Department of Water
Government of Western Australia

# Arrowsmith Water Reserve
# Drinking Water Source Protection Plan

REPORT NO. 76
July 2007

Water Resource Protection Series

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Morawa, Arrino, Perenjori, Caron, Bunjil and Latham Town Water Supplies

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Report 76

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**Subject of cover photograph**
*Arrowsmith production bore 1/87*

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# Preface

The Department of Water has prepared this Drinking Water Source Protection Plan to report on the activities and risks to water quality within the Arrowsmith Water Reserve and to recommend management strategies to address these.

A safe drinking water supply is critical to the well being of the community and catchment protection is necessary to help avoid, minimise or manage risks to water quality. The Department is committed to protecting drinking water sources to ensure the continued supply of 'safe, good quality drinking water' to consumers.

The Australian Drinking Water Guidelines recommend a multiple barrier, risk-based approach to protect public drinking water sources. Protection of drinking water catchments is the 'first barrier', with subsequent barriers implemented at the water storage, treatment and distribution stages of a water supply system. Catchment protection includes understanding the catchment, the hazards and hazardous events that can compromise drinking water quality, and developing and implementing preventive strategies and operational controls to ensure the safest possible water supply from our surface water dams and groundwater aquifers.

This plan details the location and boundary of the drinking water catchment, which provides potable water to the Morawa, Arrino, Perenjori, Caron, Bunjil and Latham Town Water Supplies. It discusses existing and future usage of the water source, describes the water supply system, identifies risks and recommends management approaches to address those risks and maximise protection of the catchment.

This plan should be used to guide State and local government land use planning decisions. It should be recognised in the Shire of Three Springs Town Planning Scheme, consistent with the Western Australian Planning Commission's *Statement of Planning Policy No. 2.7 - Public Drinking Water Source Policy*. Other stakeholders should use this document as a guide for protecting the quality of water in the Arrowsmith Public Drinking Water Source Area.

The stages involved in preparing a Drinking Water Source Protection Plan are:

| Stages in development of a Plan | | Comment |
|---|---|---|
| **1** | Prepare Drinking Water Source Protection Assessment | Prepared following catchment survey and preliminary information gathering. |
| **2** | Conduct stakeholder consultation | Advice sought from key stakeholders using the assessment as a tool for information and discussion. |
| **3** | Prepare Draft Drinking Water Source Protection Plan | Draft Plan developed taking into account input from stakeholders and any additional advice received. |
| **4** | Release Draft Drinking Water Source Protection Plan | Draft Plan released for a six week public consultation period. |
| **5** | **Publish approved Drinking Water Source Protection Plan** | **Final Plan published after considering advice received in submissions. Includes recommendations on how to protect the catchment.** |

# Summary

The wheatbelt towns of Morawa, Arrino, Perenjori, Caron, Bunjil and Latham are located in the Mid West Region of Western Australia, between 250 to 360 kilometres (km) north northeast of Perth.

These towns are supplied with water from two Water Corporation bores located in the Arrowsmith Water Reserve, 26 km north-west of Three Springs. The bores are drilled into the Parmelia Formation, which consists of interbedded sandstone, claystone, siltstone and shale. The bores are screened between 40 and 60 metres (m) in clayey and gravel sands.

Arrowsmith Water Reserve was proclaimed in 1990 under the *Country Areas Water Supply Act 1947* for the purpose of protecting the public drinking water source from potential contamination.

The aquifer is confined in the vicinity of the bores, which are artesian. This results in a low contamination risk to the aquifer from the surrounding agricultural land uses. It is proposed that the Arrowsmith Water Reserve area be reduced to reflect the low contamination risk.

It is proposed that there will be a priority one (P1) classification assigned to the proposed Water Reserve for the purposes of identification. There will be no restrictions placed on land uses surrounding the proposed reserve due to the negligible risk of contamination from present and proposed land uses.

The Arrowsmith groundwater resource lies within the Arrowsmith Groundwater Area which was proclaimed in 1975 under the *Rights in Water and Irrigation Act 1914*. This Act requires a licence to draw water from surface water and ground water areas proclaimed under the act (except for domestic and stock use) and all artesian wells throughout the state. It is important to ensure that any private bores drilled in close proximity to the reserve are properly constructed in order to prevent any contamination of the drinking water source.

