased willingness to pay for alternative sources.

The WRC has advised that the projected increase in water consumption is greater than its predicted reductions thought to be achievable through the adoption of water efficiency measures.

The WRC has indicated that before an allocation licence is issued to water service providers, the WRC will need to be satisfied that the water provider has used its best endeavours in meeting demand targets. WRC has advised that it considers that an appropriate target for the metropolitan water supply scheme would be a per capita consumption of 170 kL person/year or less in the long term. This is considerably below the projected consumption figures of 210-240 kL/person/year in the Strategy (WRC, 1997a, page 10).

At present, public water supply scheme use constitutes approximately 50 percent of total water use in the Perth Region. The EPA believes that total water use within the Perth Region from all forms of supply (scheme and self-supply) and addressing all sectors (domestic, agricultural, industrial, recreation) needs to be targeted for efficiency improvements. Water use efficiency is an important aspect of sustainable development and measures should be applied to reticulated or self-supplied industrial, mining and agricultural sectors, in addition to those already proposed for the domestic sector. In this regard the EPA notes the WRC will develop water use efficiency targets for all forms of supply (scheme and self supply) and continue promotion of water use efficiency in all sectors.

The EPA notes that:

1. the development of new water sources to service increased water requirements of Perth will have effects on the environment;
2. the Perth's Water Future Strategy identifies more potential water sources than are likely to be required to be developed by 2020/21;
3. an increased water demand is a reasonable basis to prompt investigations of potential water resources but does not in itself justify meeting that demand by providing additional water from new source development; and
4. WRC will establish water use efficiency targets for all water use sectors and use the water allocation process, as far as is practicable, to achieve these targets.

Having considered the information presented in the Strategy on water supply demand and submissions on the Strategy, the EPA advises that it:

- supports the establishment of water use efficiency targets by the WRC for all water use sectors and the use of the water allocation process, as far as is practical, to achieve these targets;
- believes that programs should be put in place to achieve targets as soon as possible; and
- considers that the environmental impact reviews for future water source development proposals should show that the new development can be justified in terms of projected water supply demand taking account of WRC water use efficiency targets and best endeavours to reduce per capita consumption.

4.2 Water Use Efficiency Measures

Information

The Perth's Water Future Strategy commits the WC, WRC and Office of Water Regulation to reducing consumption of water from the public water supply by implementing the following water use efficiency measures:

- reviewing tariff structures to encourage efficient water use;
- upgrading the leak protection and repair program;
- continuing to improve metering to reduce the amount of unmeasured water used from the system (including at Water Corporation installations);

- reviewing the current water restriction policy;
- attempting to maximise the opportunities for long-term water efficiency gains resulting from restrictions applied during drought periods;
- supporting the preparation of regulations to require use of water-efficient shower heads in new installations;
- providing sufficient resources to implement and manage the water efficiency program; and
- undertaking a domestic water use study.

WRC has advised that some of the above commitments are the responsibility of the Office of Water Regulation or the WRC (WRC, 1997a).

Support was expressed in public submissions for dual water supplies, price regulation, bore metering, water-wise appliances, imposition of water restrictions in droughts as well as water-wise gardens.

Increased water efficiency is beneficial to the environment by reducing the rate of new source development or postponing development.

Consideration

The EPA supports the general approach of the water use efficiency program proposed in the Perth's Water Future Strategy, incorporating a mixture of regulation, education and market mechanisms, to reduce consumption from the public water supply scheme. If reasonable reductions in water consumption are not achieved through the current proposed measures then increased use of regulatory measures may need to be considered.

The EPA notes that the WC and WRC have already implemented some very successful water use efficiency programs particularly for the Perth and Kalgoorlie water supply systems. This has included measures to promote the use of more efficient water appliances such as low-flush toilets, and low-flow shower heads. Similarly the WC and WRC have run extended public awareness campaigns regarding efficient garden water use.

The EPA believes that the Government's State of the Environment reporting process provides an opportunity for establishing performance indicators and reporting on the efficient use of water resources by all water use sectors.

The EPA notes that:

- the potential for environmental impacts from new source development is reduced with increased water use efficiency;
- WC and WRC have committed to a number of water use efficiency measures;
- water use efficiency also requires commitment by the community because it is changes in consumer behaviour that will deliver more efficient water use; and
- the State of the Environment reporting process can report on performance indicators for water use efficiency.

Having considered the information presented in the Strategy on water use efficiency and the submissions on the Strategy, the EPA advises that it:

- supports water use efficiency as a means of mitigating environmental impacts;
- encourages the WRC and WC to work cooperatively to promote water use efficiency by all water use sectors whether they be scheme or self supply; and
- considers that overall performance of water use efficiency should be reported through the State of the Environment reporting process.

5. Water Source Development Strategy

5.1 Selection of the Preferred Strategy

Information

The Perth's Water Future Strategy outlines the alternative means by which the water required to service the demand of the Perth metropolitan public water supply scheme may be met.

The Strategy puts forward the preferred new sources which are proposed to be developed up to and beyond 2021, as shown in Table 2 (Section 3.3). The Strategy indicates that the preferred sources have been chosen using a multi-objective planning approach to the development and evaluation of the various strategies. This approach consisted of three basic stages:

1. the development of six candidate strategies (A to F) which involved the identification of source types and water use efficiency programs and the course screening of these sources based on cost, feasibility and environmental impact;
2. the evaluation of four candidates (A, B, C and E) following the elimination of two strategies (D and F) based on feasibility and cost and the evaluation of water efficiency programs; and
3. the preparation of a preferred strategy based on the results of the evaluation of candidate strategies and water use efficiency programs.

Candidate strategy D considered development of the Yarragadee formation groundwater in the Southern Perth Basin. The use of the Yarragadee groundwater was determined in the Strategy to be too expensive for development in the short to medium term.

The evaluation of candidate strategies involved the consideration of natural environment, socio-economic, technical and financial factors. Natural environmental factors included effects on biodiversity, ecological processes and ecosystems, the conservation system and energy consumption.

The water sources considered in the four candidate strategies evaluated (A,B,C and E) are shown in Table 3.

The preferred Strategy places a heavy emphasis on the development of groundwater sources particularly in the North West Corridor and Gnangara groundwater areas. The Minister for the Environment has issued an environmental approval for the Gnangara Mound Water Resources Allocation Plan which included the Pinjar Groundwater Scheme and the EPA is currently assessing the East Gnangara Water Resources Allocation Plan which includes the Lexia Groundwater Scheme. WRC has advised that it intends to progressively prepare water resource plans for all water resource systems affected by the Strategy.

The order of the development of the new sources in the Strategy could change as a result of investigations or environmental impact assessment of individual source developments. Changes to climate or climate variability may also affect the predicted sustainable yields of sources, particularly if yields have been calculated based on the long term record, which includes a sequence of wetter years than have occurred more recently This can give an overly optimistic result and suggest yields are higher than they actually will be. WRC and WC are committed to investigating the effects of climate variability on source yields and identifying any consequent yield reductions that may become necessary.

WRC has advised that with acceptable and achievable water use efficiency it is unlikely that all the new sources in the Strategy will be required within the timeframes indicated in the Strategy.

Table 3. Preferred and Candidate Water Supply Strategies (not in order of proposed development)

Water Resource System	Source	Strategy				
		Preferred Strategy	A	B	C	E
Coastal groundwater	Quinns Rocks	*	*	*	*	*
Coastal groundwater	Whitfords	*	*	*	*	*
Coastal groundwater	Eglington	*	*	*	*	*
Coastal groundwater	Yanchep/Two Rocks	*	*	*	*	*
Serpentine-Murray	Lwr Serpentine pumpback	*		*		
Serpentine-Murray	Upr Serpentine pumpback				*	
Serpentine-Murray	Marrinup Bk pumpback		*			
Serpentine-Murray	Gooralang Bk pumpback				*	
Serpentine-Murray	Dirk Bk pumpback				*	
East Gnangara groundwater	Lexia	*	*	*	*	*
East Gnangara groundwater	Mirrabooka Stage 3	*	*	*	*	*
Swan Canning	Pt. raising Mundaring Weir	*		*		
Swan Canning	Full raising Mundaring Weir				*	
Swan Canning	Jane Brook pumpback	*		*	*	
Swan Canning	Lwr Helena pumpback raising				*	
Swan Canning	Canning Dam Full raising				*	
Swan Canning	Susannah Bk pumpback				*	
Central Gnangara groundwater	Pinjar stage 2 Part 2	*	*	*	*	*
Central Gnangara groundwater	Pinjar stage 3	*	*	*	*	*
Harvey	New Harvey Dam	*		*	*	
Harvey	Wellesley Creek pumpback	*		*	*	
Harvey	Samson Bk Dam			*		
Harvey	Logue Bk Dam			*		
Harvey	Waroona Dam	*				
North Gnangara groundwater	Barragoon stage 3	*	*	*	*	*
North Gnangara groundwater	Barragoon stage 1	*	*	*	*	*
North Gnangara groundwater	Barragoon stage 2	*			*	
North Gnangara groundwater	Muchea	*	*	*		
North Gnangara groundwater	Yeal stage 1	*	*	*	*	*
North Gnangara groundwater	Yeal Stage 2	*	*	*	*	*
Karnup-Dandalup groundwater	Karnup	*	*	*		
Karnup-Dandalup groundwater	Dandalup	*	*	*	*	
Moore River Groundwater	Breton Bay Stage 1&2		*			
Moore River Groundwater	Wedge Island Stage 1&2		*			
Moore River Groundwater	Beermullah		*			
Moore River Groundwater	Red Gully		*			
Moore River Groundwater	Victoria Plains		*			
Jandakot Groundwater	Jandakot South St 1&2				*	

Consideration

A number of water sources considered in the strategies evaluated (A, B C and E) were not included in the preferred strategy for environmental and social reasons. These were:

- South Jandakot groundwater scheme;
- Susannah Brook pumpback scheme;
- Full raising of Mundaring Weir;
- Full raising of Canning Dam;
- Gooralong Brook pumpback scheme; and
- Dirk Brook pumpback scheme (WAWA, 1995a, Figures 4.1 to 4.4)

The EPA agrees that these sources have significant environmental and/or social constraints and may not be found to be environmentally acceptable for water supply development.

The EPA notes that development of the Yarragadee formation groundwater in the Southern Perth Basin has not been proposed in the Strategy timeframe, however, there is a commitment to further investigate this water resource. The EPA agrees that this water source should be further investigated to determine the likely extent of environmental impacts and potential sustainable yield. If investigations show that development of this water resource is likely to result in limited environmental impacts then consideration should be given to advancing development of this source.

The Strategy relies principally on the development of the lowest cost sources which constitute the groundwater sources, with the Harvey Dam, partial raising of the Mundaring Weir and Jane Brook, lower Serpentine, and Wellsley River pumpback schemes being the only surface water sources proposed for development.

The EPA recognises that development of surface water sources generally has greater potential for social impacts particularly where flooding of private land will occur as a result of dam construction. A number of public submissions received by the EPA on the Strategy conveyed these concerns.

The environmental factors which will be considered by the EPA in assessing the acceptability of water sources proposed in the preferred strategy are outlined in Section 5.2 below. The WRC and WC will need to demonstrate that acceptable EWPs can be maintained, and construction impacts managed to gain approval for development of the proposed sources.

While the EPA acknowledges the stringent obligations on the WC to ensure high standards of public health in water supply, it believes that use of alternative, non-conventional water sources should be strongly pursued during the timeframe of the Strategy, particularly for non-potable components of the scheme supply, to replace conventional sources identified in the preferred Strategy.

The EPA considers that the use of alternative sources should not be constrained simply due to cost considerations. Where alternative sources are shown to be technically feasible they should be considered in preference to sources with higher environmental impacts.

The Strategy was not intended to address the total water demand needs of all users in the Perth region including non-scheme sources for water supply. WRC has advised that it will examine the need for the preparation of a water resource plan for the greater Perth Region which will consider the use of lower quality water to meet non-scheme and scheme demands (WRC, 1997a).

This plan will consider use of drainage water and groundwater in urban areas (through individual and community bore systems) to reduce pressure on high quality scheme supply.

WRC has indicated that it will actively support increased use of individual or community domestic bores in appropriate sites within urban areas as a means of achieving this.

Outdoor water uses such as gardens and swimming pools make up 26 % of the demand on the reticulated water supply scheme. There is large potential for reducing the demand on the scheme by encouraging the use of domestic bores particularly in areas where recharge has already been increased by urbanisation. There are also opportunities for the commercial supply of shallow groundwater for outside use. However it should be remembered that all these approaches merely substitute locally supplied groundwater for reticulated scheme water and that overall management of the water cycle including these groundwater bores still needs to be considered in the total environmental equation. Substitution can, however, delay the need to develop a new water source to increase the reticulated supply.

Similarly there are environmental benefits to be gained from taking water for public water supply from groundwater systems where the natural recharge has been increased as a result of extensive clearing of native vegetation. In addition higher groundwater levels from increased recharge can result in nutrient enrichment of rivers and estuaries from runoff from urban and agricultural areas surrounding these systems.

Although the commercial orientation of the WC may be seen as working against encouraging development of alternative sources to the public supply scheme, because reductions in revenue could result, the WC has made commitments to support the WRC in guiding increased installation of private or commercial bores in appropriate areas, assessing the feasibility of using treated effluent as a supply of water and encouraging the use of effluent and drainage waters.

The EPA believes that there are also opportunities for direct re-use of urban and industrial wastewater of suitable quality through re-cycling (either pre or post treatment) into other industries as process water. This approach should be favoured over establishment of new industrial bores for water supply. This is particularly relevant to the Kwinana Industrial area, where the WC is currently developing the WaterLink program with industry, which involves use of treated wastewater.

