



Government of **Western Australia**  
Department of **Water**

## Operational policy 1.01 – Managed aquifer recharge in Western Australia



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## Summary

As pressures on our water resources increase, and systems become fully allocated, new strategies are being developed to supplement natural groundwater resources and increase water availability. Managed aquifer recharge (MAR) provides a means to generate water supplies from sources that may otherwise be wasted. It can provide environmental, social and economic benefits. MAR involves recharging an aquifer under controlled conditions to store the water for later abstraction, or to achieve environmental benefits.

The Department of Water (the state's water resource management agency) aims to facilitate the approval of socially and environmentally acceptable MAR proposals. We will do this by providing a robust management framework under the existing water resource management legislation. This policy outlines the department's position on MAR, and the requirements for proponents seeking to obtain approval for an MAR scheme. It aims to ensure consistency in the assessment, approval, licensing and monitoring of MAR schemes.

Under the policy, proponents of MAR schemes will need to identify and quantify the impacts of recharge and recovery operations. The Department of Water will only approve an MAR scheme where the impacts of recharge and recovery on the groundwater system, the environment and existing groundwater users (through changes in water quantity or quality) are determined to be acceptable.

The current legislation does not provide for the granting of allocation or recharge credits to MAR operators. Instead, the Department of Water will regulate recharge operations by including conditions in the licence to take and use water. MAR schemes undertaken for environmental benefit – that do not involve recovery of water but require the construction of an injection bore – will be managed through the licence to construct the bore.

The department will work with other government agencies to ensure MAR schemes are managed appropriately so that risks to groundwater resources are minimised and groundwater quality and environmental values are maintained for current and future generations.

Specific examples of current or proposed MAR schemes in Western Australia are included in this report's appendices to provide additional direction to potential applicants.



# 1 Policy statement

The Department of Water supports managed aquifer recharge (MAR) activities that have environmental, social or economic benefits and maximise the use of the state's water resources.

The department will approve MAR schemes, provided that recharge and recovery operations will not adversely affect the groundwater system, the environment, existing groundwater users (e.g. through changes in water quality or quantity) or aquifer integrity.

Our position on MAR activities is outlined below.

## What is considered MAR

- The infiltration or injection and later recovery of treated wastewater will be considered MAR, and the department will allow banking (storage) and recovery of the recharge water.
- Re-injection of dewatering excess will be considered MAR, and the department will allow banking (storage) and abstraction of the recharge water.
- Infiltration or injection of stormwater in developments where a demonstrable excess exists will be considered MAR (demonstrable excess refers to only that portion of stormwater that cannot be infiltrated at source).
- Infiltration or injection of stormwater from existing drainage systems that normally discharge to the ocean or surface waters (commonly known as 'retrofitting') will be considered MAR.

## What is not considered MAR

- Infiltration of rainwater into aquifers via systems such as natural drains or soak wells is not considered MAR. This is a consequence of urbanisation and not purposeful recharge for later abstraction or environmental benefit.
- Land use changes or activities that result in additional groundwater recharge and raise water levels will not be considered MAR (e.g. urban development, catchment clearing or thinning/burning of vegetation). The department will account for this additional water when determining or revising the allocation limit of the groundwater resource.

## Managing impacts

- An MAR scheme should not adversely affect the environmental values of groundwater or connected surface water systems. Proponents will be required to identify, quantify and manage the risks to these systems to ensure their values are maintained and where possible, enhanced.
- The impacts of abstraction should be offset by the impacts of recharging the aquifer. Recharge and recovery operations must therefore take place within the

same groundwater system (in some cases, this could cover more than one groundwater management area). If recharge and recovery are to take place in different groundwater systems, they will be treated as separate operations.

- Adverse impacts on aquifer integrity must be minimised through proper construction of bores and appropriate injection pressures.
- The department may define MAR management zones to facilitate management of groundwater quality and abstraction near MAR schemes.
- MAR proposals involving recycled water may require the application of relevant national guidelines (e.g. *Australian guidelines for water recycling – Augmentation of drinking water; Stormwater harvesting and reuse; Managed aquifer recharge modules*).
- MAR proposals should be considered early in the land planning process where appropriate, through the *Better urban water management* (WAPC 2008) framework. This will ensure an appropriate level of consideration is given to an MAR proposal at each stage of the planning process.
- MAR proposals within public drinking water source areas (PDWSAs) will be subject to the department's groundwater protection strategies, which will depend on a number of water quality factors such as the quality of the source water, the level of treatment, and the intended end use, as well as hydrogeological and environmental risk considerations. Our *Water quality protection note no. 25: Land use compatibility in public drinking water source areas* (2004) will need to be considered in relation to the infiltration or injection of wastewater into the ground.

### Managing recovery operations

- Under the *Rights in Water and Irrigation Act 1914* (WA), water that is infiltrated or injected into the natural groundwater system is vested in the Crown. Proponents of MAR schemes must apply for a licence to take water. The licence to recover the water will be granted to the proponent undertaking recharge operations, as long as the environmental values and integrity of the aquifer are maintained and departmental and legislative requirements are met.
- Recovery will be allowed only when recharge water is available and water quality requirements are met.
- The recovery volume will generally be less than or equal to the recharge volume. The department will assign appropriate recovery figures based on estimates from hydrogeological assessments (generally undertaken by the proponent). Cases where additional groundwater can be abstracted without unacceptable impacts may exist; however, proponents will be required to demonstrate the sustainability of any additional abstraction.
- The department will support banking or storage of the recharge water within the aquifer, provided that the proponent can demonstrate the water will be available for use when required, and that the impacts of abstraction will be acceptable. We will determine the allowable period of banking of the recharge water on a case-by-

case basis, based on hydrogeological assessment and groundwater modelling. Recharge undertaken before the licence is issued will generally not count towards the banked volume.

#### **MAR licence transactions**

- The permanent transfer of water entitlements granted for MAR schemes will only be allowed when a property is sold and the new owners demonstrate, to the satisfaction of the department, that the MAR operations will continue.
- Temporary transfers of water entitlements can be made through agreements between the MAR scheme operator (licensee) and a third party. The parties must reach an agreement to take water under the existing 5C licence, ensuring that water will be available for recovery during the period of the agreement.

## 2 Background

### 2.1 Introduction

Groundwater is an extremely valuable resource in Western Australia. It provides most of our drinking water supplies, supports our agriculture and horticulture industries and the mining sector, and maintains our environment and social and cultural needs. Domestic use of groundwater for garden irrigation is also widespread and in some areas, domestic bores are the only source of drinking water.

Groundwater resources have come under pressure during the past decade due to the compounding effects of a drying climate (particularly in the state's south-west), a growing population, and increased development. Declines in groundwater levels have resulted in significant impacts on groundwater-dependent ecosystems in some areas (e.g. the Gnamptara Mound).

Government, water service providers and private groundwater users are developing strategies to overcome the decreased availability of water resources. Although increased water use efficiency is progressively being implemented to reduce water consumption, it has also become necessary to find new water supply options to supplement the natural groundwater and surface water resources that we have depended on to date.

Managed aquifer recharge (MAR) provides a means to generate water supplies from sources that may otherwise be wasted. It can provide environmental, social and economic benefits. Table 1 lists some of the potential benefits of MAR.

Some MAR schemes are already in place or under development for industrial and irrigation uses. However, MAR will not be feasible on all sites, due to hydrogeological, environmental or cost constraints. In some cases, recycling options without aquifer recharge could be preferable to MAR.

The Department of Water has developed this policy in line with the National Water Initiative, which supports greater innovation in the use of water resources for the benefit of the community and the state. The policy aims to facilitate the approval of socially and environmentally acceptable MAR proposals, by providing a management framework under the *Rights in Water and Irrigation Act 1914*.

Appendix A provides specific examples of MAR that are either operating or proposed in Western Australia, and outlines the general management approach to be applied under this policy.