The plan makes the following recommendations:

- The Water Reserve boundary should be amended to reflect the low contamination risk;
- The proposed Water Reserve should be managed for priority 1 (P1) source protection; and
- The proposed Water Reserve should be recognised in the Shire of Three Springs Town Planning Scheme and other applicable schemes and strategies.

# 1 Drinking water source overview

## 1.1 Existing water supply system

Arrowsmith wellfield, located in the Arrowsmith Water Reserve provides water to the towns of Morawa, Arrino, Perenjori, Caron, Bunjil and Latham as well as farmlands on route. The wellfield is adjacent to the Arrowsmith River, 26 km northwest of Three Springs in the Shire of Three Springs (see Figure 1).

Arrowsmith wellfield is operated by the Water Corporation and consists of two production bores (1/87 and 1/02) drilled into the Parmelia Formation and screened between 40 and 60 metres depth into clayey and gravel sands. The bores in this wellfield are artesian. The location of the bores is presented in Figure 2.

Water abstracted from the bores is pumped into the Arrowsmith Collector Tank located at the wellfield, then pumped into the Arrowsmith supply main to Billeranga Tank. From the Billeranga Tank water is supplied to Arrino, Morawa, Perenjori, Caron, Bunjil and Latham reticulation systems and farmlands via gravitation with boosting at pump stations on route.

## 1.2 Water treatment

Raw water from the Arrowsmith bores is aerated to raise the pH and then disinfected by chlorination at several locations prior to supply as drinking water. A UV disinfection facility also exists at Latham.

## 1.3 Catchment details

### 1.3.1 Physiography

The Arrowsmith wellfield occurs on the Dandaragan Plateau, a sand and laterite capped plateau, overlying Cretaceous sediments. The Plateau has an elevation ranging from about 140 to 260 m above sea level, is flat to gently undulating, and is essentially undissected over large areas. It is bounded to the west by the Dandaragan Scarp, a fairly prominent topographical feature up to some 50 m high. Deep yellow sands are common to the uplands while the valleys are dominated by deep red and yellow brown sands.

### 1.3.2 Climate

The Arrowsmith area experiences a mild Mediterranean-type climate with hot, dry summers and cool, wet winters. The average annual rainfall is about 390 millimetres.

### 1.3.3 Hydrogeology

The wellfield is drilled into the Parmelia Formation and develops groundwater derived from saturated sediments within this Formation. The Parmelia Formation consists of

an interbedded sequence of sandstone, siltstone and shale that conformably overlies the Yarragadee Formation. The Parmelia Formation includes the basal Otorowiri Member, a predominantly siltstone unit, which acts as an aquiclude restricting the leakage of groundwater into the underlying Yarragadee Formation.

The Parmelia Formation aquifer is recharged mainly by direct infiltration of rainfall outside of the Arrowsmith River Valley and also possibly by the concentration of surface run-off within the Arrowsmith River valley up-gradient of the wellfield.

Carbon 14 dating techniques have been used to determine the average age of water in the Arrowsmith bores. The average corrected age of the groundwater in bore 1/87 is 7120 years. This indicates long travel times for water infiltrating at the surface to reach the bores.

## 1.4 Future water supply requirements

The groundwater source is large compared to the current rates of abstraction (less than 20%). At this stage, Water Corporation considers the current source adequate to meet current and future demands.

## 1.5 Protection and allocation

### 1.5.1 Existing water source protection

Arrowsmith Water Reserve was proclaimed in 1990 under the *Country Areas Water Supply Act 1947*. By-laws can be applied under this Act to ensure protection of the water source against contamination.

### 1.5.2 Current allocation licence

Water resource use and conservation in Western Australia is administered by the Department of Water in accordance with the *Rights in Water and Irrigation Act 1914.* Under the Act, the right to use and control surface and groundwater is vested with the Crown. This Act requires licensing of groundwater abstraction within proclaimed groundwater areas.

The Arrowsmith groundwater resource lies within the Arrowsmith Groundwater Area which was proclaimed in 1975 under the *Rights in Water and Irrigation Act 1914.* The resource is managed in accordance with the Department's Interim Sub-Regional Allocation Strategy titled *Managing the Water Resources of the Arrowsmith Groundwater Area*, *WA*. The Water Corporation is licensed to draw 600 000 Kilolitres (kL) per annum from the Arrowsmith wellfield for public water supply purposes, under Groundwater Well Licence 65320(3). Current abstraction is lower than this, with a volume of 454 932 kL abstracted in 2005/06.