Reduced emphasis on diversion of surface water catchments may lead to fewer environmental impacts if appropriate EWPs are determined for all those groundwater sources and other consumptive uses are accommodated after EWPs are met. However, the impact of groundwater abstraction on marine ecosystems and salt water intrusion requires further investigation.

Climate change may result in lower long term average rainfall, or changed patterns of rainfall, which could produce adverse environmental impacts if the volumes of water abstracted or diverted are not adjusted to ensure appropriate environmental water provisions are maintained ahead of allocations for other consumptive uses.

The EPA notes that :

- the selection of sources included in the preferred source development strategy was based on a number of factors including cost, geographic distribution and potential environment impacts;
- a number of water sources were excluded from the preferred development strategy because of their potential environmental and/or social impact;
- the preferred source development strategy places a heavy emphasis on development of groundwater sources (about 86% of the additional supply capacity) with only limited additional surface water source development within the Strategy timeframe (ie to 2020/21);
- there is particular community concern about the development of further dams;
- the WRC intends to prepare water allocation plans for each of the water resources systems proposed for development in the Strategy;

- there is potential for urban groundwater and other lower quality sources (eg drainage and wastewater) to reduce demand (or the rate of increase in demand) on the public water supply scheme;
- the opportunity exists for reuse by industry of industrial and urban wastewater and this should be encouraged ahead of the establishment of new bores;
- alternative, 'non-conventional' sources, such as wastewater reuse and use of drainage water, will be investigated in the short to medium term, however, no allowance has been made for development of such sources to meet projected public water supply demand increases within the Strategy timeframes;
- the WRC has advised that it will examine the need for preparation of a water resource plan for the greater Perth region which will consider use of lower quality water to meet both scheme and non-scheme;
- there is a need to continue to investigate the impact of climate variability or change on water source yields and to review environmental water provisions to take account of these effects to ensure the environment is adequately protected; and
- the timing and order of source development will be regularly reviewed and may change.

Having considered the information presented in the Strategy on the preferred water source development plan and the submissions on the plan, the EPA advises that:

- it recognises that, in the short to medium term future, expansion of Perth's water supply system will continue to rely principally on the development of groundwater sources;
- approval for development of the sources identified in the preferred source development strategy will be dependent on the preparation of water resource allocation plans by the WRC (Section 2.2), which demonstrate that adequate EWPs (taking account of the impact of climate variability and change on reliability of water source yields) are made to ensure water-dependent ecological systems are protected to meet EPA environmental values and objectives;
- the water resource allocation plans and environmental reviews for the sources identified in the preferred source development plan should address the environmental factors set out in Section 5.2 below;
- alternative, non-conventional water sources such as wastewater reuse and drainage water should be strongly pursued, particularly for non-potable components of scheme supply and non-scheme supply, in conjunction with conventional sources identified in the preferred source development plan;
- the following hierarchy of preference for water source development should be adopted as far as practical:
  - development of lower quality sources or community bore systems to meet outdoor water needs;
  - preferred use of groundwater where extensive clearing has already taken place;
  - preferred use of groundwater ahead of surface water sources where it is known that environmental water requirements for water-dependent ecosystems and phreatophytic vegetation can be met, taking account of possible reductions in recharge from low rainfall years and climate change;
  - the use of alternative sources should not be constrained by cost considerations alone. Where alternative sources are shown to be technically feasible they should be considered ahead of sources with higher environmental impacts; and

- all new source developments will be subject to the provisions of Part IV of the Environmental Protection Act and in some instances further Section 16 (e) advice.

5.2 Relevant Environmental Factors

5.2.1 Identification of important environmental factors

Environmental impacts from water source developments may arise from the impact of the proposed development itself on the environment. In the case of a dam this includes unavoidable clearing of vegetation and inundation of terrestrial systems as the reservoir forms, and loss and substitution of aquatic and water-dependent ecosystems upstream and downstream. There are also other consequential impacts, such as inhibiting upstream migration of fish, which can affect breeding, and the alteration of the hydrological regime.

Removal of groundwater can result in reductions of wetland water levels and damage to or death of some types of terrestrial vegetation.

The Perth's Water Future Strategy report is a strategic, broad scale assessment, which provides limited detail on direct or indirect impacts of the various new source development options. In most instances the work necessary to determine environmental water requirements and provisions has yet to be completed.

Nonetheless, having regard for public submissions, the response to submissions by the WC, views of Government agencies (particularly the WRC) and other relevant information, the EPA is of the opinion that the following are the environmental factors likely to be of importance in the assessment of the various water source developments.

The amount of water available for maintenance of ecosystems and for possible diversion as a water source for human use is determined by climate. As this is the driving element and the dominant constraint, it is listed first. This then leads into the other environmental factors which are in turn dependent upon surface water and groundwater for their ongoing maintenance.

a) Climate variability and climate change (especially rainfall and recharge) (Section 5.2.2)

These are the driving elements determining the nature of:

b) Watercourses and surface hydrology (Section 5.2.3)

c) Groundwater quantity and quality (Section 5.2.4)

d) Wetland systems (Section 5.2.5)

e) Terrestrial vegetation (Section 5.2.6)

f) Aquatic fauna (Section 5.2.7)

g) Estuarine and marine systems (Section 5.2.8)

The above leads collectively into consideration of:

h) Biodiversity and nature conservation values(Section 5.2.9)

Other aspects requiring consideration include:

i) Recreation (Section 5.2.10)

j) Cultural, heritage and social surroundings (Section 5.2.11)

k) Intergenerational equity (Section 5.2.12)

Table 4 provides a summary of the environmental factors which are considered most significant for each of the eight water resources systems proposed for development in the Strategy.

Table 4. Key environmental factors for assessment of water resource systems/sources.

WATER RESOURCE SYSTEM/SOURCE	KEY ENVIRONMENTAL FACTORS
1. Metropolitan Coastal Groundwater a) Quinns b) Whitfords c) Eglinton d) Yanchep/Two Rocks	• groundwater quality (salt water intrusion and urban development)
2. Central Gnangara Groundwater a) Pinjar Stage 2 part 2 b) Pinjar Stage 3	• groundwater quantity (water levels) • wetland systems • terrestrial vegetation
3. East Gnangara Groundwater a) Lexia b) Mirrabooka Stage 3	• groundwater quantity (water levels) • wetland systems • terrestrial vegetation
4. North Gnangara Groundwater a) Barragoon Stage 1 b) Barragoon Stage 2 c) Barragoon Stage 3 d) Yeal Stage 1 e) Yeal Stage 2 f) Muchea	• groundwater quantity (water levels) • wetland systems • terrestrial vegetation • aquatic fauna (stygofauna)
5. Swan-Canning Surface Water a) Partial raising Mundaring Weir b) Jane Brook Pumpback (to raised Mundaring Weir)	• watercourse and surface hydrology • terrestrial vegetation • aquatic fauna • cultural, heritage (Aboriginal and European)
6. Karnup-Dandalup Groundwater a) Karnup b) Dandalup	• groundwater quantity (water levels) • wetland systems • terrestrial vegetation • social surroundings (agricultural areas)

7. Serpentine-Murray Surface Water a) Lower Serpentine (below falls) pumpback	• watercourse and surface hydrology • aquatic fauna • social surroundings (Serpentine Falls) • cultural, heritage (Aboriginal)
8. Harvey Surface Water a) New Harvey Dam b) Wellesley Creek pumpback (to Harvey Dam) c) Waroona Dam	• watercourse and surface hydrology • terrestrial vegetation • aquatic fauna • social surroundings • cultural, heritage (Aboriginal, European) • recreation

Although this report identifies the environmental issues which require further investigation it should be noted that this review is not of any individual proposed water source but of the Strategy as a whole. Advice is provided recognising that the timing of the various elements of the Strategy is dependent upon the success or otherwise of implementation of water conservation measures. The focus in this report is not on the direct impacts associated with an individual water source proposal and its associated infrastructure which would be considered subsequently under Section 38 of the *Environmental Protection Act, 1986*, or further Section 16 advice.

5.2.2 Climate Variability and Climate Change

Information

Australian ecosystems are naturally very variable and much of this relates to the large year-to year variability of Australia's climate. Much of this variability is because Australia lies near the centre of the so-called Southern Oscillation, a large disturbance in atmospheric circulation which occurs about once every two to seven years (Commonwealth of Australia, 1996). In addition, every few years the surface waters in the central and eastern Pacific increase in temperature, a phenomenon known as El Nino, and this leads to substantial changes in atmospheric circulation throughout the whole Asia-Pacific Region. The generic term El Nino - Southern Oscillation

(ENSO) is often used to refer to the changes that accompany an El Nino event (Commonwealth of Australia, 1996).

ENSO has its greatest impact on rainfall and air temperature but can be detected in the continuous records of nearly all climatic variables. The effects are most pronounced in the eastern two thirds of the continent, but there are also alterations to the Leeuwin Current off Western Australia with accompanying other effects.

In addition to the ENSO, there are variations in the sea-surface temperature in the Indian Ocean which effect the passage of north-west rain-bearing cloud bands, with resulting climatic variability. These cloud bands bring increased winter rainfall to southern and western parts of the continent (Commonwealth of Australia, 1996).

Longer term climatic fluctuations have also been observed through investigations into changes in circulation patterns (Salinger et al (in press) cited in Commonwealth of Australia, 1996). Results show various patterns and changes, including warming and cooling of mean temperatures, reductions in diurnal temperature range (from increased overnight minimum temperatures), and increased cloudiness. These trends are consistent with other parts of the world and Salinger et al (in press, cited in Commonwealth of Australia, 1996, p.5-14) concluded that "there is a longer-term climate warming trend which is not inconsistent with the enhanced greenhouse effect, and is not directly related to ENSO".

The Climatic Impact Group of the CSIRO Division of Atmospheric Research (CSIRO, 1992a) suggested that changes in mean annual rainfall of up to - 10% to + 10% could occur in the south-west of Western Australia by the year 2030. It is widely accepted that there has been a general decline in rainfall over the south-west of the State although reasons for this are not

known (CSIRO, 1992b). The decline in rainfall has been accompanied by a general reduction in the flow of some streams by as much as 25% (WAWA, 1995a).

In contrast there was a period of high rainfall in 1963-1967, during which maximum groundwater levels in some parts of the coastal plain rose about 2.5 m above their present level.

The lowering of the water tables from abstraction of groundwater is exacerbated by reductions in recharge from lower than average rainfall conditions

The Strategy points out that the estimated water yields for existing and proposed sources in the Strategy are based on statistical properties of historic stream flow from the past 40 years. Stream gauging has shown that there has been a general decrease in streamflow since 1970 with the average over the last 20 years being about two thirds of the average of the last 40 years. The Strategy has therefore assumed that the flows for the last 20 years is an extended drought and that higher streamflows will recur in the future. If this is not the case then the water yields for the existing and proposed sources will need to be re-estimated. This would lead to the rate of source development being increased to "make up lost yield".

Consideration

The EPA's objective for this factor is to ensure that EWRs and EWPs are conservative enough to protect environmental values, taking proper account of climate variability and climate change.

A statistical approach is required to ensure that adequate and conservative allowance for the environment is made to take account of wet and dry years, after which water for other uses can be allocated.

Climate variability is normal but uncertainty exists as to whether the recently observed rainfall decreases are permanent (ie that they will remain at those levels over the long term) and whether the impact of the greenhouse effect will further enhance the observed reductions.

If the observed or predicted changes to the climate are sustained, ecological changes will result. In this situation environmental water provisions and sustainable water yields for all water resources may alter and this will need to be recognised in adjustments to water allocation planning. If the observed changes are not permanent but are just part of the natural variation in climatic conditions, source yields will need to be carefully assessed to ensure that they are not being based on an overly optimistic above average rainfall sequence of years.

The EPA notes that:

1. a reduction in the amount of rainfall has occurred over the last 20 years in the areas subject to the Strategy ;
2. it is not known whether the observed rainfall reduction is permanent (ie will remain over the long term);
3. the greenhouse effect may bring about enhanced changes in rainfall patterns which may be significant; and

4. the estimated water yields for existing and proposed sources in the Strategy are based on stream flow records for the past 40 years, and that if yields need to be revised downwards, the rate of source development will need to be increased.

In considering aspects of climate variability or change, any future water allocation planning carried out by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or source development proponents

WRC

1. The effects of climate variability and potential climate change on water resources should be considered in determining environmental requirements to meet the EPA's objectives.
2. The allocation of water to the environment should be conservative to allow for variations in climate and possible enhanced climate change effects from greenhouse.
3. Environmental water provisions should be reviewed every five years to ensure that they are adequately taking account of the effects of climate variability, ecosystem changes and possible enhanced climate change.

Proponents of source development

1. The effects of climate variability and potential climate change on water sources should be considered in determining system yield and planning new source development.

5.2.3 Watercourses and Surface Hydrology

Information

The rivers and streams of the Darling Plateau and Scarp support a rich invertebrate fauna, including several species of scientific importance because of their relationships to taxa otherwise extinct. Many invertebrate species are endemic. The rivers and streams also support many native endemic fish species.

Land clearing and associated erosion, sedimentation and salinisation have severely altered the physical and ecological characteristics of many of these streams.

The damming of rivers has created barriers to fish migration and this is known to have reduced the breeding range of some species. Alterations to flow regimes has given rise to changes in fringing vegetation and erosion which has led to the filling of pools with sediment. Inundation of swamps along the rivers, replacement of shallow water habitats with deep water habitats, and clearing of fringing vegetation below the maximum waterline of reservoirs are other impacts that result from the construction of dams.