**Table 1. Benefits of managed aquifer recharge**

<b>Environmental benefits</b>	<b>Social benefits</b>	<b>Economic benefits</b>
Maximising the use of water resources	Generating additional water supplies to meet demand	Generating additional water supplies from sources that would otherwise be wasted
Reducing pressure on natural water resources	Maintaining existing water allocations and economic activity in a drying climate	Ability to increase capacity in line with demand (after Pyne 2006)
Protection of ecosystems from the impacts of abstraction (e.g. through supplementation or hydraulic barriers)	Maintaining valued ecosystems	Low capital costs (Pyne 2006)
Improvement of water quality in aquifers and connected surface water systems	Ability to use brackish aquifers that could not be used directly (Pyne 2006)	In some cases, aquifers may provide passive treatment of recharged water (after Pyne 2006)
Prevention/management of saltwater intrusion	No algae or mosquitoes (unlike surface storage) (after Pyne 2006)	Reduced evaporation losses as the water is stored in aquifers instead of dams (after Pyne 2006)
Reduction of impacts of dewatering (i.e. through re-injection)	Using aquifers for storage and allowing land to be used for other purposes	Ability to locate close to water demand centres (after Pyne 2006)
Low greenhouse gas emissions compared with remote pumped storages	Long-term storage or water banking (excess water is stored during wet years and recovered during drought years or when existing supplies are low (after Pyne 2006)	Seasonal storage (excess water is stored during wet seasons and recovered during dry seasons or when demand is high (after Pyne 2006)
May be used to restore groundwater levels	Emergency storage (to meet demand in case the primary water supply is unavailable)	Deferring expansion of water facilities (after Pyne 2006)

## 2.2 What is managed aquifer recharge?

Under this policy, MAR is defined as:

*“...the purposeful recharge of an aquifer under controlled conditions in order to store water for later abstraction, to achieve environmental benefits, or to mitigate the impacts of abstraction. It may involve the passive treatment of water through natural processes within the aquifer, to achieve a desired water quality.”*

There are many potential sources of recharge water (refer to Section 4.1). Some pre-treatment of the source water is usually required before recharging the aquifer, to ensure that adverse impacts on groundwater quality are within acceptable limits. This will generally depend on the outcome of a risk assessment undertaken in accordance with the Australian guidelines for water recycling (refer to Section 5.2).

Aquifers can be recharged by injection or infiltration. Injection can be carried out using a bore or series of bores. Common infiltration structures for MAR include infiltration ponds and trenches.

Abstraction or recovery of the recharge water is normally undertaken using a bore or series of bores. In some cases, recharge and recovery can be undertaken using the same bore (this is also known as aquifer storage and recovery; ASR). However, in most MAR schemes, recharge and recovery operations are undertaken by different bores, especially those where the recharge water must reside in the aquifer for some time as part of the treatment process. The different types of MAR are outlined in the *Australian guidelines for water recycling: Managed aquifer recharge (2009)*.

## 2.3 Intent

This policy's intent is to facilitate the approval of socially and environmentally acceptable MAR projects in Western Australia, by providing a management framework under the current water resource management legislation (the *Rights in Water and Irrigation Act 1914*). The policy aims to ensure consistency in the assessment, approval, licensing and monitoring of MAR schemes.

## 2.4 Application

This policy applies to artesian wells/bores throughout the entire state of Western Australia and to non-artesian wells/bores in proclaimed groundwater areas. It supersedes earlier policies or practices associated with MAR schemes adopted by the Department of Water.

Water allocation plans will have regard for this policy when reserving water resources for future use. A plan may override this policy where a local issue requires specific management.

## 2.5 Policy links

This policy has links with the Department of Water's other strategic and operational policies on water management in this state. It also has links with national agreements, policies and guidelines. These documents include:

- *National Water Initiative*
- *National water quality management strategy*
- *State water quality management strategy*
- *Operational policy 5.05 – Giving an undertaking to grant a water licence or permit*
- *Operational policy 5.08 – Use of operating strategies in the water licensing process*
- *Operational policy 5.12 – Hydrogeological reporting associated with a groundwater well licence*
- *Operational policy 5.13 – Water entitlement transactions for Western Australia*
- *Water quality protection note no. 25: Land use compatibility in public drinking water source areas*
- *Australian guidelines for water recycling: Managing health and environmental risks (Phase 1)*
- *Australian guidelines for water recycling: (Phase 2. Module 1 – Augmentation of drinking water supplies; Module 2 – Stormwater harvesting and reuse; Module 3 – Managed aquifer recharge)*
- *Better urban water management (WAPC 2008)*
- *National principles for the provision of water for ecosystems (ARMCANZ & ANZECC 1996)*

Local area policies and allocation management plans should also be considered when MAR proposals are being developed.

## 2.6 Legislative requirements

Several Western Australian government agencies have a role in the approval and ongoing management of MAR projects through various Acts. Proponents of MAR schemes are responsible for contacting these agencies and ensuring that regulatory requirements are met. As part of the licensing process, proponents may be required to provide approvals from other government agencies to the Department of Water.

### Department of Water

- *Rights in Water and Irrigation Act 1914 (WA)*

The *Rights in Water and Irrigation Act 1914* establishes a legislative framework for managing and allocating water resources in Western Australia. Under the Act, the

right to the use, flow and control of the water in watercourses, wetlands and underground water sources is vested in the Crown. The Act requires all artesian wells/bores to be licensed for their construction (under section 26D) and the taking of water (under section 5C). Non-artesian wells/bores in proclaimed groundwater areas must also be licensed under sections 26D and 5C.

The department is responsible for administering the powers and functions set out in the *Rights in Water and Irrigation Act 1914*.

- *Metropolitan Water Supply, Sewerage and Drainage Act 1909 (WA)* and *Country Areas Water Supply Act 1947 (WA)*

The department also manages and protects water quality within public drinking water source areas (PDWSAs). These areas include the catchment areas of surface water sources (reservoirs) and the recharge and abstraction areas of groundwater sources. These areas are presently proclaimed as water reserves (proposed areas of surface water or groundwater development), catchment areas or underground water pollution control areas (UWPCAs) under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*, or water reserves or catchment areas under the *Country Areas Water Supply Act 1947*. The legislation enables the department to regulate land use, control potentially polluting activities, inspect premises and take steps to prevent or clean up pollution within these areas, in partnership with environment and land planning agencies.

#### Department of Environment and Conservation & Environment Protection Authority

- *Environmental Protection Act 1986 (WA)*

The *Environmental Protection Act 1986* is the paramount environmental legislation in the state and regulates a wide range of activities that may have an environmental impact. MAR proposals that are likely to have a significant environmental impact, or are of a prescribed class, will be referred to the Office of the Environmental Protection Authority (EPA) under section 38 of the Act and may require community consultation as part of the environmental impact assessment process.

- *Contaminated Sites Act 2003 (WA)*

The *Contaminated Sites Act 2003* may also be relevant to the establishment of MAR schemes. Proponents should ensure that the proposed location of MAR recharge and abstraction works is not within or near a contaminated site.

#### Department of Health

- *Health Act 1911 (WA)*

MAR proposals may require Department of Health approval under the *Health Act 1911*, if the proposed end use of the recharged water has the potential to affect human health.

## 3 Considerations related to bores

### 3.1 Placement of bores/works

The placement of recharge and recovery bores/works is an important design consideration for achieving the desired water quality and minimising impacts on the environment, the groundwater system and existing groundwater users.

Issues to consider include, but are not limited to:

- *Proximity of injection bore(s) or infiltration works to existing production bores or groundwater-dependent ecosystems (GDEs).* There is potential for the recharge water to adversely affect the water quality in nearby bores or GDEs if, for example, the injected/infiltrated water is of a different quality to the receiving groundwater.
- *Proximity of recovery bore(s) to existing production bores.* If recovery bores are positioned too close to existing bores, water supplies of the existing bores may be affected due to interference between the bores. It may also result in stored recharge water being accessed by the existing production bores.
- *Distance between recharge and recovery bores/works.* In MAR operations where the aquifer is used as part of the treatment process to attain the desired water quality, the recovery bore (and existing or proposed production bores) should be far enough from the recharge bore/works to allow the required storage time and achieve the necessary water quality. This will not apply to aquifer storage and recovery operations, where recharge and recovery is undertaken using a single bore.

### 3.2 Construction of bores/works for recharge and recovery

Proper bore construction minimises the potential for adverse impacts from recharge and recovery, and reduces the potential for cross-contamination between aquifers. Bores should be constructed to the accepted standards set out in the *Minimum construction requirements for water bores in Australia* (2003). These guidelines cover bore design for abstraction, not specifically for injection. For MAR schemes involving injection, bore design should also take into account factors such as:

- the effects of construction and annulus backfill materials on well efficiencies and upward flow in the well annulus
- appropriate headworks design to eliminate air entrainment and cascading in the well
- appropriate use of materials for the MAR operations' expected timeframe (i.e. they should ensure bore longevity).

Test pumping should be carried out when bores are completed to determine appropriate abstraction rates, ensure that injection is feasible, and calculate optimum

injection rates. The department provides guidance on test pumping in *Operational policy 5.12*.

Bore performance should be monitored regularly to minimise potential problems such as well screen and aquifer clogging. Strategies such as filtration and backflushing may need to be used regularly, depending on the quality of the recharge water and groundwater.