Watercourses need their fringing vegetation protected to prevent further erosion and environmental degradation and erosion. Riparian native vegetation is poorly represented in the dedicated conservation estate with the result that even degraded areas with a potential for repair and restoration are now important.

Recognition of this situation has led to the proposal for the Darling Range Regional Park to protect the vegetation that remains.

A number of public submissions expressed concern about the environmental impacts of the proposed Harvey Dam and proposed raising of the Mundaring Weir.

Considerations

The EPA's objective for this factor is to maintain the environmental integrity, functions and values of watercourses.

The methodology and criteria for the determination of EWRs of surface streams downstream from water storages are still in their infancy and require further development for WA conditions. The amount of water to protect ecological values downstream of dams, taking account of summer and winter differences, is not well understood. However, the EPA recognises the development work being undertaken by the WRC in setting EWPs for surface water systems in recent water allocation planning such as the Collie River and Harvey Basin.

Streams that are currently in reasonable condition require protection to maintain their ecological functions and environmental values.

In its assessment of the ERMP Next Major Water Supply Source for Perth, the EPA indicated that while the raising of the Mundaring Dam may be environmentally acceptable in principle there were matters of environmental concern which required detailed assessment by the EPA (EPA, 1988).

A partial raising (5m) of the weir would increase the area of storage and inundate an additional area of about 200 ha. This represents about 40-60% of the remaining Murray Low Rainfall vegetation complex in the Helena Valley above the dam (Ian Pound & Associates, 1994).

The new and larger Harvey Dam could further reduce streamflow and the area of the remaining Lowden vegetation complex dominated by the most northern occurrence of peppermint in river valleys (Ian Pound & Associates, 1994). This proposal would also result in the flooding of agricultural land.

The EPA believes that consideration should be given to redirection of water from existing storages in the south-west of the State if excess capacity is identified in these dams. This is an environmentally benign alternative in comparison to developing new storage dams.

The EPA notes that:

1. methodology and criteria for determination of EWRs and EWPs for surface water flows in WA systems are preliminary and need further development;
2. stream-lines which are currently in reasonable condition require protection consistent with EPA objectives;
3. the partial raising of the Mundaring Weir could have impacts on important remnant vegetation, landuses and below dam streamflow regimes, although these are already highly modified;
4. the new Harvey Dam could generate impacts on important remnant vegetation and landuses but that below dam streamflow regimes would largely remain as at present; and
5. the diversion of water from existing dams is a relatively environmentally benign option where excess capacity is identified.

In considering aspects of watercourses and surface hydrology, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or source development proponents

WRC

1. Develop methodologies and criteria for determining EWRs and EWPs for surface water flows in WA systems to meet EPA environmental objectives for consideration by the EPA. The approved methodologies and criteria should then be applied in developing water allocation plans.
2. Water allocation plans, defining EWRs and EWPs to meet EPA environmental objectives should be prepared for each surface water catchment/basin prior to the submission of water source development proposals (ie dams or pumpback schemes) for the catchment/basin. These plans should be referred to the EPA for assessment .
3. EWPs should be designed to protect the environmental integrity, functions and values of watercourses to meet objectives set by the EPA.
4. EWPs should be frequently reviewed as new data become available on the water allocation required to protect environmental values.

WRC and proponents of source developments

1. Consider the diversion of water from existing storages in preference to the creation of new, surface water sources or the expansion of existing surface water sources where excess capacity is identified.

Proponents of source developments

1. Plan and design dams and pumpback schemes, including operating strategies, to ensure water releases meet approved EWPs, and to minimise impacts on watercourses.
2. Refer any proposal for a specific surface water source development to the EPA for its consideration under the *Environmental Protection Act.*

5.2.4 Groundwater Quantity and Quality

Information

The regional groundwater regime of the Swan Coastal Plain is being influenced by urbanisation and land clearing which results in reduced evapotranspiration and rising watertables in many areas. Activities that may offset this effect are tree plantations, which draw heavily on the superficial aquifer; abstraction by private users; and public supplies abstracted by the WC. Davidson (1995) provides a compilation of information on groundwater resources of the Swan Coastal Plain.

Groundwater drawdown in the shallow aquifer can affect wetlands and phreatophytic vegetation. These aspects are addressed further in Sections 5.2.5 and 5.2.8.

The superficial aquifer on the coastal plain discharges to rivers and streams and to the ocean near the coastline. Over-abstraction from the shallow aquifer may result in salt water intrusion to the shallow aquifer in areas close to the coast and rivers. Examples of this move in the interface between the sea water and the shallow groundwater exist in the Applecross and Cottesloe areas.

Caves in the vicinity of Yanchep National Park and areas around Carabooda support a rich cave fauna of highly adapted and scientifically important species (stygofauna and troglobytic fauna). Even small changes in groundwater levels in this area could cause underground streams to change or dry out completely, with resulting loss of the water source or cave faunas.

The decline of the watertable leading to the current drying of the Yanchep Caves is the result of a combination of pine plantations on the western flank of the Gnangara Mound, water abstraction from private bores in the Carabooda area, and depressed recharge from below average rainfall over the last 20 years.

Groundwater drawdown in the shallow aquifer may also affect summer pastures in rural areas.

The deep aquifers of the coastal plain (Leederville and Yarragadee) are at present relatively unaffected by short-term weather variations and abstraction. However, they are slow to recharge and care needs to be taken to ensure that abstraction of water from these sources occurs at a sustainable rate.

The degree of interconnection between the shallow and deep aquifers on the Swan Coastal Plain has recently been studied in a collaborative project between WRC and WC (PPK Environment and Infrastructure, 1998). While areas where impacts may occur have been identified, the magnitude of the impact requires confirmation and a range of development scenarios need to be evaluated.

Consideration

The EPA's objective for this factor is to maintain the quantity and quality of groundwater so that existing and potential uses, including environmental integrity, values and functions of ecosystems are maintained and protected.

Methodology and criteria for determining EWRs for ecological systems dependent on groundwater are more developed than those for ecological systems dependent on streamflows. These have been developed and applied in preparing water allocation plans for the Gnangara and Jandakot groundwater mounds (EPA Bulletins 295, 587, 817). These essentially relate to the pattern of groundwater levels which must be maintained in wetlands and in areas where groundwater supports phreatophytic vegetation. While monitoring is continuing, the methodology and criteria which have been developed appear effective to date.

The caves and aquifers in the vicinity of Yanchep National Park and Carabooda require particular attention. The precise relationships between drawdown, groundwater levels in the caves, and the ecological requirements of the subterranean aquatic fauna are not well known and will require detailed investigation to protect the fauna. This will require on-going management of activities on the Gnangara Mound.

The proposed Karnup-Dandalup groundwater scheme is mainly located in a rural area with shallow water table. Attention will need to be given to issues associated with impacts on summer pastures during water allocation and source development planning in this area.

A large portion of the public water supply abstraction comes from the deep artesian aquifers (Leederville and Yarragadee Formations). While the potential environmental impacts of abstraction from these aquifers is thought to be minimal, the EPA supports the ongoing investigations by the WRC and WC on the degree of interconnection between the shallow and deep aquifers, to identify recharge areas where water levels and hence water-dependent ecological systems may be impacted. This is fundamental to determining the environmentally sustainable yields of the artesian aquifers. It will also aid identification and protection of the recharge areas.

The EPA notes that:

1. overuse of shallow groundwater near the coast or rivers may result in saltwater intrusion;
2. the WRC intends to continue to investigate the potential for saltwater intrusion;
3. methodology and criteria for determining EWRs for ecological systems dependent on groundwater have been developed and applied for a number of groundwater sources in WA, and appear to have been effective to date;
4. the interconnection between deep and shallow aquifers requires confirmation and further evaluation to determine environmentally sustainable yields, and that aquifer recharge areas need to adequately identified and protected; and
5. aquifer and cave fauna in Yanchep National Park may be affected by reduced groundwater levels resulting from forestry activities and private and public groundwater use.

In considering aspects of groundwater quantity, any future water allocation planning by the WRC or water source development proposals by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or water source development proponents

WRC

1. Environmental water requirements and provisions to meet EPA environmental objectives and values should continue to be established for groundwater-dependent ecosystems to guide proponents in wellfield planning and design. This should include groundwater variation requirements to protect the ecological integrity of wetlands, cave fauna and phreatophytic vegetation.
2. Continue to monitor salt water intrusion as a result of groundwater abstraction from coastal aquifers.
3. Investigations should be undertaken to determine the impact on the shallow and deep aquifers of a range of private and public source development scenarios for the deep aquifers to determine environmentally sustainable yields. Recharge areas should be adequately identified and protected.

Proponents of source developments

1. Plan and design wellfields, including operation strategies, to ensure that groundwater levels meet approved EWPs.
2. Source development proposals should ensure that aquifer and cave fauna are not adversely affected by water abstraction.
3. Refer any proposal for a specific groundwater source development to the EPA for its consideration under the *Environmental Protection Act.*

5.2.5 Wetland Systems

Information

Perth's Water Future Strategy defines wetlands as fresh and brackish creeks, rivers, estuaries, lakes, sumplands, damplands, floodplains and palusplains. The rivers of the Darling Plateau and Scarp and estuaries are addressed in Sections 5.2.3 and 5.2.7.

Many of the wetlands of the Swan Coastal Plain are surface expressions of the groundwater and as such are susceptible to impact from groundwater drawdown as well as from runoff, especially from urban areas. Excessive rates and extent of groundwater drawdown by abstraction can adversely affect the ecological functions and values of wetlands. Similarly excessive amounts of additional water from surface water sources, such as urbanised areas and road pavement also affect the ecological functions and values of wetlands, often adversely.

Hill *et al* (1996) has defined the location and nature of most of the important wetlands on the coastal plain. This has included categorising the conservation value of wetlands.

Recent studies of 240 wetlands on the Swan Coastal Plain recorded 12 species of birds which occur only on seasonal wetlands (Balla, 1994). These wetlands are maintained by very shallow water tables and are the most likely to be affected by drought or drawdown of the water table through abstraction of water from the superficial aquifer.

On the Swan Coastal Plain, the damplands and wetlands support a rich diversity of bird fauna, including species protected under Japanese-Australia (JAMBA) and Chinese-Australia (CAMBA) Migratory Bird Agreements. Several are also RAMSAR wetlands. These international agreements impose an obligation to protect the wetlands and habitats used by these birds.

The WRC allocates groundwater to service providers (such as the WC) and users on the basis of maintaining a hydrologic regime that will protect important wetland values, as determined by the EPA.

The EPA has previously assessed potential groundwater sources on the Gnangara and Jandakot mounds under Section 38 of the Act (EPA Bulletins 295, 587, 817). These assessments have led to the development of a methodology and criteria for allocation of water to wetlands for these areas and this may be suitable to apply to other groundwater systems.

In areas where clearing or urbanisation has led to increased recharge, larger areas of open water in wetlands can be created which can lead to reduction of biodiversity and other wetland values (WAWA, 1995a).

The Karnup-Dandalup groundwater system is an area where extensive clearing for agricultural activities has resulted in raised groundwater levels and waterlogging. This has led to increased loss of nutrients to the Peel Inlet (WAWA, 1995a). One area of conservation significance is the Lowlands property, which is the subject of a System 6 Recommendation M105.

Consideration

The EPA's objective in regard to this factor is to maintain the environmental integrity, functions and values of wetlands.

The EPA's position on wetlands is that such a large proportion of the Swan Coastal Plain wetlands has been damaged by human activities that the remaining wetlands require special protection. Consequently the EPA's position is that all wetlands are important and that a 'no net loss' approach is philosophically appropriate as a starting point in the assessment of developing proposals. This means that all reasonable and practicable measures should be taken to minimise the potential impact on wetlands, either directly or indirectly, irrespective of the nature of the proposed development, the size or type of the wetland likely to be impacted or the magnitude of the wetland impact.

Any area of wetland which may be affected by further development should have its conservation status and condition reviewed in the context of local, regional, state, national and international significance.

The EPA's position is that EWPs should be made for the protection of wetlands prior to allocation of groundwater for consumptive uses. If EWPs are proposed which are less than the environmental water requirements for protection of a particularly significant wetland (that is, loss or some diminishment of the wetland's environmental value will occur), the EPA may require mitigation strategies to be applied, and a wetland replacement program established if loss of the wetland is likely.

Concerns were expressed in public submissions of the potential impacts of changes in groundwater levels on wetlands.

The EPA notes:

1. international obligations for the protection of wetlands and migratory bird species that use wetlands;
2. that a categorisation of the conservation value of many remaining wetlands on the Swan Coastal Plain has been undertaken;
3. that all remaining wetlands are important and negative impacts from groundwater abstraction should be avoided, especially for wetlands identified as having particular conservation values;
4. the WRC approach to proposing EWPs for protection of the environmental integrity, functions and values of wetlands, as required by the EPA;
5. that where negative impacts on wetlands are, proposed mitigation strategies should be applied and, where necessary, a wetland replacement program implemented;

6. that for some groundwater systems, further information is required to enable determination of the amount of water available for consumptive uses after environmental provisions for wetlands have been set;

7. elevation of the water table in some areas where there has been extensive land clearing or urban development;

In considering aspects of wetland systems, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or water source development proponents

WRC

1. In determining EWRs and EWPs for wetland systems, consideration should be given to the functions and importance of wetlands in a local, regional, national and international context.

2. Water requirements to meet the EPA's environmental objectives for the protection of wetlands systems should be investigated by the WRC so that the environmental water provisions to protect wetland functions and values can be referred to the EPA for assessment as early as practicable in the water allocation process.

WRC and proponents of source developments

1. Groundwater systems experiencing water table rise from clearing should be considered for substantial areas of native vegetation. In this regard detailed studies and water allocation planning for the Karnup- source development in preference to those systems supporting significant wetlands and Dandalup groundwater system should be initiated.

Proponents of source developments

1. Plan and design wellfields, including operating strategies, to minimise impacts on wetland systems and communities.

2. Implement environmental management programs to mitigate impacts of wellfield drawdown on wetland, and, where required, replace important wetlands lost.

3. Refer any proposal for a specific source development to the EPA for its consideration under the *Environmental Protection Act*..

5.2.6 Terrestrial Vegetation

Information

Regionally significant native vegetation often includes damplands and wetlands, as discussed Section 5.2.5. However, the relationship between some of the "dry-land" vegetation and the water table is only known in some instances. Vegetation in proximity to groundwater (eg lying over the groundwater mounds) is dependent on the level of the water table and can therefore be affected adversely by reducing the height of the water table, and by altering the rate at which it changes. In addition, the lowering of the water table from abstraction of groundwater can be exacerbated by reductions in recharge from lower than average rainfall conditions.

Havel (1975) predicted a change to a more xeric environment on the northern Swan Coastal Plain and Mattiske (1992) showed this is already occurring in Whiteman Park. Vegetation stress was mainly demonstrated in middle topographic elevations (AGC Woodward-Clyde, 1991), rather than lower elevations. Vegetation at upper elevations on the Bassendean Dune System is adapted to drier conditions whereas at lower elevations the plants may have access to

water. These plants at lower elevations are likely to be affected more by reductions in water table height.

Regional groundwater rises as a result of land clearing and urbanisation, because of increased runoff and loss of deep-rooted vegetation reduces water removal from evapotranspiration. Water abstraction by private users that draw heavily on the superficial aquifers can offset these effects. Tree plantations (eg pines) can reduce recharge to effectively zero (Davidson, 1995) but when the pines are removed, water tables rise dramatically, as occurred at Kardinya.

Salinisation of groundwater and surface waters can also result from loss of deep rooted vegetation.

A procedure for determination of EWRs for groundwater-dependent vegetation, based on sound technical knowledge already exists. However, a comparable procedure for surface water systems is not as developed.

Although much of the vegetation remaining on the Swan Coastal Plain is clearly associated with wetlands, there are some substantial areas of other terrestrial vegetation, including within Yanchep and Neerabup National Parks, Melaleuca Park and the proposed Jandakot Banksia Park which, although not strictly classified as wetland vegetation, are still dependent upon groundwater. New groundwater schemes proposed in the northern parts of the Gnangara groundwater mound (refer Table 2) could impact vegetation within the Yanchep and Neerabup National Parks, and new schemes in the eastern part of mound (Table 2) could impact vegetation in Melaleuca Park. Investigations for these schemes will need to ensure that EWPs provide adequate protection of vegetation in these parks. No new groundwater developments are proposed for the Jandakot Mound in the Strategy, so no additional impacts are expected on vegetation in the Jandakot Banksia Park.

Terrestrial vegetation in the catchment areas above dams is affected by inundation and dams also alter downstream hydrology which can have impacts on terrestrial vegetation nearby.

Consideration

The EPA's objective in regard to this factor is to maintain the abundance, biodiversity, geographic distribution and productivity of vegetation communities. The importance of vegetation for the conservation of biodiversity of flora and fauna is addressed further in Section 5.2.9.

The Barragoon groundwater scheme may impact vegetation associated with the Karrakatta and Quindalup soil complexes, which are not adequately represented in reserves. However, there are no known phreatophytes on these soil complexes. Future abstraction could exacerbate the current cumulative impacts of pine plantations and stock grazing on these complexes (Ian Pound & Associates, 1994).

Vegetation communities are adversely affected by increasing the size of impoundments, whether from inundation or the clearing of vegetation related to surface water development proposals, such as a dam on the Harvey River, or raising the height of the Mundaring Weir. Vegetation downstream of the Mundaring Weir along the Helena River is subject to System 6 Recommendation M 34. Inundation from the new Harvey Dam may intrude into an area proposed for inclusion in an adjoining Nature Reserve.

The WC has made a commitment to investigate minimising clearing of the inundation zone of Mundaring Weir and options for smaller dams on the Harvey River to minimise impacts on vegetation and fauna. The EPA agrees that these matters should be addressed in the environmental assessments for these sources.

The WC has also made a commitment to carry out research into the effects of thinning of native forest on water inflow to dams. However, thinning of native forests on the Darling Plateau to alter the runoff characteristics of the catchments to increase water yield could have impacts on biodiversity that may be undesirable or unacceptable.

Many public submissions considered that forest thinning of native forests was unacceptable and concerns were expressed about the potential impact of groundwater abstraction on the remaining banksia woodlands and other remnant vegetation.

The EPA notes;

1. that a scientifically-based methodology and criteria for determining EWRs for groundwater-dependent vegetation has been applied in WA and appears to be effective;
2. that a scientifically-based procedure for determining EWRs for ecosystems dependent on surface water in WA has not been developed yet;
3. the potential in various source development proposals for the inundation of areas with significant vegetation communities; and
4. the commitment to refer specific source development proposals to EPA for consideration and assessment.

In considering aspects of terrestrial vegetation, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or water source development proponents

WRC

1. Continue studies to improve determination of EWRs for groundwater-dependent terrestrial vegetation
2. Undertake studies and develop methodologies and criteria for determining EWRs of riparian vegetation that may be affected by the diversion of surface water. Such studies should be focused to address EPA environmental objectives and include survey and mapping of flora and vegetation that may be affected by alterations to the existing hydrological regime.
3. Water allocation planning should ensure adequate EWPs to protect regionally significant vegetation, as determined in studies such as Perth's Bushplan and System 6 update.
4. The WRC should undertake studies to determine the potential impact on ecological and biodiversity values of thinning native forests to increase surface water yields should this be further considered.

Proponents of Source Development

1. Undertake studies of the values and significance of any terrestrial and riparian flora and vegetation associations that may be affected by inundation, clearing and diversion of water associated with development of dams and pumpback schemes, to demonstrate that EPA environmental objectives can be met.
2. Prepare environmental management procedures to minimise, mitigate and avoid impacts on flora and vegetation communities.
3. Refer any proposal for a specific source development to the EPA for its consideration under the Environmental Protection Act.

5.2.7 Aquatic Fauna

Information

The information in Section 5.2.3 on watercourses and surface hydrology, and section 5.2.5 on wetlands is also relevant here.

The aquatic animals of the Swan Coastal Plain, Jarrah Forest and Avon Wheatbelt Biogeographic Regions (Thackway and Cresswell, 1995) inhabit two main categories of aquatic habitat: lakes and other standing waters (lotic habitats) and rivers and streams (lentic habitats) (Williams, 1982). Some of the habitats in both categories are highly modified or artificial (such as reservoirs and drains), or affected by secondary changes such as salinisation caused by land clearing and the consequent alterations to groundwater levels and streamflow regimes. The flow regime, degree of permanence and salinity are all important determinants of the types of animals occurring within particular habitats.

The south western part of Australia has aquatic animals of the same orders and classes as those found in most other parts of the world, but the species occurring here tend to be geographically restricted rather than widespread in their distribution (Williams, 1982; Allen, 1982; Allen, 1989). Unlike the mega-biodiversity that occurs in the terrestrial flora of the South West, the aquatic fauna is relatively depauperate and several families of animals simply do not occur. This is probably because of the relative impermanence and small size of many aquatic habitats, combined with the nutrient-poor waters resulting from the extreme age of the landscape in which this fauna evolved. The absence of large, diverse crops of algae seems to have disadvantaged some groups of animals, so that they are relatively insignificant elements of the fauna, or do not occur at all.

The sandy soils of the coastal plain and gravelly lateritic soils of the Darling Scarp contain groundwater, and produce relatively low amounts of surface runoff when compared with landscapes elsewhere. The shallow, unconfined aquifers are known to support limited assemblages of subterranean aquatic fauna, known as stygofauna (refer to Section 5.2.4). The status, composition and distribution of the stygofauna of the region is not well known.

Changes to the aquatic habitats of the region since European settlement have been profound. Many wetlands have been filled or drained, many streams dammed and their valleys flooded, most streams and standing waterbodies in agricultural or urban areas are now artificially enriched with nutrients and virtually all streams in the Avon catchment are now saline. These changes have meant that species that were formerly widespread, such as the marron (*Cherax tenuimanus*), have disappeared from much of their former range, and some species may be threatened with extinction. The storages in the Darling Scarp are now important refuges for marron and freshwater mussels which have declined over much of their former range.

Consideration

The EPA's objective for this factor is to maintain or enhance the native faunal biodiversity of the lakes and standing waters, rivers and streams and unconfined aquifers of the region.

The potential for impacts from development of groundwater sources proposed in the Strategy relates principally to wetlands. The methodology and criteria developed by the WRC for determining EWRs and provisions for wetlands includes consideration of aquatic fauna requirements. Monitoring programmes established for wetlands on the Gnangara and Jandakot groundwater mounds include aquatic fauna.

Considerable baseline biological monitoring was carried out on the Darling Range and Swan Coastal Plain streams in the 1980's by the then Metropolitan Water Authority. Towards the end of the 1980's, research focused on more strategic studies on ecological aspects including impacts on fish of barriers caused by dams, life cycle of fish, effects of different monitoring techniques on invertebrate community structure and biological energy flow. Most of this work has been summarised by Davis et al (in press). The results of this research will be important in the determining of EWRs and EWPs in water allocation plans for the surface water systems proposed for development in the Perth's Water Future Strategy (Harvey River basin, raised Mundaring Dam, Jane Brook and lower Serpentine River).

In considering aspects of the aquatic fauna, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or source development proponents

1. Continue studies into aquatic fauna generally, and of individual species, so that distributions and status of the elements of the fauna are better defined, and the impacts of water resource development on the fauna can be adequately managed or mitigated in the long term.
2. In preparing water allocation plans for each catchment/basin, define the current faunal assemblage of the catchment/basin, and how these are likely to be affected by proposed water source development, and EWPs to ensure adequate protection of fauna.

WRC and proponents of source developments

1. Where feasible, for example where downstream environmental water flow is to be restored, carry out the work necessary to encourage recolonisation or re-introduction of species where they have become absent.

Proponents of source developments

1. Plan and design dams and pumpback schemes to minimise and mitigate impacts on aquatic fauna.

5.2.8 Estuarine and Marine Systems

Information

Estuaries experience ocean tidal influences as well as inflow from surface water and groundwater.

Salinity levels of west coast lagoonal estuaries show substantial seasonal variation. Streams entering lagoonal estuaries typically support fewer fish species than those in Eastern Australia. However, the lagoons are very productive because they are nutrient-enriched systems and support a high plant and animal biomass. Salinity is an important factor in determining the composition of fish populations in estuaries and streams.

Shallow aquifers of the Swan Coastal Plain often discharge into shallow water along beach margins or further offshore at limestone reef structures.

Streams and artificially created drains entering estuaries can convey large quantities of nutrients that can give rise to algal blooms, such as in the Swan/Canning and the Peel/Harvey Estuaries.

Deep aquifers are known to discharge into the ocean some distance offshore, but the potential impacts of reducing these discharges is thought to be limited.

Consideration

The EPA's objective for this factor is to maintain the environmental integrity, values and functions of estuaries and marine waters and embayments.

The abstraction of groundwater by sources proposed in the Strategy is expected to have little impact on estuarine and marine systems. Potential impacts on the marine system were considered in evaluating development of the groundwater sources in the North West Corridor (WAWA 1992). The WC has committed to review known relationships between groundwater discharge to the ocean and the marine environment in relationship to its wellfields where this is an issue of concern.

The surface inflow to estuaries on the Swan Coastal Plain has generally increased since European settlement, despite construction of dams on the Darling Range, due to increased streamflow as a result of extensive land clearing. The EPA considered the issue of reduced streamflow to the Peel-Harvey estuary in its assessment of the North Dandalup Dam (EPA Bulletin 343). The EPA found that construction of the dam would not have a significant impact on the estuary.

In its water allocation plan for the Harvey Basin (WRC, 1998), WRC has estimated that surface inflow to the Harvey estuary is currently 50% greater than it was prior to European settlement.

The proposed raising of Mundaring Weir, and the Jane Brook pumpback scheme are not expected to significantly alter surface inflow to the Swan-Canning estuary.

In considering aspects of estuarine and marine systems, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or source development proponents

WRC

1. Define the ecological significance of flows to the estuarine and marine environment from rivers that will be sources for public water supply and identify EWRs and EWPs to be maintained to protect estuaries and marine systems.
2. Define the ecological significance of groundwater inflows to the estuarine and marine environment from aquifers that will be sources for public water supply and identify the environmental requirements and provisions to be maintained to protect estuarine and marine systems.
3. Define and implement catchment management measures, including streamflow regimes where these would assist, to reduce nutrient export to the Swan/Canning and Peel/Harvey estuaries, so that high primary and secondary production are maintained without frequent nuisance algal blooms occurring.

5.2.9 Biodiversity and Nature Conservation Values

Information

Australia has a very large number of unique and unusual plants, animals and micro-organisms. There is probably in excess of one million species, of which less than 15 percent have been described. Lack of knowledge about the diversity of life and the effect of our activities on this fundamental resource poses the most significant threat to its conservation and management (Commonwealth of Australia, 1996). The term biodiversity covers the variety of all forms of life, plants and animals, the genes they contain and the ecosystems of which they are a part. Consequently biodiversity is considered at three levels - ecosystem diversity, species diversity and genetic diversity.