The department will place conditions on licences granted to construct bores (section 26D licences) to ensure that bores are properly constructed by an appropriately certified driller.

Works such as infiltration pits or trenches do not fall under the definition of 'well' used in the *Rights in Water and Irrigation Act 1914* if they do not intercept the watertable. The department has no regulatory mechanism to manage infiltration to the watertable via these works. However, if they do intercept the watertable, they are defined as wells under the Act, and the construction can be licensed.

Some MAR schemes involving infiltration may be regulated by the Department of Health, which has powers to manage water quality issues relating to human health. Other schemes may be regulated by the Department of Environment and Conservation, which has powers to manage environmental pollution and harm issues under the *Environmental Protection Act 1986* (refer to Section 2.6).

## 4 Water quantity considerations

### 4.1 Sourcing recharge water

Potential water sources for MAR schemes include but are not limited to:

- groundwater drawn from other aquifers
- water from streams, lakes or dams
- treated wastewater sourced from industrial sites or sewerage treatment plants (refer to App. A.1 and A.2)
- dewatering excess from mine sites or construction sites (refer to App. A.3)
- excess stormwater or stormwater redirected from existing drainage systems (refer to App. A.4)
- excess agricultural runoff.

Proponents must consider the impacts of taking water from a particular source to recharge an aquifer. For example, taking water from a lake or stream may impact downstream users or the local ecology. Likewise, if the recharge water is sourced from piped drains, the downstream hydraulic viability of the drains may be affected.

Proponents must obtain approvals from the relevant agencies to use these sources. For example, if recharge water is sourced from a groundwater or surface water resource that is proclaimed under the *Rights in Water and Irrigation Act 1914*, a licence to take the water will be required from the Department of Water.

### 4.2 Recharging an aquifer

Recharging of an aquifer via injection or infiltration must be properly managed to avoid adverse impacts on the aquifer, the surrounding environment and existing groundwater users. A proponent must consider the impacts of recharging an aquifer when assessing the viability of a proposed MAR scheme. These include:

- potential damage (e.g. fracturing) to the aquifer being recharged or to overlying/underlying aquifers, due to excessive injection pressure (operator competency is a factor)
- raising of the watertable to a level that causes problems such as waterlogging and foundation impacts
- surface discharge if groundwater mounding is too close to the surface, with potential impacts on surface water bodies and vegetation, or potential health implications where human contact occurs
- changes to the groundwater flow regime
- changes to groundwater quality (improvements/degradation) in the aquifer being recharged or overlying/underlying aquifers due to differences in the chemistry of

the recharge water and in-situ groundwater (e.g. salinity and mixing, oxidation-reduction processes, acidity)

- significant changes in groundwater temperature, which can result in geochemical changes or stratification
- changes to water chemistry in hydraulically-connected surface water systems
- aquifer clogging (biological, physical, chemical or mechanical) and changes to the aquifer's recharge potential
- effects on aquifer stability, decreasing the aquifer's transmissivity (dissolution of aquifer matrix).

The department will manage the recharge phase of an MAR scheme by requiring proponents to demonstrate, before recharge or recovery operations begin, that the scheme's impacts will be acceptable. The licensing process and information required are outlined in Section 6.4.

As part of the hydrogeological assessment, recharge volumes should be estimated through investigations such as infiltration tests and test pumping. This will help determine the feasibility of a proposed MAR scheme, and provide a level of certainty for both regulators and proponents. The degree of testing that is appropriate may vary depending on the scale of the proposed scheme.

Proponents should use the estimated recharge volume to calculate the volume of water able to be recovered.

### 4.3 Banking of recharge water

In this policy, the term 'banking' applies to the storing of recharge water in the aquifer for a period of time, so that it can be recovered at a later time.

The department will support banking or storage of recharge water within an aquifer, as long as the proponent can demonstrate the water will be available for recovery when required, and the impacts will be acceptable.

The department will determine the allowable period of banking on a case-by-case basis, based on the proponent's hydrogeological assessment (which may include groundwater modelling) and other information. Recharge undertaken before the issue of the licence will generally not count towards the banked volume or water entitlement.

### 4.4 Recovery of recharge water

The purpose of MAR is often to abstract or recover water that is purposely infiltrated or injected into the aquifer. The percentage of recharge water that can be recovered will depend on factors such as the location of MAR bores in relation to other groundwater users, and the aquifer's hydrogeological characteristics controlling the rate of movement of water.

An overriding constraint is that the recharge and recovery should take place within the same aquifer or connected aquifers (i.e. the same groundwater system). If recharge and recovery are to take place in different groundwater systems, they will be treated as separate operations.

The department cannot guarantee that recharge water will be available for abstraction by the MAR scheme's proponent; just as we cannot guarantee that the desired quality will be obtained.

The main issues associated with recovering the recharged water are discussed in the following sections.

### Potential impacts of recovery

The impacts of recovering recharge water in an MAR scheme should largely be offset by the impacts of injection or infiltration. For example, in an unconfined aquifer, water might be injected along the coast to prevent movement of the saltwater interface, while groundwater is recovered up-gradient. Another scenario could be the recharge of an aquifer near a valued wetland to maintain the wetland's water levels, while recovering water elsewhere within the aquifer or connected aquifers (i.e. groundwater system) where impacts would be minimal.

In a confined aquifer, the department advocates that groundwater be recovered from where the injection of water increased groundwater storage (i.e. where pressure heads are raised significantly). However, other abstraction scenarios could also be acceptable, such as injection into the confined aquifer's recharge area, with recovery elsewhere in the aquifer.

The recovery of water must be licensed under section 5C of the *Rights in Water and Irrigation Act 1914*. The licensing process and information required are outlined in Section 6.4.

### Timelag between recharge and recovery

The timelag between recharge and recovery should be determined as part of the proponent's hydrogeological assessment. The timelag could simply be the time required for recharge water to reach recovery bores; however, it may increase in cases where passive treatment within the aquifer is required to meet water quality standards for end use, or depend on the period of banking required.

The timelag will affect the water available for recovery, and will need to be considered in licensing decisions. The proponent may be required to recharge water for a certain period of time before recovery, to allow increases in potentiometric levels or water levels to reach the recovery bore.

If the aim of retention is to meet specific water quality requirements for an end use, and the potential exists for human exposure, then approval is required from the Department of Health to allow validation and verification of water quality.

## Determining recovery volumes

The percentage of recharge water that can be recovered will depend on a variety of factors, which the proponent will need to consider as part of their hydrogeological assessment, including:

- *The volume of recharge.* If the volume of recharge increases or decreases, the recovery volume will change accordingly.
- *The aquifer's level of use (i.e. percentage allocated relative to the allocation limit) and management of allocations in the area of the MAR scheme.* Reductions in allocations may be required where the aquifer's level of use is high and causing adverse impacts. Although MAR recharge and recovery volumes will be managed separately to the allocation limit, the recovery volumes allowed in such instances could be less than the recharge volumes. This would ensure that allocation decisions are equitable for all groundwater users and that the incentive for undertaking MAR is not removed.
- *The condition of groundwater-dependent ecosystems (GDEs) in the area.* MAR schemes undertaken near GDEs should not adversely affect those GDEs. Where GDEs are stressed due to declining groundwater levels, a proportion of recharge water from MAR schemes may need to remain in the aquifer for the benefit of the GDEs.
- *The migration of groundwater away from the recharge and recovery points.* The proponent will need to consider the rate of groundwater flow in the assessment to ensure that recharge water is available at the proposed time of recovery.
- *The quality of the existing groundwater and recharge water.* Differences in water quality can affect the recovery volume.

In most cases, it may be possible to recover 100 per cent of the recharge water. In stressed aquifers, however, it may only be possible to recover a proportion of the recharge volume. In such aquifers, management strategies outlined in water allocation plans may be in place to limit how much water can be recovered.

There could also be cases where MAR results in a significant improvement to the native groundwater quality. For example, injecting fresher water into an aquifer will decrease the salinity of the in situ groundwater, increasing the aquifer's value to the community and potentially allowing more water than has been recharged to be recovered (if the impacts of recovering the additional water are acceptable).

Proponents will estimate the likely recoverable volumes as part of their hydrogeological assessment. The department will determine appropriate recovery volumes based on these estimates and other management considerations.

## 5 Water quality considerations

### 5.1 Management framework

The Department of Water will adopt a risk management approach for assessing MAR schemes to ensure an aquifer's environmental value or beneficial use is maintained. This approach is consistent with the *Australian guidelines for water recycling: Managed aquifer recharge* (2009), and the Environmental Protection Authority's strategic advice (*EPA Bulletin 1199*, 2005).