Each ecosystem differs from all others because it contains a unique combination of species (and genes) and because these species interact with one another and with each environment in different ways (Commonwealth of Australia, 1996). Species diversity is the number of species and their relative abundance in a defined area. Genetic diversity is the variety of genes contained in all the species in a given area.

The four main reasons for preserving biodiversity relate to ecosystem processes, ethics, aesthetics and culture, and economics.

The South West of Western Australia (the Southwest Botanical Province) is an internationally recognised centre of biodiversity as it contains over one third of Australia's plant species of which 70 percent are endemic (Commonwealth of Australia, 1996).

Consideration

The EPA's objective in regard to the factor biodiversity is to maintain biological diversity meaning the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.

The EPA's objective in regard to the factor nature conservation is to ensure that nature conservation values are adequately protected at the local, regional national and international level, through the creation of a comprehensive, adequate and representative (CAR) system of reserves.

In considering aspects of biodiversity and nature conservation values, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or water source development proponents

WRC

1. In carrying out water allocation planning the WRC should ensure that adequate consideration is given to the regional significance of biodiversity and that future water source developments do not jeopardise the provision and management of a comprehensive, adequate and representative system of reserves (CAR system) to protect biodiversity.

Proponents of source development

1. Proponents should ensure that biodiversity values are maintained.

5.2.10 Recreation

Information

A socio-economic evaluation of strategies was undertaken by the WAWA as part of the process of selecting a preferred water supply strategy.

Dams and catchments are used for passive recreation, such as barbeques and bushwalking, but water-contact recreation is not permitted on most dams in Western Australia and other activities permitted within catchment areas are restricted. This is an approach to ensure water quality remains high and to minimise the amount of water treatment required.

Some water supply areas are used for major activities, such as "Rally Australia", which occurs once a year. This event has resulted in increases in reservoir turbidity in Mundaring Weir, probably from erosion in the catchment (Water Corporation, pers. comm.).

The Perth's Water Future Strategy has the potential to affect recreational use of dams in the Waroona-Harvey area. Dams in the Waroona area are an important recreation resource and are the closest dams to Perth where on-water recreational uses such as water skiing are permitted. The Shire of Waroona anticipates that the recreation and tourism potential of the reservoirs will be increased in the future.

The proposed construction of the new Harvey Dam could increase potential recreational opportunities in the region. In addition, releases could be maintained from the Stirling Dam to support white-water activities such as canoeing and slalom activities downstream provided issues of possible river bank erosion are managed.

Restricting access to the Mundaring Weir recreation area may be expected during construction activities associated with the raising of the Mundaring Weir.

Consideration

The EPA's objective for this factor is to ensure that recreational uses as developed or proposed by planning and other agencies are balanced with the needs for high quality water and low levels of water treatment.

It is envisaged in the long term that water from the Waroona Irrigation District which is surplus to irrigation requirements would be redirected and used for public water supply . The redirection of surplus irrigation water to public water supply could result in restrictions being placed on water contact recreation activities to protect the quality of water supply. This could lead to impacts on existing commercial activities which rely on current levels of recreation.

If existing and future recreation opportunities are to be supported, this could lead to the need for additional treatment of water diverted for public supply, with attendant increased costs of water and possible public health considerations.

The WC has made a commitment to study the alternative water quality management measures associated with the impacts of tourism and recreation on the Waroona-Harvey reservoirs.

Public submissions expressed concerns about the loss of recreational use in the Serpentine National Park. This would need to be addressed by the WRC and WC in planning for development of this lower Serpentine pumpback source.

The EPA notes:

1. The potential for expanded recreational development associated with the new Harvey Dam;
2. The potential adverse impacts on existing and potential recreation development arising from the diversion of surplus irrigation water from the Waroona Dams for public water supply; and
3. The WC's commitment to study alternative water quality management measures which would be a consequence of increased recreational access and use.

In considering aspects of recreation, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or water source development proponents

WRC

1. The WRC should consider existing and potential recreational values in the water allocation planning for water resources systems identified for development in the Strategy.

Proponents of source developments

1. The WC should, in consultation with the Shires of Harvey and Waroona, review policies for the recreational use and development of reservoirs in these Shires following the preparation of a water allocation plan for the Harvey River basin.
2. The WC should continue studies of the impacts on water quality of recreation uses on reservoirs, and in catchments, and prepare management strategies to ensure that acceptable water quality is maintained.

5.2.11 Cultural, Heritage and Social Surroundings

Information

Raising of the Mundaring Weir could affect the values of this weir as an important heritage/architectural feature.

Ethnographic surveys found the vicinity of the Mundaring Weir to be an area of current significance to Aboriginal people.

In public submissions it was indicated that:

- any water source development needs to consider its possible impact on Aboriginal heritage and an Aboriginal heritage study should be carried out prior to any development;
- culturally sensitive programs are needed to ensure Aboriginal people are included in the consultation process. Such programs need to have links to existing information networks in the metropolitan area; and
- the Serpentine River has Aboriginal significance as it was a movement route for Aboriginal people, and there are known sites of Aboriginal significance located on it.

Consideration

The EPA's objective for this factor is to ensure that cultural and heritage values are protected.

The WC has acknowledged the heritage value of Mundaring Weir in the Strategy and has made a commitment to develop a scheme design which will allow the architectural integrity of the Weir to be retained.

The WC has also made a commitment to consult with the Aboriginal community prior to any expansion to the Mundaring Weir, and to conduct studies into possible impacts of water source developments on Aboriginal heritage on a site specific basis. A similar commitment should be made in respect of other sources including Serpentine River.

The effects of inundation on both Aboriginal and European heritage arising from the new Harvey Dam need to be determined.

The EPA notes:

1. The need for the WC to develop a scheme design to retain the architectural integrity of Mundaring Weir if this is to be further developed.
2. The commitment of the WC to consult with the Aboriginal community and to conduct studies on a site specific basis.
3. The need to undertake detailed surveys to determine the impacts of inundation from the new Harvey Dam and other surface water developments on Aboriginal and European heritage sites.

In considering aspects of heritage, any future water allocation planning by the WRC or water source development planning by proponents should take account of, but not be limited to, the following:

Studies and further action to be undertaken by the WRC or water source development proponents

WRC

1. WRC should consider the presence of heritage sites and cultural values in the water allocation planning process.

Proponents of water source developments

1. Proponents of source development proposals should undertake detailed Aboriginal and European site surveys as part of the preparation of an environmental review for the proposal. This applies particularly to the proposed further development of Mundaring Weir, and Serpentine River.
2. Proponents should liaise with the Aboriginal community to ascertain any Aboriginal interest in areas affected by source development proposals.

5.2.12 Intergenerational equity considerations

The National Strategy for Ecologically Sustainable Development has as its core objectives three statements which together indicate the importance of having regard for the future in the decisions and actions of today. These objectives are:

- to enhance individual and community wellbeing and welfare by following a path of economic development that safeguards the welfare of future generations;
- to provide for equity within and between generations; and
- to protect biological diversity and maintain essential ecological processes and life-support systems (Commonwealth of Australia, 1996).

Ecological sustainability requires the maintenance and support of a healthy and diverse ecosystem on behalf of existing and future generations of humans and other species. This means sustaining biodiversity, ecological integrity, "natural capital" and social integrity (Commonwealth of Australia, 1996). Because we do not have adequate knowledge to evaluate how much of our natural resources need to be preserved for the future (for future generations to use), and we do not in most instances know enough about how to maintain ecological integrity, it is prudent to err on the side of caution and try to retain our existing biodiversity, and to use our renewable stocks at a rate no greater than that needed to replenish them, and to use non-renewable stocks with great care (Commonwealth of Australia, 1996).

6. Policy and Research and Development Initiatives

6.1 Policy, Research and Development and Management Commitments

The Perth's Water Future Strategy includes a program of policy and research and development initiatives, and a list of management commitments related to these and other elements of the Strategy.

The EPA recognises that the Strategy was prepared by the former Water Authority of WA and that there are now three separate, independent organisations with distinct responsibilities for water resource management, water service standards and development of water supplies.

Since the restructuring of these agencies, the WC and WRC have reviewed the management commitments made in the Strategy. The WC revised commitments and WRC position are set out in the WRC's review of the Strategy (WRC, 1997a). A copy is included as Appendix 6 of this report.

The EPA considers that the management commitments are comprehensive in identifying issues which need to be addressed in water allocation and source development planning for Perth's future water supply, and that they propose appropriate policy, research and development initiatives to address these issues.

In particular the EPA supports:

- the adoption of the precautionary principle for the protection of water resources used or planned to be used for public supplies (commitment 1);
- the development of a methodology for determining environmental and consumptive streamflow requirements as part of water allocation planning (commitment 6); and
- the development of a strategy to guide the installation of private groundwater bores in appropriate areas and encourage the wise use of this resource (commitment 38).

The EPA also strongly supports the commitments related to reuse of wastewater and use of drainage water (commitment 9-12 and 34). As indicated in Section 5.1 of this report the EPA considers that wastewater reuse and the use of drainage water, along with water use efficiency measures, have the greatest capacity to minimise, and where possible avoid, environmental impacts from new water supply developments.

Consideration of wastewater reuse and use of drainage water should not be constrained by cost considerations alone. Where wastewater reuse and/or use of drainage water are shown to be technically feasible they should be considered in preference to developing sources with higher environmental impacts.

7. Conclusions

The EPA commends the former Water Authority of WA on its initiative to prepare a long term water supply strategy for Perth, and its involvement of the public in this process. The EPA considers that the Strategy provides a sound framework for future planning, investigations, and research and development of water sources to meet Perth's increasing demands.

Particular attention needs to be given to water use efficiency and to innovation, including research and development initiatives for wastewater reuse and use of drainage water, as these have the greatest potential to minimise and avoid environmental impacts from development of dams and groundwater schemes.

The provision of adequate water to protect ecological systems dependent on water resources will be a fundamental component of the assessment by the EPA of any allocation plan in future water source proposed for development as part of the Strategy.

The EPA acknowledges that it has a key role through the provisions of the EP Act to establish environmental values and objectives which need to be met by environmental water allocations in WA. Amendments currently proposed to the Act will enable Water Allocation Plans to be formally assessed under the Act, and for the Minister for the Environment to set legally binding conditions to ensure EWPs are sustained.

8. Recommendations

Recommendation 1

That the Minister for the Environment notes that the EPA has provided advice in this report on the Perth's Water Future Strategy to assist the Water Corporation and Water and Rivers Commission in their future planning and investigations of water supply options for Perth.

Recommendation 2

That the Minister for the Environment notes that the EPA advice covers the key components of the Strategy, being the proposed water use efficiency program, specific groundwater and surface water sources proposed to be developed between now and 2021, and, policy and research and development initiatives.

Recommendation 3

That the Minister for the Environment notes the EPA principles for Water Allocation and Management that underpin the advice in this report.

Recommendation 4

That the Minister for the Environment notes that the Water and Rivers Commission is coordinating implementation of a program to meet the State's requirements in respect of the COAG Agreement on Water Resources Policy, and that this includes establishing a water allocation process which specifically recognises the need to maintain adequate water resources to protect environmental systems, in accordance with the EPA's environmental values and objectives.

Recommendation 5

That the Minister for the Environment notes that amendments currently proposed to the *Environmental Protection Act* will support the water allocation processes being developed as part of the COAG Agreement by enabling water allocation plans to be formally assessed under the Act, and for the Minister to set legally binding conditions to ensure that environmental water provisions to meet the EPA's environmental values and objectives are sustained.

Recommendation 6

That the Minister for the Environment notes that water resource allocation plans and individual source development proposals will need to be referred to the EPA for consideration under the *Environmental Protection Act*, prior to approval of any of the water sources proposed for development as part of the Strategy.

Recommendation 7

That the Minister for the Environment endorses the EPA advice contained in this report and in transmitting the advice to the Minister for Water Resources, advises him that the Strategy provides a sound framework for future planning and investigations for Perth's water supply, and that particular attention should be given to establishing appropriate water use efficiency targets for all water use sectors, and to innovation, including research and development initiatives for wastewater reuse and use of drainage water.