### 5.2 Risk assessment

The department may require proponents to submit an environmental risk assessment in accordance with the *Australian guidelines for water recycling: Managed aquifer recharge*. The risk assessment will be considered by relevant agencies as part of the approvals process.

The guidelines include a 12-step risk assessment process that aims to identify, assess and manage environmental risks associated with a proposed scheme. The level of detail required for a risk assessment will depend on factors such as:

- scale of the scheme
- source of the water
- method of treatment
- sensitivity of the receiving environment
- potential impacts of abstraction
- proposed end-use of the abstracted water.

As part of this process, an MAR scheme's proponent must identify the relevant environmental values to be protected (by contacting the relevant government agency to determine the environmental value of the water resource). There may also be particular environmental qualities that the community wishes to preserve. All require protection from the effects of pollution and waste discharges.

In the context of this MAR policy, relevant environmental values must be protected within the aquifers in which recharge and abstraction will take place, as well as any connected ecosystems. This involves consideration of the quality of the source water to be recharged, and the water quality required for enduse.

The environmental values recognised in the *National water quality management strategy, Australian & New Zealand guidelines for fresh and marine water quality 4* (NHMRC & NRMCC 2004) are:

- aquatic ecosystems
- primary industries (irrigation and general water uses, stock drinking water, aquaculture and human consumers of aquatic foods)

- recreation and aesthetics
- drinking water
- industrial water
- cultural and spiritual values.

The guidelines provide a risk management approach for to protect these values.

The department seeks to maintain the environmental value of aquifers by requiring the quality of the water recharging an aquifer to be equal to or better than the quality of the receiving groundwater. Proponents of MAR schemes will need to demonstrate this to the department's satisfaction.

Health and broader environmental issues must be addressed separately in consultation with the Department of Health or the Department of Environment and Conservation and the Environment Protection Authority respectively.

### 5.3 Protection of stored recharge water

Protecting the quality of stored recharge water is an important issue for proponents of MAR schemes to consider. Once in the aquifer, the recharge water may be contaminated in several ways, including land use over unconfined aquifers, existing contaminant plumes in groundwater, and aquifer contamination from nearby bores.

There is provision to protect groundwater quality within public drinking water source areas (PDWSAs). Underground water pollution control areas (UWPCAs), catchments and water reserves are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*. By-laws created under these Acts are used to control potentially polluting activities and to take the necessary steps to prevent or remediate water quality contamination risks or incidents.

Drinking water source protection plans identify risks and constrain land use through priority protection areas (e.g. P1, P2 and P3) and protection zones (e.g. wellhead and reservoir protection zones).

Outside of PDWSAs, the department has no legislative powers to protect the quality of groundwater stored in an MAR scheme. In these areas, the *Environmental Protection Act 1986*, administered by the Department of Environment and Conservation, is the primary legislation for protecting water quality in the state. However, the Department of Water is responsible for the conservation, protection and management of Western Australia's water resources. To manage risks to water quality outside of PDWSAs, we provide advice on best management practice for a range of land use activities in our water quality protection notes.

To ensure the recharge water will be available to the intended end user at the required quality, protection of water quality must be considered by the proponent at an MAR scheme's planning stage, and the department must consider quality issues in the licensing process. However, we cannot guarantee that the water quality will

meet the proponent's requirements. It is the proponent's responsibility to ensure the water is fit-for-purpose and to factor in any possible impacts that a change in water quality may have, as well as consider contingency planning in the event that the water is not fit-for-purpose.

The department will define MAR management zones to facilitate the management of groundwater quality and recovery in the vicinity of MAR schemes. The zones will be used as an internal management tool to ensure the location of MAR schemes is considered in the processing of other licence applications in the area. They will be defined by the department, based on investigations undertaken by the proponent, and mapped on the department's geographic information system for internal use.

MAR zones may also be identified in allocation plans for significant or long-term MAR schemes. They could also assist the state's planning process via the *Better urban water management* (WAPC 2008) framework.

## 6 How the department will manage MAR schemes

### 6.1 Who should hold the licence to take water?

For most MAR schemes there will be one proponent for both the recharge and recovery phase. Yet this may not always be the case. For example, treated wastewater may be infiltrated into an aquifer by a wastewater plant operator, and the water may be recovered down-gradient by a local government authority for irrigating public open space. Another scenario could be that a water service provider recharges an aquifer to augment the groundwater supplies of a group of groundwater users, such as wine growers or councils.

It could be difficult to resolve supply issues if recharge and recovery are not linked. To ensure this link is maintained under the current legislative provisions, the licence to take (recover) water will be granted to the company undertaking the recharge operations. The licensee then has the option of allowing third parties to recover the water, by forming agreements with those parties.

In granting the licence, the location of the recovery bores (draw points) must be known, and the licensee must have legal access to the land on which they are located. If the locations of the recovery bores are not known at the time of the 5C licence application, the Department of Water may give an undertaking to grant a licence at a later time, in accordance with *Operational policy 5.05*.

### 6.2 Rights to recharge water and recharge credits

There is an expectation that proponents of MAR schemes should have rights to a portion or all of the water they recharge into the aquifer – through recharge or allocation credits (where a unit of credit is given for abstraction, in return for each unit of aquifer recharge). The department recognises that recharge credits can be a significant benefit of MAR, and create an incentive to reuse or recycle water resources that would otherwise be wasted. However, under the *Rights in Water and Irrigation Act 1914*, water that is recharged into the natural groundwater system is vested in the Crown (i.e. when the recharge water enters the groundwater system, the proponent does not retain ownership of that water). Proponents of MAR schemes have the same rights as other licence holders and must apply for a licence to recover the recharge water. The MAR water will be allocated at the discretion of the department, according to this policy.

Although the department is not in a position to issue allocation or recharge credits for MAR schemes under the *Rights in Water and Irrigation Act 1914*, we encourage the development of MAR schemes that will result in additional water – as long as the aquifer's environmental values and integrity are maintained. We will grant licences to MAR proponents for taking water, provided that departmental and legislative requirements are met.

Because MAR recharge and recovery volumes will be managed separately to the allocation limit, applications for MAR will not be subject to the first-in, first-served policy, or other similar mechanisms the department uses when granting new water entitlements.

### 6.3 MAR volumes and the allocation limit

To ensure the long-term sustainability of water resources, limits must be placed on how much water can be taken from any single resource. These limits are referred to as allocation limits and are determined by the department. They help us to decide whether to grant a new water entitlement or not. Generally, licensed water entitlements are granted up to these allocation limits.

MAR schemes contribute an additional input to the natural water balance, increasing how much water can be taken from a given resource. The department will not amend allocation limits to reflect changes in the water balance resulting from MAR. Instead, MAR recharge and recovery volumes will be recorded against a separate MAR category within the department's water allocation systems. This will allow transparency and simplify management, while enabling consideration of MAR in licensing and planning decisions.

To increase transparency, the location of significant or long-term MAR schemes and defined management zones with expected recharge and recovery volumes will be included in water allocation plans.

### 6.4 How the department will licence MAR schemes

The department regulates MAR schemes through the following instruments:

- Licence to construct or alter a well: section 26D, *Rights in Water and Irrigation Act 1914*.
- Licence to take and use groundwater: section 5C, *Rights in Water and Irrigation Act 1914*.
- Agreement: Schedule 1, clause 30, *Rights in Water and Irrigation Act 1914*.

The department usually requires supplementary information to support applications for these instruments.

Our process for licensing MAR schemes is outlined below in general terms. The process applies to schemes that involve the construction of bores or the abstraction of groundwater from bores in proclaimed groundwater areas. Specific requirements may vary on a case-by-case basis. Proponents should contact us for guidance on specific requirements for their proposal.

#### Application for a licence to construct bores/works (section 26D)

The department requires proponents of MAR schemes to undertake a hydrogeological investigation to assess the viability of the proposed scheme and

identify the potential impacts of recharge and recovery. This is undertaken at the applicant's expense.

To construct investigation, injection, recovery and monitoring bores, a licence is required from the department under section 26D of the *Rights in Water and Irrigation Act 1914*. Infiltration works that intercept the watertable will also require a licence under section 26D. The licence to construct a well will include conditions requiring the drilling and investigation results to be supplied to us. This will generally include:

- A detailed hydrogeological assessment (e.g. H2 or H3 as appropriate) in accordance with the department's *Operational policy 5.12*. Additional information specific to MAR should also be included (e.g. determination of recharge and recovery volumes, assessment of potential impacts of injection on aquifer integrity, and determination of travel times for recharge water).