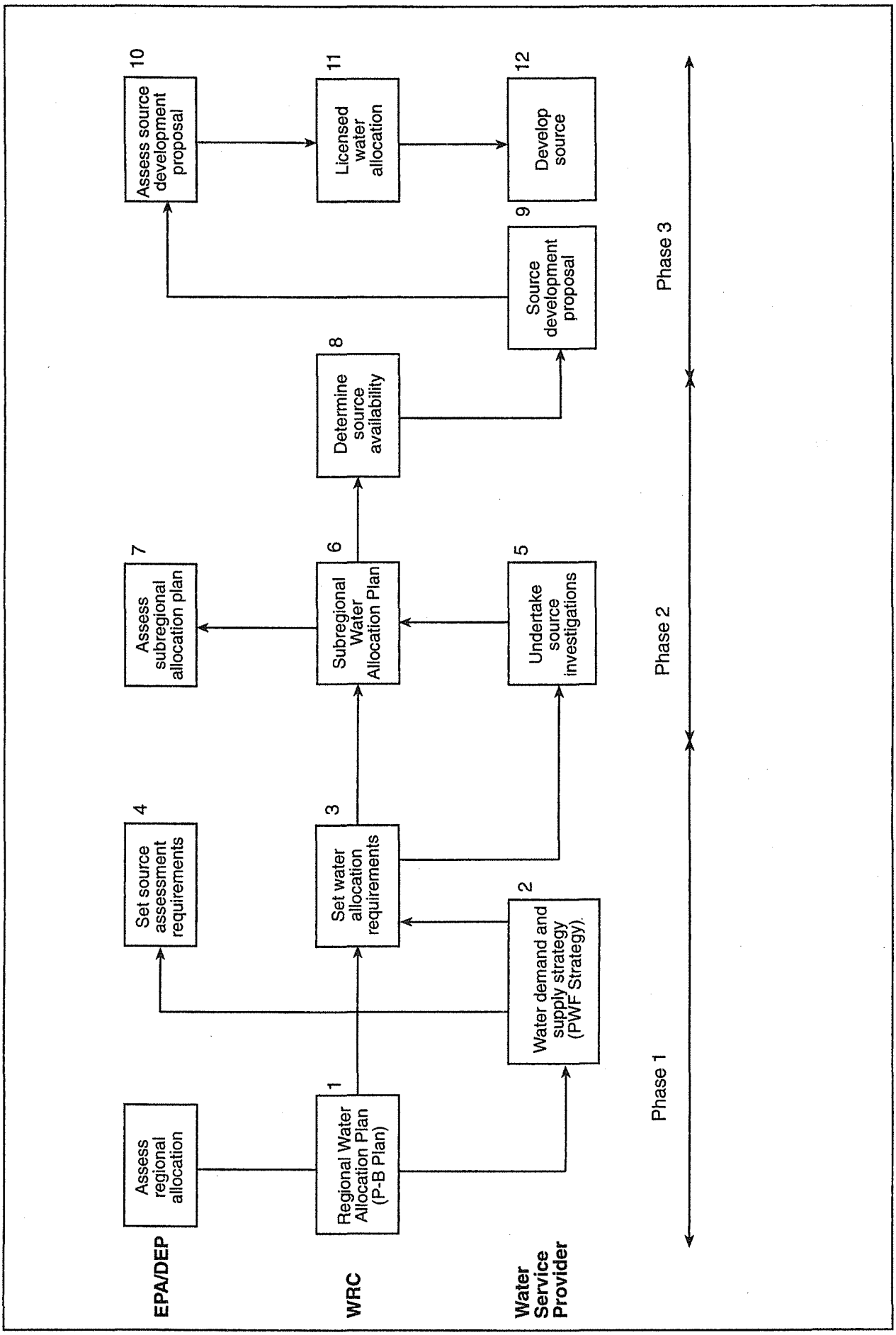

Figure 1. Water allocation planning and environmental assessment process (Source: Modified from Water and Rivers Commission, 1997).

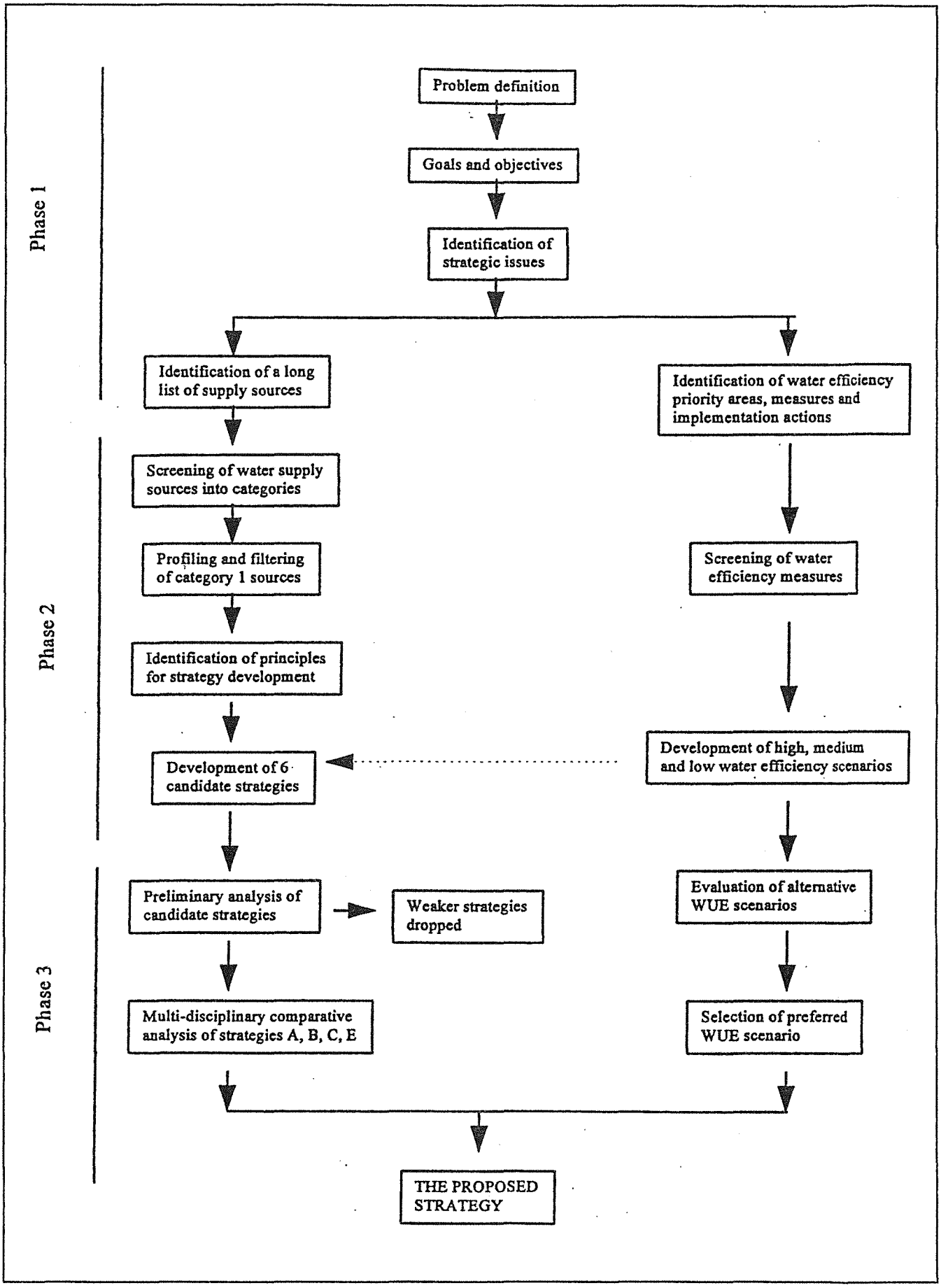

Figure 2. Strategy formulation process (Source: Water Authority, 1995).

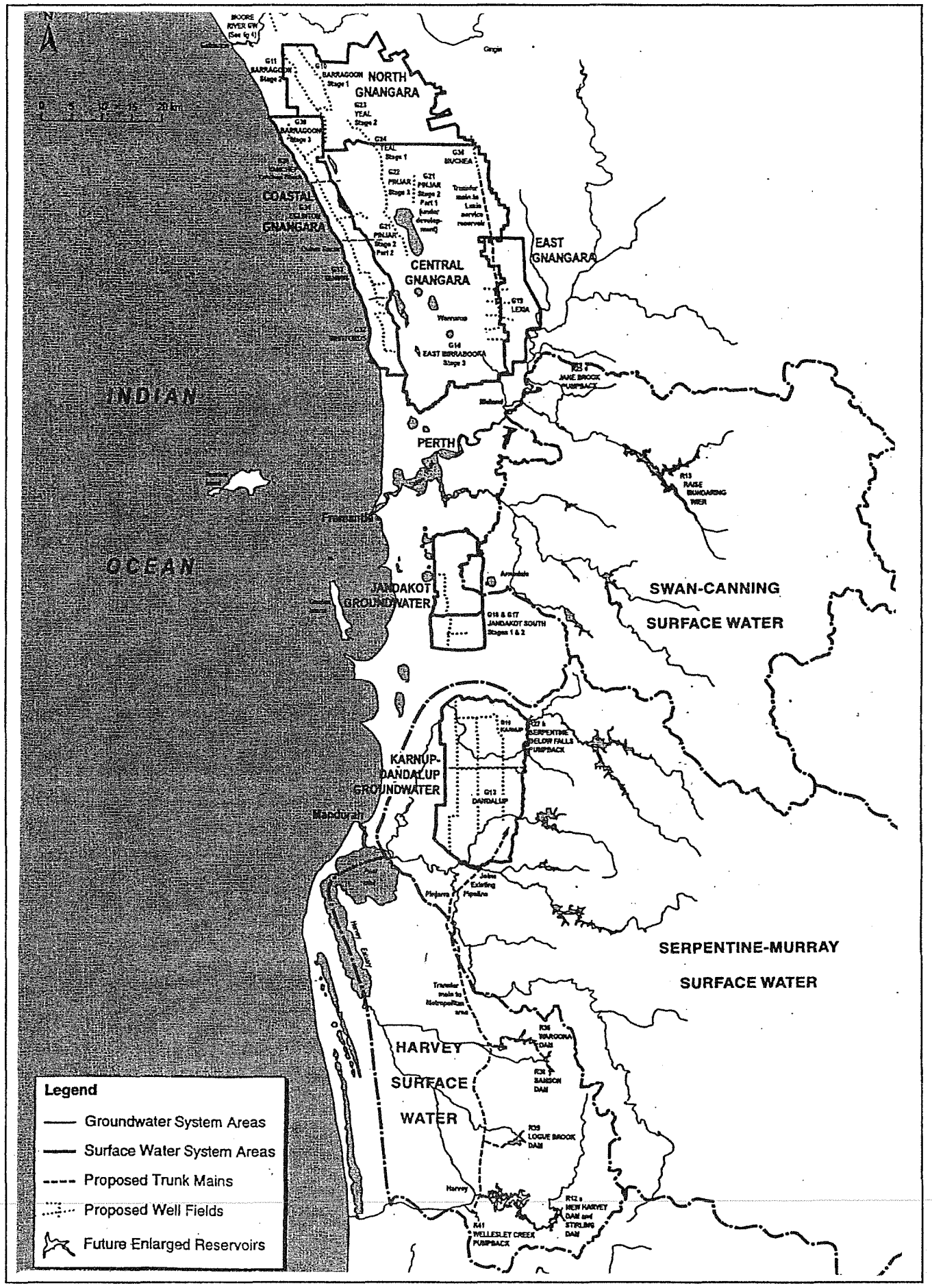

Figure 3. Water resource system areas (Source: Water and Rivers Commission, 1997).

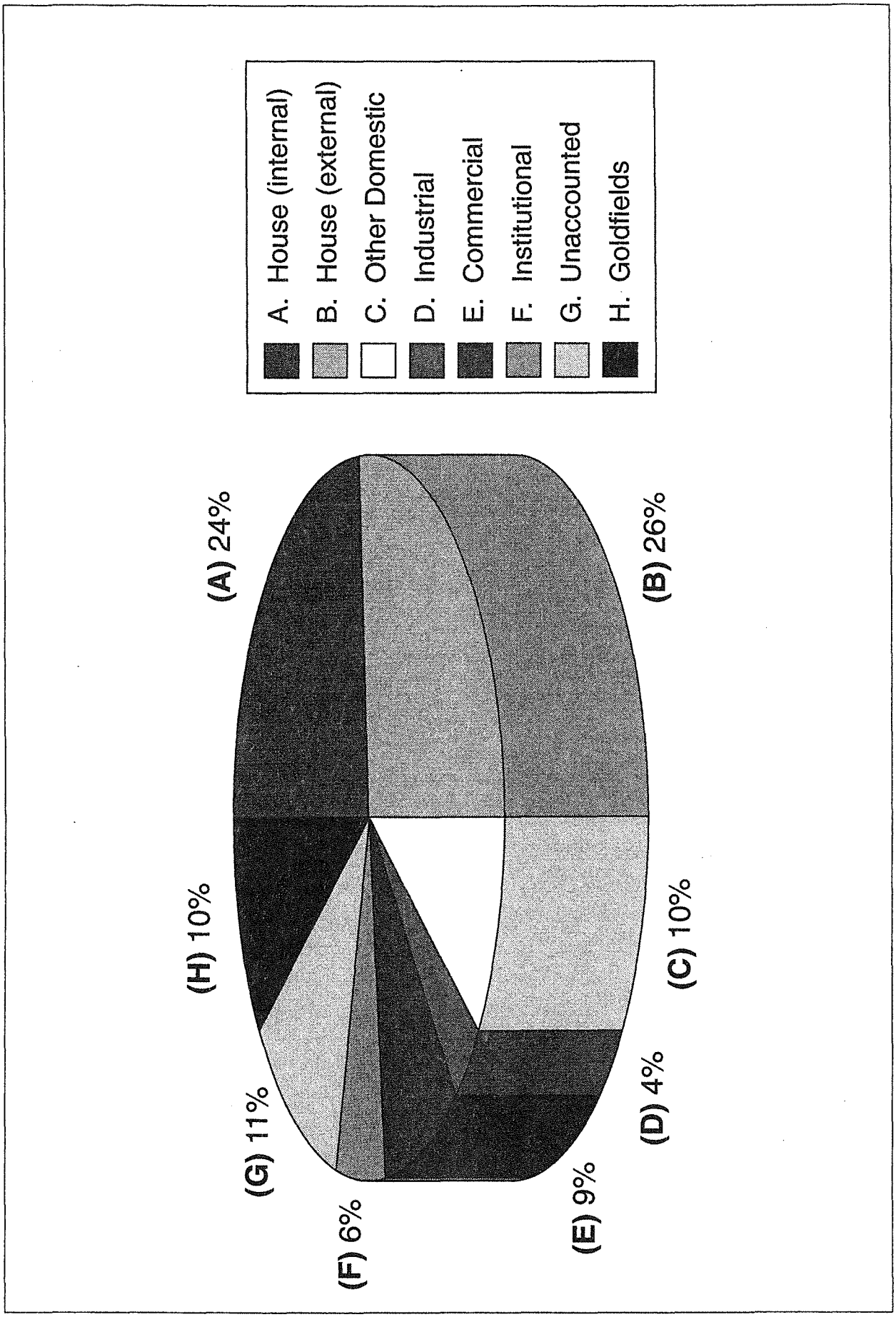

Figure 4. Break-down of water use from the Perth, Mandurah and Goldfields water supply scheme.