We will advise the applicant of the acceptable timeframe for the drilling investigation and submitting the hydrogeological report.

#### *MAR schemes for environmental benefit*

Some MAR schemes may be undertaken for environmental benefit and only involve recharge, not recovery (e.g. artificial maintenance of a wetland through groundwater recharge). These schemes will only require a section 26D licence, not a licence to take water. On completion of the hydrogeological investigations, proponents must provide the required information for assessing the potential impacts of recharging the aquifer, in accordance with the section 26D licence.

#### **Application for a licence to take water and information required (section 5C)**

Under section 5C of the *Rights in Water and Irrigation Act 1914*, a licence is required to recover the water infiltrated or injected into an aquifer. Proponents must submit an application and be granted a licence before they start recharge or recovery operations. Additional information will be required to support the licence application to allow the department to assess the potential impacts of a proposed MAR scheme upon the environment, other groundwater users, or aquifers. This could include:

- A detailed hydrogeological assessment to be submitted after investigations undertaken to comply with section 26D licence conditions.
- Risk assessment and proposed management in accordance with the *Australian guidelines for water recycling: Managed aquifer recharge*.
- An operating strategy in accordance with the department's *Operational policy 5.08 – Use of operating strategies in the water licensing process*. This document should detail the licensee's responsibilities for managing the impacts of recharge and recovery, and be approved by the department. It should include details such as the location of recharge and recovery works, recharge and recovery rates and volumes, source of recharge water, treatment methods, residence/banking times, intended use and metering protocols. The information from the hydrogeological assessment will help to develop the operating strategy.

- Application of the department's *Water quality protection note no. 25: Land use compatibility in public drinking water source areas*, where the proposed MAR scheme is within a drinking water source area.
- Application of the *Australian guidelines for water recycling: Managed aquifer recharge* (2009).
- Any other information that the department requires to assess the proposal.

If the department determines that the potential impacts and proposed management of the MAR scheme are acceptable, based on the above information, a licence to take water will be granted.

For significant proposals that are referred to the EPA, the department would consider the proposal only after the EPA's assessment or where relevant, the setting of Ministerial Conditions by the Minister for the Environment.

## 6.5 Public consultation

The department requires proponents to advertise applications to abstract more than 100 000 kL/year from a groundwater resource. We will consider submissions received as part of the assessment under the *Rights in Water and Irrigation Act 1914*.

The Australian water recycling guidelines (Phase 1) emphasise the importance of consultation and communication throughout the development of a water recycling scheme. This is also important for MAR schemes using recycled water.

## 6.6 MAR licence transactions

Under this policy, the recharge and recovery operations (including banking of the water) must be linked and the licence to take water will be granted to the company undertaking the recharge.

The permanent transfer of water entitlements will only be allowed in cases where the MAR licensee wishes to sell the MAR operation to another party as an ongoing concern. The department will approve such transfers, provided the new owners demonstrate to our satisfaction that the MAR operations will continue.

The MAR licensee has the option of leasing part or all of their water entitlement to allow a third party to recover the recharge water. An application for an agreement must be submitted to the department for approval (*Form E – Application for approval of agreement to take water under an existing licence*). We will approve the agreement if we are satisfied the licensee will recharge enough water to meet the agreed recovery arrangements.

## 6.7 Consideration of MAR in development proposals

The department may receive proposals for MAR schemes by way of district and local water management strategies, in support of land planning decisions. MAR may be one of the options for fit-for-purpose water supply in areas where water sources are limited.

If MAR is being considered as part of a district water management strategy, the proponent should undertake a preliminary study investigating:

- hydrogeological characteristics of the development site
- the area's environmental features and their values
- potential sources of recharge water
- broad characterisation of the quality of recharge water and native groundwater
- proposed treatment methods to obtain the desired water quality
- proposed recharge and abstraction details (e.g. locations, quantities, residence time)
- intended use.

After assessing the study, we will inform the Department of Planning and the proponent about whether we approve of the proposed MAR as a water supply option. Because there will be cases where MAR proves not to be technically feasible, or too costly, the proponent should have alternative water supply options.

The Department of Planning requires the feasibility of MAR proposals to be proven at the local water management strategy stage. At this stage, we will require proponents to follow the licensing process outlined in Section 6.4. If we are satisfied with the information provided and determine that the potential impacts of the proposed MAR scheme are acceptable, we will grant a licence to take water provided the locations of recharge and recovery bores are known and the licensee has legal access to the land on which they are located. Otherwise we will give an undertaking to grant a licence at a later stage, in accordance with *Operational policy 5.05*.

If at the district water management strategy stage the proponent requires more certainty that we will grant a licence for MAR operations, they will need to undertake the investigations required as part of the water licensing process (refer to Section 6.4).

For MAR proposals that relate to potable water supply (e.g. in-house/building use in an urban/industrial development), the Department of Planning requires feasibility to be demonstrated earlier – at the district water management strategy stage – before the land is rezoned.

## 6.8 Ongoing management of MAR schemes

### Metering recharge and recovery

Recharge and recovery volumes must be metered for licensing purposes, particularly to enable the calculation of recovery volumes. It is the proponent's responsibility to purchase, install and maintain accurate cumulative water meters on all recharge and recovery bores.

Meters must be installed in accordance with the department's policy on metering the taking of water (2009), our guidelines for water meter installation (2007) and

legislative provisions under the Rights in Water and Irrigation (Approved Meters) Order 2009. Under this Order, a meter is approved for use if it:

- a) complies with Australian Technical Specification 4747–2008: Meters for non-urban water supply, published by Standards Australia, or
- b) has been tested at a National Association of Testing Authority (NATA) accredited laboratory and verified on a NATA report, or a certificate to be within 2.5 per cent accuracy, and
- c) is installed in accordance with the manufacturer's specifications.

If recharge is undertaken via infiltration, a meter must be placed at the point of entry into the infiltration works, in order to determine recharge volumes. Factors such as evaporation must be considered when recoverable volumes are estimated as part of the hydrogeological assessment.

Details of each water meter fitted (e.g. date of installation, serial number and meter manufacturer's name) are to be provided to the department for each relevant bore.

It is also the proponent's responsibility to read meters periodically and submit these readings to us for each water year, or as specified on departmental licences.

### Monitoring and reporting

Monitoring and reporting requirements will be specified as conditions on groundwater well licences (section 5C) and in related operating strategies.

The proponent may be required to construct monitoring bores to monitor groundwater levels and quality. A groundwater monitoring report will generally be required on a regular basis and must be submitted to the department in accordance with licence conditions. The costs will be borne by the proponent.

The reports should follow the department's *Operational policy 5.12*, although additional information will be required such as reporting of meter readings and recharge/recovery volumes. These additional requirements should be determined in consultation with the department.

## 7 Review

The Department of Water will review this policy in five years or sooner if the introduction of new water management initiatives or legislation results in significant changes, or to include findings from the groundwater replenishment trial on the Gngara Mound.

## 8 Regional inquiries

Please direct any inquiries relating to this policy's implementation or the management of water resources to the following regional offices:

Kimberley Region  
Lot 225 Bandicoot Drive  
Kununurra WA 6743  
Telephone (08) 9166 4100  
Facsimile (08) 9168 3174

Swan–Avon Region  
7 Ellam Street  
Victoria Park WA 6100  
Telephone (08) 6250 8000  
Facsimile (08) 6250 8050

Pilbara Region  
Lot 4608 Cherratta Road  
Karratha WA 6714  
Telephone (08) 9144 2000  
Facsimile (08) 9144 2610

Mandurah Region  
107 Breakwater Parade  
Mandurah WA 6210  
Telephone (08) 9550 4222  
Facsimile (08) 9581 4560

South Coast Region  
5 Bevan Street  
Albany WA 6330  
Telephone (08) 9842 5760  
Facsimile (08) 9842 1204

Mid–West Gascoyne Region  
94 Sanford Street  
Geraldton WA 6530  
Telephone (08) 9965 7400  
Facsimile (08) 9964 5983

South West Region  
35–39 McCombe Rd  
Halifax WA 6231  
Telephone (08) 9726 4111  
Facsimile (08) 9726 4100

# Appendices

## Appendix A – Examples of MAR schemes

### A.1 MAR using treated wastewater, for non-potable use

The most common source of wastewater is municipal wastewater derived from sewerage systems in urban and rural areas and collected at wastewater treatment plants (WWTPs). The wastewater is treated and disposed of into the ground via infiltration structures such as ponds, trenches and galleries. This practice has been undertaken for many years at WWTPs within regional centres.