Appendix 1

EPA Position in respect of Water Allocation and Management Issues

1. Allocation of water to meet the requirements of the environment should be the first allocation.

2. Total water resource, minus conservatively estimated environmental water provisions, following assessment by the EPA, gives the amount available to allocate to other uses.

3. Allocations to the environment should be sufficient to ensure healthy water-dependent ecosystems at all times. Thus allocations should be based on dry rather than average conditions and should include a margin for safety.

4. Allocations for the environment should recognise the natural variability of Australian environmental systems, including that for some rivers, where seasonal drying and reduced flows are normal. Such patterns should be replicated as far as is practicable for new sources.

5. In some instances environmental systems have already been affected by dams which may have either reduced or prevented flows downstream of the dam, or in some instances, have turned what was a seasonally dry river into a permanently flowing one (eg the Lower Ord below the dam on Lake Kununurra). In such cases restoration of pre-dam flow patterns may have undesirable effects on present environmental values and consideration of re-establishing flows needs to take full account of the existing environmental values which have resulted from the changed flow patterns. Restoration of pre-dam downstream flow regimes may not always be environmentally desirable.

6. Allocations to the environment should be conservative (generous) rather than precise. It is much easier to adjust environmental allocations by having spare capacity than it is to try and acquire environmental water from other uses once allocated. Allocations should also be reviewed regularly to ensure that the environment objectives are being met.

7. Water needed for the environment needs to be protected from users/providers who obtain water from their own bores, sometimes in an unregulated manner. Groundwater aquifers need to be monitored or managed properly and adequate measures put in place to assess cumulative effects and their impacts on water-dependent systems and the environment in general. Protection of environmental water allocations is the responsibility of all water users, not just government and water managers and providers.

8. Private bores, especially those of large users such as industry, still remove water from aquifers and sometimes have a lower degree of control and environmental protection than that imposed on scheme water use from water service providers. In addition, multiple smaller users such as irrigators can also be responsible for considerable use of water. This can be significant, particularly if the water abstraction is from direct run of river or riverbed aquifers. All users/providers should be treated alike with equity of treatment of providers of water in relation to environmental safeguards.

9. EPA will identify environmental values and objectives and ensure that sufficient water is allocated to protect these in the long term. The Water and Rivers Commission and water service providers' tasks are to demonstrate clearly that the EPA objectives will be met and that environmental values will not be compromised. The WRC is also responsible for ensuring that the research necessary to identify technical requirements and the numerical values of the qualitative statements of EPA objectives is carried out, and to propose to the EPA the water allocation required to protect the environment.

10. Diversion of water from existing storages should be considered in preference to the creation of new surface water storages or the expansion of existing surface water storages where excess capacity is identified. This approach has minimal new environmental effects. The EPA supports the reform of water allocations and transfer of rights to use water, as a mechanism for encouraging water to be used for highest values, and thus reducing demands on new water sources.

11. To foster sustainable use, industrial users should be encouraged to use treated wastewater as a water source whenever requirements for water quality can be met, in preference to either increasing abstraction from existing bores, or establishing new water sources, including self supply bores.

    Most industry currently supplies itself via bores which is sometimes not metered and yet should be part of the per capita consumption figure. Although at present the Water Corporation supplies only about 10 percent of industrial water to Kwinana, there is the potential for greater supply to the industrial sector from re-use of treated wastewater through the recently launched WaterLink initiative.

12. Per capita water consumption performance targets should be set to take account of all water uses (ie. scheme and non-scheme) and across all sectors (ie. domestic, industrial, agricultural and recreational).

13. Water use efficiency targets should be set for each sector (domestic, agricultural, industrial, mining etc) and measures of improved efficiency should then be reflected in each sector, otherwise significant improvements in domestic efficiency could be eclipsed by even relatively small increases in other sectors (for example, the projected water consumption in the Ord Stage 2 irrigation project could be approximately four times that of the current Perth domestic market).

14. The EPA supports the former Water Authority of WA position, retained by the Water and Rivers Commission and Water Corporation, on maintaining "closed" surface water catchments where there is any risk or uncertainty that development may have a negative impact on water quality that might increase contamination levels which would require higher levels of water treatment.

15. Groundwater resources for public water supply need statutory protection against development, contamination and over-exploitation.

Appendix 2

Definitions

The following definitions are used in this report:

Term	Meaning
allocation for consumptive uses	Amount of water made available for a range of uses that consume water. This allocation should be made from the amount of water left after that needed by the environment has been allocated.
consumptive use	Use of water for human needs, eg urban, industry, agriculture.
environmental water provisions (EWPs)	The amount of water allocated to (provided to) the environment. Usually this will be greater than or equal to the environmental water requirements, but may be less, in which case the condition and health of water-dependent ecosystems may deteriorate.
environmental water requirements (EWRs)	The amount of water that water-dependent ecosystems require to be sustained and to remain healthy.
gigalitre (GL)	One thousand million litres or one million kilolitres or one million cubic metres of water.
inter-basin transfer	Transfer of water from an area where it naturally collects, for use in a different area outside the area of collection.
kilolitre (kL)	One thousand litres or one cubic metre of water.
megalitre (ML)	One million litres or 1000 cubic metres of water.
per capita water consumption for the water supply scheme	Total consumptive use from the scheme (domestic, industrial, commercial, institutional, etc) divided by the number of residents.
total per capita water consumption	Total consumptive use for all sectors (domestic, industrial, mining, recreation, agricultural etc), both scheme and self supply, divided by the total population of Western Australia.
water use efficiency	A measure of how wisely (or non-wastefully) water is used. A high per capita figure for water consumption indicates lower water use efficiency than does a lower figure. Targets for water use efficiency can be set for components of water use, for example, water used on the garden, in the kitchen, bathroom, etc.

Appendix 3

Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council National Principles for the Provision of Water for Ecosystems

Principles

Basic premise of principles

PRINCIPLE 1	River regulation and/or consumptive use should be recognised as potentially impacting on ecological values.

Determining environmental water provisions

PRINCIPLE 2	Provision of water for ecosystems should be on the basis of the best scientific information available on the water regimes necessary to sustain the ecological values of water dependent ecosystems.

Provision of water for ecosystems

PRINCIPLE 3	Environmental water provisions should be legally recognised.
PRINCIPLE 4	In systems where there are existing users, provision of water for ecosystems should go as far as possible to meet the water regime necessary to sustain the ecological values of aquatic ecosystems whilst recognising the existing rights of other water users.
PRINCIPLE 5	Where environmental water requirements cannot be met due to existing users, action (including reallocation) should be taken to meet environmental needs.
PRINCIPLE 6	Further allocation of water for any use should only be on the basis that natural ecological processes and biodiversity are sustained (i.e. ecological values are sustained).

Management of environmental water allocations

PRINCIPLE 7	Accountabilities in all aspects of management of environmental water provisions should be transparent and clearly defined.
PRINCIPLE 8	Environmental water provisions should be responsive to monitoring and improvements in understanding of environmental water requirements.

Other uses

PRINCIPLE 9	All water uses should be managed in a manner which recognises ecological values.
PRINCIPLE 10	Appropriate demand management and water pricing strategies should be used to assist in sustaining ecological values of water resources.

Further research

PRINCIPLE 11	Strategic and applied research to improve understanding of environmental water requirements is essential.

Community involvement

PRINCIPLE 12 All relevant environmental, social and economic stakeholders will be involved in water allocation planning and decision-making on environmental water provisions.

Sustainable Land and Water Resources Management Committee
Subcommittee on Water Resources
Occasional Paper SWR N° 3, July 1996

Appendix 4

List of Submitters to Perth's Water Future

Community Associations

Baldivis Community Association
Conservation Council of WA
Country Women's Association of WA
Harvey Hills Preservation Group
Local Plants Group
Ocean Reef Residents Association
Peel Preservation Group
Serpentine-Jarrahdale Ratepayers Association
Serpentine-Jarrahdale Tourist Information Centre
Serpentine River Group
Waterbird Conservation Group
Wetlands Conservation Society

Local and State Government Agencies

Aboriginal Affairs Department
Busselton Water Board
Department of Conservation and Land Management
City of Melville
City of Wanneroo
Department of Resources Development
Health Department of WA
Ministry for Planning
National Parks and Nature Conservation Authority
Shire of Mundaring
Shire of Serpentine-Jarrahdale

Individuals

A Herlihy
M Campbell
R Drummond
M Richardson
J Hawkes
I Devoy
R Willis
H Bombard, R Ravi, W Barber
O Mueller
A Hart

Appendix 5

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Appendix 6

List of Management Commitments

WRC Position on Perth's Water Future Strategy
Revised Management Commitments

The Management Commitments proposed in the Strategy are detailed in the Table below. The first column contains the original Water Authority commitments contained in the Strategy. The revised Water Corporation commitments are presented in the second column including those considered by the Water Corporation to be best sponsored by the Water and Rivers Commission. The position of the WRC for each commitment is outlined in the third column.

No.	WAWA ORIGINAL COMMITMENT	WC REVISED COMMITMENT	WRC POSITION
	LAND AND WATER PLANNING POLICY ISSUES		
	Water Quality Protection:		
1	Continue to promote the precautionary principle for the protection of water resources and strongly recommend that the Priority classification system be enforced through statute and that statutory status be granted to water resources allocation and management plans.	The Water and Rivers Commission will continue to promote the precautionary principle for the protection of water resources and endeavour to have the Priority classification system enforced through statute and that statutory status be granted to water resources allocation and management plans.	WRC agrees with the application of the precautionary principle in water resource management. Statutory backing for management plans is a matter currently under consideration as part of the review of water resource legislation.
13	Work with DPUD to promote the application of Water Sensitive Urban Design principles to minimise the risk of groundwater contamination of North West Corridor Groundwater Schemes.	The Water and Rivers Commission will promote the application of Water Sensitive Urban Design principles to minimise the risk of groundwater contamination of North West Corridor Groundwater Schemes.	WRC supports this commitment as being more generally applied. WRC will expect the Water Corporation to promote the concept and put it into practice through its own activities.
	Management of native forest		
2	Continue to explore the potential of forest thinning to sustainable increase water yields within acceptable environmental outcomes.	The Water Corporation will continue to work with other agencies to research the potential of forest thinning to sustainably increase water yields within acceptable environmental outcomes.	The WRC believes that forest thinning to obtain additional yield may prove to be difficult because the associated environmental and forest management issues are complex.
	Management of pine plantations		
3	Work with the Conservation and Land Management Department to reach agreement on the most desirable management of pine plantations located over priority groundwater areas.	The Water Corporation will work with the Water and Rivers Commission and the Conservation and Land Management Department to reach agreement on the most desirable management of pine plantations located over priority ground water areas.	Pine plantations consume water and therefore compete for the allocation of water for other uses. Pine plantations are consuming more water each year due to their age. Such an allocation should not be to the detriment of existing environmental water requirements. WRC fully supports CALM plans to replace pine plantations with native vegetation on the Gnangara mound.

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21	Yeal Stages 1 and 2 groundwater scheme: work with CALM to reach agreement on the most desirable management of pine plantations located over priority groundwater areas such as Yeal Stages 1 and 2.	Yeal Stages 1 and 2 groundwater scheme: the Water and Rivers Commission and CALM will work towards the most desirable management of pine plantations that impact potential groundwater schemes such as Yeal Stages 1 and 2.	As for 3 on previous page.
	STRATEGIC ENVIRONMENTAL ISSUES		
	Groundwater operating strategy		
4	Investigate a more sophisticated groundwater operating strategy to optimise the utilisation of sources and reduce the costs of supply and lessen environmental impacts.	Groundwater operating strategy: the Water Corporation will investigate a more sophisticated groundwater operating strategy to optimise the utilisation of sources and reduce the costs of supply and lessen environmental impacts.	WRC supports this commitment.
	Allocation of streamflow:		
6	Develop a method for determining environmental and consumptive streamflow requirements as part of subregional allocation planning for surface water resources.	The Water and Rivers Commission will develop a method for determining environmental and consumptive streamflow requirements as part of water allocation planning.	WRC will meet this commitment but will expect that the determination of EWPs may be included in the requirements to be met by a potential user before a licence can be considered.
	Groundwater discharge and the salt-water interface		
7	Monitor, review known relationships and develop strategies to manage the salt-water interface.	Groundwater discharge and the salt-water interface: the Water Corporation will review known relationships and develop strategies to manage the salt-water interface in its wellfields.	WRC supports such investigations provided the results are presented to the WRC for evaluation.
8	Review known relationships between groundwater discharge to the ocean and the marine environment.	Groundwater discharge and the marine environment: the Water Corporation will review known relationships between groundwater discharge to the ocean and the marine environment in relationship to its wellfields where this is an issue of concern.	WRC supports such investigations provided the results are presented to the WRC for evaluation.