In recent times, due to the demands on groundwater resources in some areas, interest has developed in abstracting the infiltrated wastewater. The original intent of infiltrating treated wastewater at WWTPs was to dispose of this wastewater, not to store or treat it for later recovery or environmental benefit as per the definition of MAR in this policy (Section 2.2).

However, the department recognises that treated wastewater can provide a valuable resource that can be reused. Where the treated wastewater infiltrating into the aquifer has not been previously accounted for in the resource's allocation limit, and the WWTP operator applies for a licence to recover the infiltrated wastewater, the department will consider this as MAR. This will enable this policy's requirements to be applied to wastewater disposal, raising the management level and allowing for better management of the groundwater resource.

There is also growing interest in opportunities for the injection of treated wastewater, sourced either from WWTPs or via sewer mining, for later recovery for use in horticulture or irrigating public open space.

Wastewater for infiltration or injection can also be sourced from industrial or commercial processes. Provided the water is treated to the appropriate level, and the requirements of this policy are applied, these sources may be considered for MAR.

#### *Management approach*

The following management approach will generally apply to MAR using treated wastewater for non-potable use.

- 1 A licence to construct or alter a well (section 26D) is required to construct injection (where relevant), recovery and monitoring bores. The construction of infiltration structures (pits, ponds, galleries etc.) must be licensed if they intersect the watertable.
- 2 A licence to take water (section 5C), issued to the party undertaking the recharge. Recharge undertaken before the section 5C licence application will generally not be considered as part of the water entitlement. Documentation to be provided to the department in support of the section 5C licence application includes:

- Application of other relevant national guidelines (e.g. *Australian guidelines for water recycling – Augmentation of drinking water; Stormwater harvesting and reuse; Managed aquifer recharge modules*).
  - A hydrogeological assessment that examines the potential impacts of the infiltration or injection, and the potential for banking of recharge water, if required.
  - An operating strategy will be required and must be approved before the granting of the licence to take water.
- 3 Banking of the recharge water will be approved if the hydrogeological assessment shows that the water will be available for use and the impacts of recovery will be acceptable. The department will determine the allowable period of banking on a case-by-case basis, based on the proponent's hydrogeological assessment/groundwater modelling and other information.
  - 4 In cases where recharge and recovery is to be undertaken by different operators, the parties must reach an agreement to take water under the existing section 5C licence, ensuring that enough water will be available for recovery during the period of the agreement. An application must be submitted to the department for approval (*Form E – Application for approval of agreement to take water under an existing licence*).
  - 5 Groundwater monitoring reports will be required. The detail and frequency will be determined by the department.

## A.2 MAR using recycled water from wastewater treatment plants for drinking water use (groundwater replenishment)

The use of recycled wastewater for drinking purposes is a new water source option in Western Australia. This option is being investigated via a trial within the grounds of the Water Corporation's Beenyup WWTP on the Gnangara Mound. This type of MAR is also known as groundwater replenishment (GWR).

GWR is a process whereby wastewater from a WWTP is treated to a high standard (e.g. by reverse osmosis) and then pumped into a suitable aquifer. The high quality treated wastewater mixes with existing groundwater in the aquifer for an appropriate time to ensure that any residual contaminant risk is mitigated. The water is then recovered and treated appropriately for use in a drinking water supply system.

The department recognises the significant potential benefit of GWR and supports the trial at Beenyup on the Gnangara Mound. We will support a full-scale scheme if the current trial demonstrates that health, social, environmental and water resource impacts are acceptable.

The Water Corporation's GWR trial on the Gnangara Mound will provide valuable information for assessing future GWR projects in public drinking water source areas and elsewhere in the state.

### *Management approach*

The following management approach will generally apply to MAR schemes for drinking water use.

- 1 A licence to construct or alter a well (section 26D) is required to construct injection, recovery and monitoring bores.
- 3 A licence to take water (section 5C), issued to the party undertaking the recharge. Documentation to be provided to the department in support of the section 5C licence application includes:
  - Application of other relevant national guidelines (e.g. *Australian guidelines for water recycling – Augmentation of drinking water; Stormwater harvesting and reuse; Managed aquifer recharge* modules).
  - A hydrogeological assessment that examines the potential impacts of the infiltration or injection, and the potential for banking of recharge water, if required.
  - An operating strategy will be required and must be approved before the granting of the licence to take water.

- Documentation showing that other departmental approvals have been obtained where necessary (e.g. Department of Health).
- 3 Banking of the recharge water will be approved if the hydrogeological assessment shows that the water will be available for use and the impacts of recovery will be acceptable. The department will determine the allowable period of banking on a case-by-case basis, based on the proponent's hydrogeological assessment/groundwater modelling and other information.
- 4 Groundwater monitoring reports will be required. The detail and frequency will be determined by the department.

## A.3 Re-injection of dewatering excess

Dewatering occurs throughout the state at mine and construction sites to lower groundwater levels and enable the required activities. Some of the abstracted groundwater might be used on-site for purposes such as dust suppression. However, there is usually excess water that needs to be disposed of. It has been common practice in the past to dispose of this abstracted groundwater by discharging it to surface water systems. This often creates environmental issues, because the quality of the groundwater can be significantly different to that of the receiving surface water, or it can change the flow regime of the surface water system.

Re-injection of dewatering excess into aquifers may be used to:

- Minimise the impacts on surface water regimes. The abstracted groundwater may be re-injected into aquifers that are connected to the surface water systems to allow the recharge water to flow naturally into the surface waters, rather than being discharged directly into the surface waters. This is being done at several mine sites in the Pilbara and is also becoming an alternative method of disposal at construction sites. Proponents undertaking re-injection to minimise impacts on surface water systems are showing interest in banking that water and recovering it at a later time, to offset the costs of re-injection.
- Protect groundwater-dependent ecosystems from the impact of dewatering. This may be achieved by creating a hydraulic barrier between the ecosystem and the cone of depression. Examples of this re-injection can be found in the Pilbara. In such cases, the MAR scheme would generally not involve recovery of the injected water.

### *Management approach*

The following management approach will be applied to MAR applications involving re-injection of dewatering excess.

- 1 A licence to construct or alter a well (section 26D) is required to construct injection, recovery and monitoring bores.
- 2 A licence to take water (section 5C), issued to the party undertaking the recharge. Documentation to be provided to the department in support of the section 5C licence application includes:
  - Application of other relevant national guidelines (e.g. *Australian guidelines for water recycling – Augmentation of drinking water; Stormwater harvesting and reuse; Managed aquifer recharge modules*).
  - A hydrogeological assessment that examines the potential impacts of the infiltration or injection, and the potential for banking of recharge water, if required.
  - An operating strategy will be required and must be approved before the granting of the licence to take water.

– A water management plan may be required in the Pilbara region, in accordance with the *Pilbara water in mining guidelines* (DoW 2009).

- 3 Banking of the recharge water will be approved if the hydrogeological assessment shows that the water will be available for use and the impacts of recovery will be acceptable. The department will determine the allowable period of banking on a case-by-case basis, based on the proponent's hydrogeological assessment/groundwater modelling and other information.
- 4 Groundwater monitoring reports will be required. The detail and frequency will be determined by the department.
- 5 In cases where recharge and recovery is to be undertaken by different operators, the parties must reach an agreement to take water under the existing section 5C licence, ensuring that enough water will be available for recovery for the period of the agreement. An application must be submitted to the department for approval (*Form E – Application for approval of agreement to take water under an existing licence*).

Existing operations needing to re-inject dewatering excess and already holding a section 5C licence will need to obtain another licence from the department specifically for the MAR operations. We will not amend the existing licence to incorporate the MAR operations.

## A.4 MAR using stormwater

When a catchment is developed, the proportion of land covered by impervious surfaces (e.g. roads, parking areas, compacted soils, roofs, driveways and pavement) is increased. This typically results in greater runoff than would have occurred pre-development, reducing evapotranspiration and the area available for the rainwater to infiltrate into the groundwater.

Traditionally, the runoff is drained away from the catchment to surface water bodies (ocean, rivers, lakes etc.) through open or piped drains. These may carry away up to 80 per cent of the rainfall volume in clay catchments and up to 25 per cent in sandy catchments. As a result, recharge of the shallow, unconfined aquifers reduces and the volume of water in receiving surface water bodies increases.

New approaches to stormwater management are being put in place. These aim to infiltrate rainfall at or near the source to keep the water balance of the site as close as possible to its pre-development hydrology. This prevents pollution at the source, maximises infiltration to reduce stormwater runoff, and recharges the local groundwater. This design philosophy is known as water sensitive urban design (WSUD).

Current stormwater practices are discussed in detail in the *Stormwater management manual for Western Australia* found on the department's website <[www.water.wa.gov.au](http://www.water.wa.gov.au)>.