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	ALTERNATIVE SOURCES TO SCHEME SUPPLY		
	WRC believes the following commitments should be undertaken in the context of a water resource management plan for Perth. This plan would examine closely alternative sources which could reduce the demand for scheme supply.		
	Private groundwater bores:		
38	Develop a strategy to guide the installation of private groundwater bores in appropriate areas and encourage the wise use of this resource.	The Water Corporation will support the Water and River Commission in the development of a strategy to guide the installation of private groundwater bores in appropriate areas and encourage the wise use of this resource.	WRC believes there is a major opportunity for the substitution of scheme supply with groundwater in suburban Perth. The use of non potable water for garden watering has the potential to substantially reduce scheme demand. WRC will be examining ways of encouraging the sustainable use of this source.
	Reuse of wastewater		
9	Demonstrate the feasibility of treating effluent to produce water suitable for industrial use and seek opportunities for reuse for cooling water and other purposes at Kwinana and elsewhere where this would reduce the demand for potable quality water.	The Water Corporation will determine the feasibility of treating effluent to produce water suitable for industrial use and seek opportunities for reuse for cooling water and other purposes at Kwinana and elsewhere where this would reduce the demand for potable quality water.	WRC supports the reuse of waste water provided such an activity is a benefit to water resource management. The commitment should be amended to replace "potable quality water" with "scheme water or groundwater where abstraction exceeds the sustainable yield." The commitment should also state the results of the feasibility will be forwarded to WRC for evaluation.
10	Encourage the use of effluent on golf courses and playing fields close to treatment plants where this would reduce the demand for potable quality water.	The Water Corporation will encourage the use of effluent on golf courses and playing fields close to treatment plants where this would reduce the demand for potable quality water.	As for 9 above.
11	The potential of recharging the Yarragadee aquifer with treated wastewater so that additional potable quality water withdrawal can occur elsewhere.	The Water Corporation will investigate the potential of recharging the Yarragadee aquifer with treated wastewater so that additional potable quality water withdrawal can occur elsewhere.	The Water Corporation should also consider investigating recharging the Leederville aquifer with drainage water and forward the results to WRC.
34	Reuse of greywater: trial the domestic reuse of greywater for subsurface irrigation and if successful, prepare guidelines and regulations with Public Health Department and Local Authorities.	The Water and Rivers Commission will trial the domestic reuse of greywater for subsurface irrigation and if successful, prepare guidelines and regulations with Public Health Department and Local Authorities.	WRC will encourage others through the exercise of its powers to trial or investigate the use of greywater.
	Use of drainage water		
12	Investigate and encourage the potential for the use of drainage water where this would reduce the demand for potable quality water from the public supply system.	The Water Corporation will investigate and encourage the potential for the use of drainage water where this would reduce the demand for potable water.	As for 9 above.

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	Rainwater tanks		
37	While not endorsing the use of rainwater tanks, provide advice as to the benefits, costs and risks of the use of tanks.	The Water Corporation, while not endorsing the use of rainwater tanks, will provide advice as to the benefits, costs and risks of the use of tanks where appropriate.	WRC supports this commitment but acknowledges that rainwater tanks are not a significant alternative source to scheme supply.
	SOURCE OPTIONS FOR SCHEME SUPPLY SHORT TO MEDIUM TERM		
	Jane Brook pumpback scheme		
14	Commence the process of proclaiming the Jane Brook catchment as a Water Reserve including consultation with the community and the Local Authority.	The Water Corporation will work with the Water and Rivers Commission in the process of proclaiming the Jane Brook catchment as a Water Reserve including consultation with the community and the Local Authority.	WRC is responsible for the protection of water resources and will determine in consultation with the Water Corporation the best time to commence the process of declaring a water reserve over the Jane Brook catchment.
	Mundaring Weir raising		
17	Environmental issues: investigate minimising clearing of vegetation in the new zone of inundation to reduce impact on the existing vegetation complex.	Environmental issues: the Water Corporation will investigate minimising clearing of vegetation in the new zone of inundation to reduce impact on the existing vegetation complex.	WRC believes the raising of the Mundaring Weir has a number of environmental constraints which has led to a number of concerns being expressed in public submissions. WRC believes a water resource management plan should be prepared for this catchment with the benefit of public input. The plan should be completed prior to WRC considering any application for an increased water allocation from this source.
15	Aboriginal issues: consult with the Aboriginal community preceding any raising of the Mundaring Weir.	Mundaring Weir raising and Aboriginal issues: the Water Corporation will consult with the Aboriginal community preceding any raising of the Mundaring Weir.	WRC would expect that such undertakings would commence well ahead of the submission of an application for an allocation and the preparation of an EIA for raising Mundaring Weir.
16	Heritage issues: develop a scheme design which will allow the architectural integrity of the Mundaring Weir to be retained.	Heritage issues: the Water Corporation will, in the raising of Mundaring Weir, develop a design which, as much as possible, retain the heritage values.	WRC supports this commitment.

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	Serpentine (Karnup and Dandalup) groundwater schemes		
18	Determine the physical and water quality characteristics of the groundwater system and develop a subregional allocation plan.	The Water Corporation will determine the physical and water quality characteristics of the groundwater system.	WRC will prepare a water resource management plan for this groundwater system prior to considering any application for an allocation for scheme supply. The investigations proposed by the Water Corporation are supported in principle but will be required to be in accordance with conditions of an exploration licence from the WRC. The investigations will be carried out within the context of assisting the preparation of the water resource plan.
	Mirrabooka Stage 3 groundwater scheme		
19	Monitor the pollution plume from the liquid waste disposal site and more accurately determine groundwater flow and drawdown effects.	The Water Corporation will work with the Water and Rivers Commission on the implications of pollution from the liquid waste disposal site.	This commitment should be amended to read as follows; "The Water Corporation will monitor the pollution from the liquid waste disposal according to the requirements of the WRC and report the results regularly to the WRC".
	Muchea groundwater scheme		
20	Examine the relationship between the aquifer and surface water occurrences (wetlands) including mound springs and the Ellen Brook and determine groundwater flow relationships and effects of drawdown.	The Water Corporation will work with the Water and Rivers Commission to determine the relationship between the aquifer and surface water occurrences (wetlands) including mound springs and the Ellen Brook and groundwater flow relationships and effects of drawdown.	WRC will need to prepare a water resource management plan for this groundwater system prior to considering any application for an allocation for scheme supply. The investigations proposed by the Water Corporation are supported in principle but will be required to be in accordance with conditions of an exploration licence from the WRC. The investigations will be carried out within the context of assisting the preparation of the water resource plan.
	New Harvey Dam		
24	Waroona-Harvey Irrigation Dams: study the water quality issues and alternative water quality management measures associated with the potential impact on tourism and recreation values of these reservoirs and catchments if activities were restricted to protect water quality.	Waroona-Harvey Irrigation Dams: the Water Corporation will study the water quality issues and alternative water quality management measures associated with the potential impact on tourism and recreation values of these reservoirs and catchments if activities were restricted to protect water quality.	WRC will need to prepare a water resource management plan for the Harvey River surface water system prior to considering any application for an allocation from this source for scheme supply. The investigations proposed by the Water Corporation are supported in principle but will be required to be in accordance with conditions of an investigation licence from the WRC. The investigations will be carried out within the context of assisting the preparation of the water resources plan.

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23	Environmental impacts of New Harvey Dam: investigate smaller reservoirs and the socio-economic impacts and the environmental impacts (particularly the fauna present in the streamline vegetation).	Environmental impacts of New Harvey Dam: the Water Corporation will investigate smaller reservoirs to minimise the socio-economic impacts and the environmental impacts (particularly the fauna present in the streamline vegetation).	This will be required to support the preparation of the water resource management plan.
22	Social impacts of New Harvey Dam: implement within the year, a social impact management strategy for the proposed New Harvey Dam in consultation with affected landowners and the Shire of Harvey.	Social impacts of New Harvey Dam: the Water Corporation will implement within a year of the approval of the Strategy, a social impact management strategy for the proposed New Harvey Dam in consultation with affected landowners and the Shire of Harvey.	This commitment is premature given the WRC response to commitment 24. A social impact assessment study should be carried out within the context of the water resource management plan.
	LONGER TERM SCHEME SUPPLY SOURCE OPTIONS		
	Moore River Groundwater		
25	Investigate the quantity and quality of water potentially available for potable supply, leading to the development of a subregional allocation plan with the involvement of the Gingin Shire, horticultural groups and other stakeholders in the resolution of allocation issues.	Moore River Groundwater: the Water Corporation will investigate the potential of these sources as part of the longer-term water supply for Perth-Mandurah and indicate the Corporation's interest in these sources to the Water and Rivers Commission for their water allocation planning purposes.	Investigations into the potential of other sources for long term scheme supply should be a part of the normal water resource planning process. If other than desktop studies are proposed an exploration licence from the WRC will be required. Such a licence will only be issued where the investigation is a useful component of water resource planning undertaken by the WRC.
	Surface water in the Bunbury region:		
26	Continue to include the important water sources in the Bunbury region (diversions of the Brunswick, lower Collie, Ferguson amongst others) as part of the longer-term supply for Perth-Mandurah.	Surface water in the Bunbury region: the Water Corporation will investigate the potential of these sources as part of the longer-term water supply for Perth-Mandurah and indicate the Corporation's interest in these sources to the Water and Rivers Commission for their water allocation planning purposes.	Investigations into the potential of other sources for long term scheme supply should be a part of the normal water resource planning process. If other than desktop studies are proposed an investigation licence from the WRC will be required. Such a licence will only be issued where the investigation is a useful component of water resource planning undertaken by the WRC.

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	Yarragadee (southern Perth Basin) source:		
27	Investigate the potential of the Yarragadee source for the longer-term supply to the Perth-Mandurah area and consider the allocation of some of this resource in the 'Busselton to Walpole' regional water allocation plan currently under development.	Yarragadee (southern Perth Basin) source: the Water Corporation will investigate the potential of this resource as part of the longer-term water supply for Perth-Mandurah and indicate the Corporation's interest in this source to the Water and Rivers Commission for their water allocation planning purposes.	Investigations into the potential of sources for long term scheme supply should be a part of the normal water resource planning process. If other than desktop studies are proposed an exploration licence from the WRC will be required. Such a licence will only be issued where the investigation is a useful component of water resource planning undertaken by the WRC.
	Lower south west surface water		
28	Consider allocation of some of the Donnelly River, Warren River and Margaret River (amongst others) to public supply as part of the 'Busselton to Walpole' regional water allocation planning.	Lower south west surface water: the Water Corporation will investigate the potential of these sources as part of the longer-term water supply for Perth-Mandurah and indicate the Corporation's interest in these sources to the Water and Rivers Commission for their water allocation planning purposes.	Investigations into the potential of sources for long term scheme supply should be a part of the normal water resource planning process. If other than desktop studies are proposed an investigation licence from the WRC will be required. Such a licence will only be issued where the investigation is a useful component of water resource planning undertaken by the WRC.
		WATER USE EFFICIENCY	
	Tariff reform		
29	Consider increasing the high end block prices to discourage high water use.	Tariff reform: the Water Corporation will review the tariff structure to encourage efficient water use.	The WRC supports this initiative and will evaluate results in conjunction with the OWR.
	Leak reduction		
30	Upgrade the Authority's leak detection and repair program so far as it is cost effective in relation to the avoided supply costs.	Leak reduction: the Water Corporation will upgrade the leak detection and repair program so far as it is cost effective in relation to the avoided supply costs.	WRC supports this commitment as an important element of water use efficiency. The results of the leak reduction program should be progressively reported to WRC.
	Unmeasured water reduction		
31	Continue to reduce the amount of unmeasured water particularly that used at Water Authority installations.	Unmeasured water reduction: the Water Corporation will continue to improve metering to reduce the amount of unmeasured water, including that used at Water Corporation installations.	WRC supports this commitment.

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	Water restrictions policy		
5	Review the current water restriction policy and determine, with public involvement, the technical, environmental and socio-economic impacts of changing the policy.	Water restrictions policy: the Water Corporation will review the current water restriction policy and determine, with public involvement, the technical, environmental and socio-economic impacts of changing the policy.	WRC has the primary responsibility to ensure the wise use of water resources and consequently has a role in reviewing water restrictions policies in terms of their impact on allocations. The Office of Water Regulation has a primary responsibility in this matter as it affects the quality of service to customers and may affect water prices.
	Restrictions and drought response for Perth		
32	Maximise the opportunities for long term water efficiency gains in drought periods and consider the introduction of permanent daytime water bans.	Restrictions and drought response: the Water Corporation will attempt to maximise the opportunities for long term water efficiency gains in drought periods, including permanent daytime water bans.	WRC supports this commitment.
	Efficient showers		
33	Regulate to make efficient shower heads compulsory for all new or replacement installations.	Efficient showers: the Water Corporation will consider the regulation of the use of efficient shower heads for all new or replacement installations.	While WRC is responsible for promoting the wise use of water, and WC is responsible to help its customers to use less water, the OWR is responsible for the preparation of regulations relating to plumbing services. The WC will work with the OWR to ensure appropriate regulations are put in place.
	Domestic water use study		
35	Carry out a domestic water use study based on that of 1982 to establish a baseline for supply planning and water efficiency. Estimated cost of $500 000 over several years.	The Water Corporation will carry out a domestic water use study (based on that of 1982) to establish a baseline for supply planning and water efficiency.	WRC supports the early completion of this study. The results of such a study will be important in reviewing performance against agreed targets and determine trends in consumption.
	Management of water efficiency program		
36	Provide sufficient resources to implement and manage the water efficiency program. Estimated cost of $100 000 per year for the first four years and $50 000 per year in subsequent years.	The Water Corporation will provide sufficient resources to implement and manage the water efficiency program (estimated cost of $100 000 per year for the first four years and $50 000 per year in subsequent years).	WRC supports this commitment but advises that the actual costs may vary from these estimates.