### *Infiltrated stormwater*

In areas such as the Swan coastal plain, where extensive sand aquifers lie beneath many urban developments, stormwater runoff from impervious surfaces is commonly managed using infiltration systems. Runoff from roads, roofs and other hard surfaces is infiltrated into the sand aquifer using systems such as soakwells, infiltration trenches, constructed basins, garden beds or other vegetated areas. Together with a reduction in evaporation and transpiration, this results in an increase in aquifer recharge in urban areas. This form of aquifer recharge is a consequence of urbanisation; it is not 'managed' by a proponent as purposeful recharge for later recovery or environmental benefit.

The amount of water available from stormwater infiltration depends on constraints such as drainage and the presence of acid sulfate soils or groundwater dependent ecosystems. In some developments, drains control the level of the watertable, so once the drain level is reached, additional recharge becomes drainage water.

The infiltrated stormwater is recovered by the large number of garden bores throughout the state, particularly in metropolitan Perth.

Under this policy, the department will not consider this type of infiltrated stormwater as MAR.

### *Raised watertables due to land use changes/activities*

In significant developments where catchment clearing has seen an increase in groundwater levels due to the reduction of evapotranspiration, additional groundwater may be available for use. The department will account for this additional water when determining or revising the allocation limit of the groundwater resource. The department can then allocate this water through the normal licensing process.

The same management approach will be applied to cases where watertables are raised as a consequence of thinning or burning vegetation.

### *Harvested stormwater*

In high density developments or in areas with limited infiltration potential (e.g. due to high groundwater levels or clay soils), an increase in stormwater runoff may be created. There may be opportunities to collect stormwater from the roofs of buildings and use it to maintain a site's water balance. It should be noted that high groundwater levels or soils with lower hydraulic conductivities do not necessarily preclude the use of infiltration techniques, and best practice stormwater management should be applied to reduce the impacts of urbanisation on the site's water balance.

The department encourages reuse of this rainwater. In some circumstances, the 'harvested' stormwater runoff can be used directly, or where suitable, MAR may be used as a method to store and/or provide additional passive treatment of the water before use.

Urban stormwater runoff may be contributing to the water requirements of ecosystems such as watercourses or wetlands. The environmental water requirements of these ecosystems must be satisfied before stormwater is used as a source for MAR schemes. The water must also be a demonstrably acceptable quality to ensure that the aquifer's environmental values are maintained or enhanced.

### *Redirected stormwater*

There will be other cases where additional recharge is created as a result of redirecting stormwater discharge. For example, stormwater discharged to surface waters or the ocean might be redirected to infiltrate into the ground. This form of change to a stormwater system (commonly known as 'retrofitting') which captures stormwater that would otherwise have been lost to aquifers and creates additional recharge, will be considered as MAR under this policy. However, the environmental water requirements of any ecosystems previously receiving the stormwater recharge must be accounted for. The water must also be a demonstrably acceptable quality to ensure that the aquifer's environmental values are maintained or enhanced.

### *Management approach*

The following management approach will generally apply to MAR applications using stormwater. Relevant documentation is to be provided to the department in support of the section 5C licence application.

- 1 A licence to construct or alter a well (section 26D) is required to construct injection, recovery and monitoring bores.
- 2 A licence to take water (section 5C), issued to the party undertaking the recharge. Documentation to be provided to the department in support of the section 5C licence application includes:
  - Application of other relevant national guidelines (e.g. *Australian guidelines for water recycling – Augmentation of drinking water; Stormwater harvesting and reuse; Managed aquifer recharge* modules).
  - A hydrogeological assessment that examines the potential impacts of the infiltration or injection, and the potential for banking of recharge water, if required.
  - An operating strategy will be required and must be approved before the granting of the licence to take water.
  - The proponent must demonstrate that they have accounted for the environmental water requirements of any ecosystems previously receiving the stormwater input.
- 3 Banking of the recharge water will be approved if the hydrogeological assessment shows that the water will be available for use and the impacts of recovery will be acceptable. The department will determine the allowable period of banking on a case-by-case basis, based on the proponent's hydrogeological assessment/groundwater modelling and other information.
- 4 Groundwater monitoring reports will be required. The detail and frequency will be determined by the department.
- 5 In cases where recharge and recovery is to be undertaken by different operators, the parties must reach an agreement to take water under the existing section 5C licence, ensuring that enough water will be available for recovery for the period of the agreement. An application must be submitted to the department for approval (*Form E – Application for approval of agreement to take water under an existing licence*).

# Appendix B – Regulatory framework for MAR in WA

## B.1 National and state framework documents

The need to introduce wider reforms to the management of water resources was identified after the drought in 2001. Committees were formed to debate the directions of the reforms and numerous forums were held to raise awareness of the issues, elicit views and comment on the proposed reforms. The conclusions of this work outlined the need for improved markets to facilitate more effective allocation and sustainable use of water resources, by adopting a more modern and flexible legislative framework.

In April 2006, the Government of Western Australia signed the National Water Initiative (NWI), an agreement between the Australian and state and territory governments. The NWI's principles closely reflect the conclusions of Western Australia's water resource management reform process. The NWI's overall objective is to achieve a nationally compatible market, with a regulatory and planning based system for managing surface water and groundwater resources for rural and urban use that optimises economic, social and environmental outcomes. The NWI builds on the 1994 Council of Australian Governments (COAG) water reform program and is deliberately prescriptive to improve the progress of jurisdictions in implementing water reforms.

To fully implement the NWI's objectives and actions in Western Australia, a new Water Resources Management Bill may be drafted that considers the NWI's principles.

The *State water recycling strategy* was released in June 2008. The strategy set directions for recycling across a range of sectors including industry, agriculture and public open space. It also provided for the development of a Waterwise Communities toolkit, and a regulatory framework to support water recycling. The Department of Water, as a key agency responsible for water recycling, will coordinate the strategy's implementation and progress water recycling across the state.

The *National water quality management strategy* (NWQMS) sets out a national framework to achieve sustainable use of the nation's water resources by protecting and enhancing their quality, while maintaining economic and social development.

It provides the information and tools to help communities manage their water resources to meet current and future needs. It provides policies, a process and a series of national guidelines for water quality management.

The *State water quality management strategy* (SWQMS) for Western Australia includes policies, principles, objectives and implementation strategies agreed to across Australia. It recognises that water quality management is a responsibility shared by government (at all levels), industry and the community.

The Environment Protection and Heritage Council and the Natural Resource Management Ministerial Council have developed *Australian guidelines for water recycling: Managing health and environmental risks* (2009). These guidelines form part of the NWQMS.

The guidelines comprise a risk management framework and specific guidance on managing the health and environmental risks associated with the use of recycled water.

Phase one of the guidelines focuses on:

- the reuse of large-scale treated sewerage and greywater (including residential garden watering, car washing, toilet flushing and clothes washing)
- irrigation for public open space, agriculture and horticulture
- fire protection and fire fighting
- industrial uses (including cooling water)
- greywater treated on-site (e.g. high rise apartments and office blocks) for use for garden watering, car washing, toilet flushing and clothes washing.

Phase two of the guidelines comprises three modules – augmentation of drinking water supplies, stormwater harvesting and reuse, and managed aquifer recharge.

## B.2 Licensing instruments under the *Rights in Water and Irrigation Act 1914*

### *Licences to take water*

The *Rights in Water and Irrigation Act 1914* requires proponents to hold a licence to take water from any artesian well/bore throughout the state, and from non-artesian wells/bores located within proclaimed groundwater areas. Licences to take water are issued under section 5C of the *Rights in Water and Irrigation Act 1914*. Some exemptions apply; for example, taking water for stock and garden uses (up to 1500 kL/year) in most areas of the state.

Under the *Rights in Water and Irrigation Act 1914*, the grant or refusal of a licence under section 5C is at the department's discretion. Clause 7(2) provides that in assessing an application for a licence under section 5C, the department is to have regard to all matters that it considers relevant, including whether the proposed taking and use of the water is ecologically sustainable and environmentally acceptable; or whether it may have a detrimental effect on another person. The department can refuse an application on the grounds that the potential impacts of the taking and use of the water are unacceptable.

Clause 7(2) also requires the department to consider the public interest. Federal and state governments have identified innovation in water resources – specifically recycling and MAR – as being in the public interest. The department must therefore take innovation into account when assessing proposed MAR schemes, and where possible, facilitate them through appropriate policies and guidelines.

Clause 4(2) of Schedule 1 of the Act provides that a licence applicant must provide the department with any further information we may require to assess the application. This information may include a hydrogeological assessment of the proposed taking and use of the water, to help us determine the potential impact of granting a licence under section 5C.

In some cases, it may be necessary for the department to refuse to grant an application, notwithstanding that the applicant has borne significant costs in undertaking a hydrogeological assessment.

In granting a licence under section 5C of the Act, the department will impose such terms and conditions as it considers fit, having regard to all the matters that we consider relevant, including whether the proposed taking and use of the water is in accordance with the matters set out in clause 7(2) of Schedule 1 of the *Rights in Water and Irrigation Act 1914*.

The department will sometimes impose conditions on a section 5C licence requiring the licensee to submit regular groundwater monitoring information on existing operations. This will allow us to assess whether the impacts are acceptable, or if changes to groundwater abstraction and/or the management regime are required.

Terms and conditions on licences under section 5C can incorporate other documents, which then form part of the licence conditions. The licensee must then comply with the requirements of these documents, if he or she is to maintain the entitlement to access and use of the water. An example is a department-approved operating strategy, which the licensee may need to prepare in accordance with *Operational policy 5.08*

#### *Licences to construct bores*

Before constructing a bore (which may also be referred to as a well), or altering an existing bore (whether for the purposes of investigation, monitoring, abstraction or recharge), a licence to construct or alter a well must first be obtained from the department under Section 26D of the *Rights in Water and Irrigation Act 1914*.

The drilling of a bore and the associated disturbance to the surrounding area must also comply with the *Aboriginal Heritage Act 1972 (WA)* and the *Native Title Act 1993 (Cwlth)*. If the area is subject to a Native Title claim, the applicant must notify the registered claimant group so they can comment on the proposed activities.

## Glossary

Abstraction	Pumping groundwater from an aquifer.
Allocation	The volume of water taken from a water source (groundwater or surface water) for use by an individual, usually in accordance with a licence granted under the <i>Rights in Water and Irrigation Act 1914</i> . Also referred to as 'water entitlement'.
Allocation limit	The amount of water set aside for annual licensed use. In the department's current water licensing system, the allocation limit is a volumetric licensing limit.
Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water. Usually described by whether they consist of sedimentary deposits (sand, gravel, sandstone) or fractured rock. Aquifer types include unconfined, confined and artesian.
Artesian aquifer	A confined aquifer in which the hydraulic pressure is sufficient to cause water to rise above the land surface in a well/bore or spring. If the pressure is insufficient to cause the well to flow at the surface, it is called a sub-artesian aquifer.
Artesian bore	A well/bore, including all associated works, from which water flows, or has flowed, naturally to the surface.
Banking	In this policy, the term banking applies to the storing of recharge water in the aquifer for a period of time, so that it can be used when required.
Bore	A small-diameter, normally vertical hole, usually drilled with machinery to obtain access to underground water for monitoring or abstraction purposes. Referred to as a 'well' in the <i>Rights in Water and Irrigation Act 1914</i> .
Confined aquifer	An aquifer saturated with water which is under pressure because it is situated between relatively impervious layers.
Ecological values	The natural ecological processes occurring within water-dependent ecosystems and the biodiversity of these systems.
Ecological water requirements (EWR)	The water regime needed to maintain the ecological values (including assets, functions and processes) of water-dependent ecosystems at a low level of risk.
Ecosystem	A term used to describe a specific environment (e.g. lake), including all of the biological, chemical and physical resources and the interrelationships and dependencies that occur between those resources.

Environment	Living things, their physical, biological and social surrounding and interactions between all of these.
Environmental water provisions	The water volume that is provided to maintain the environment, including the social and cultural requirements, as a result of the water allocation decision-making process. Environmental water provisions take into account the ecological, social, cultural and economic impacts. They may meet in part or in full the ecological water requirements.
Environmental values	Environmental values (as defined by ARMCANZ & ANZECC 1994) are particular values or uses of the environment that contribute to a healthy ecosystem, or public or private benefit, welfare, safety or health and which require protection from the effects of pollution, waste discharges and deposits. They were often called 'beneficial uses' in the water quality literature, but this term has lost favour because of its exploitative connotations.
Full allocation	A management area where all the available water resources have already been allocated.
Groundwater	The water that occurs in pore spaces and fractures in soil and rock beneath the ground surface.
Groundwater-dependent ecosystem (GDE)	An ecosystem that depends on groundwater for its existence and health.
Hydrogeology	The science associated with the occurrence, distribution, movement and quality of groundwater.
Hydrology	The scientific study of the properties, distribution, use and circulation of the water on Earth and in the atmosphere in all of its forms.
Policy	A guiding principle that may not be directly supported by any legislation but has been adopted by the department as its guide to undertaking its business.
Potentiometric level	An imaginary surface representing the total head of groundwater and defined by the level (surface) to which water will rise in a well.
Recharge	The addition of water to an aquifer. This occurs naturally through the infiltration of water into the soil. It can also be purposefully undertaken by people through controlled infiltration or injection, in which case it is considered as managed aquifer recharge under this policy.
Recharge water	Water that is infiltrated or injected into an aquifer to purposefully recharge the aquifer.
Recovery	Retrieval of recharge water infiltrated or injected as part of a MAR

scheme, via abstraction from a bore/well.

Subarea	A subdivision within a groundwater area, defined for the purpose of managing the allocation of groundwater resources. Subareas are not proclaimed and can therefore be changed internally without being gazetted.
Unconfined or watertable aquifer	An aquifer which is nearest the surface in the geological sequence, having no overlying confining layer to limit its volume or exert pressure. The upper surface of the groundwater within the aquifer is called the watertable. The aquifer generally receives direct recharge from rainfall.
Water entitlement	The quantity of groundwater permitted to be abstracted by a well licence, usually specified in kilolitres/year (kL/year).
Watertable	The saturated level of the unconfined groundwater. Wetlands in low-lying areas are often seasonal or permanent surface expressions of the watertable.
Well	An opening in the ground made or used to obtain access to underground water. This includes soaks, wells, bores and excavations.

## References

- ARMCANZ & ANZECC 1994, *National water quality management strategy: Policies and principles – a reference document*, Paper no. 2, April 1994, Agriculture and Resource Management Council of Australia and New Zealand and Australian and New Zealand Environment and Conservation Council, Canberra.
- 1996, *National principles for the provision of water for ecosystems*.
- NHMRC & NRMCC 2004, *National water quality management strategy, Australian & New Zealand guidelines for fresh and marine water quality 4*, Australian Government, National Health and Medical Research Council & Natural Resource Management Ministerial Council, Canberra.
- Australian Government, National Health and Medical Research Council & Natural Resource Management Ministerial Council, 2004, *National water quality management strategy, Australian drinking water guidelines 6*, Australian Government, National Health and Medical Research Council & Natural Resource Management Ministerial Council, Canberra.
- 2004, *Intergovernmental agreement on a National Water Initiative, 2004*, Australian Government, Canberra.
- 2009, Natural Resource Management Ministerial Council, Environment Protection & Heritage Council and the Australian Health Ministers' Conference 2009, *Australian guidelines for water recycling: Managing health and environmental risks (Phase 1)*, Canberra.
- 2009, Natural Resource Management Ministerial Council, Environment Protection & Heritage Council and the Australian Health Ministers' Conference, 2009, *Australian guidelines for water recycling: Managing health and environmental risks (Phase 2)*, *Managed aquifer recharge*, Canberra
- Department of Water 2004, *Water quality protection note no.25: Land use compatibility in public drinking water source areas*, Department of Water, Perth.
- 2008, *Guidelines for water meter installation*, Allocation note, Department of Water, Perth
- 2009, *Strategic policy 5.03 – Metering the taking of water*, Department of Water, Perth.
- 2009. *Pilbara water in mining guidelines*, Water resource allocation planning series, Report no. 34, Department of Water, Perth.
- 2010, *Operational policy 5.05 – Giving an undertaking to grant a water licence or permit*, Department of Water, Perth
- 2010, *Operational policy 5.08 – Use of operating strategies in the water licensing process*, Department of Water, Perth
- 2010, *Operational policy 5.13 – Water entitlement transactions for Western Australia*, Department of Water, Perth

Environmental Protection Authority 2005, 'Strategic advice on managed aquifer recharge using treated wastewater on the Swan coastal plain', *Bulletin 1199*, Environmental Protection Authority, Perth.

Land and Water Biodiversity Committee 2003, *Minimum construction requirements for water bores in Australia, Edition 2*.

Pyne, R & David G 2006, *Aquifer storage recovery: a guide to groundwater recharge through wells, Edition 2*.

Western Australian Planning Commission 2008, *Better urban water management*.



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