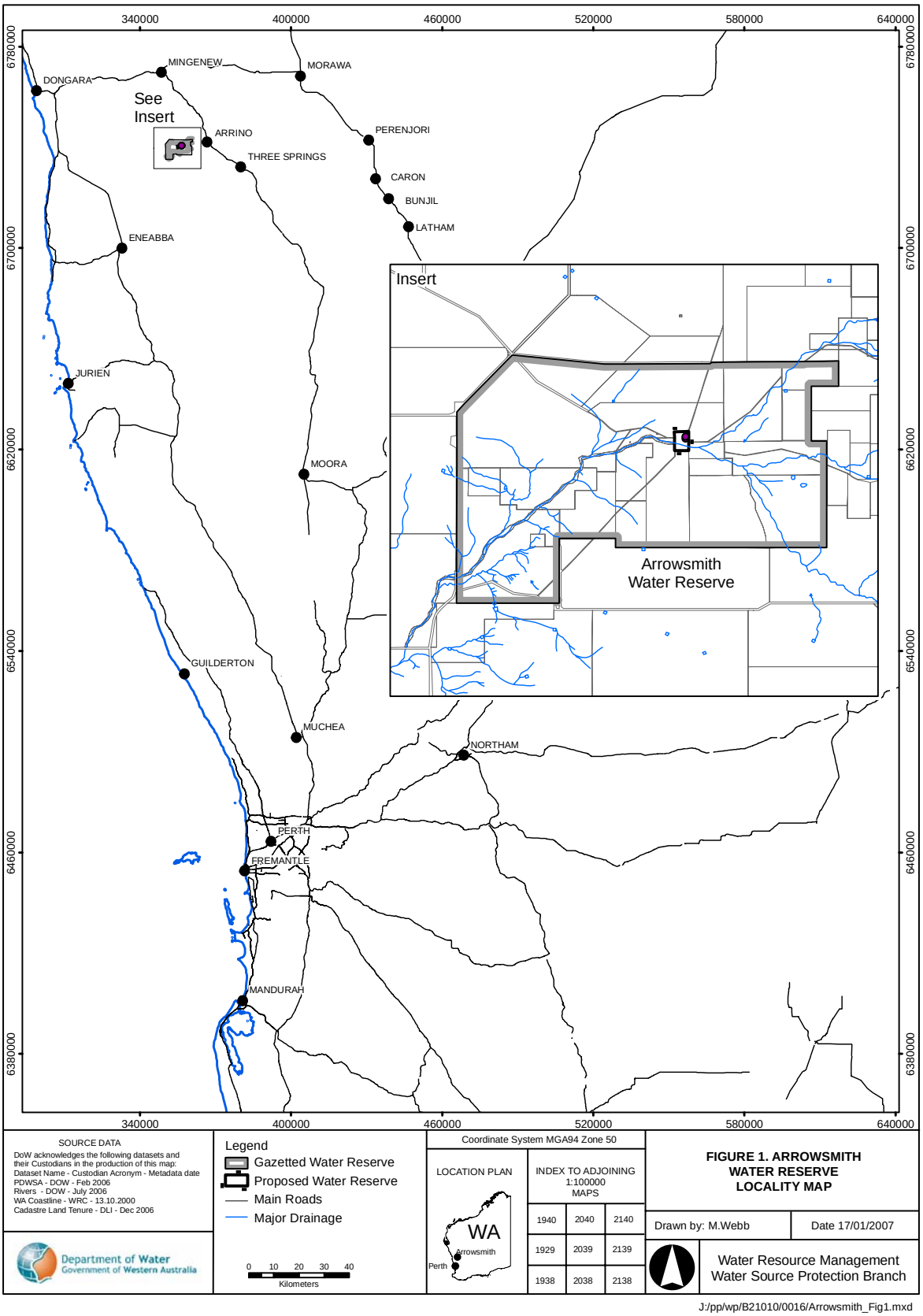


*Figure 1 Arrowsmith Water Reserve locality map*

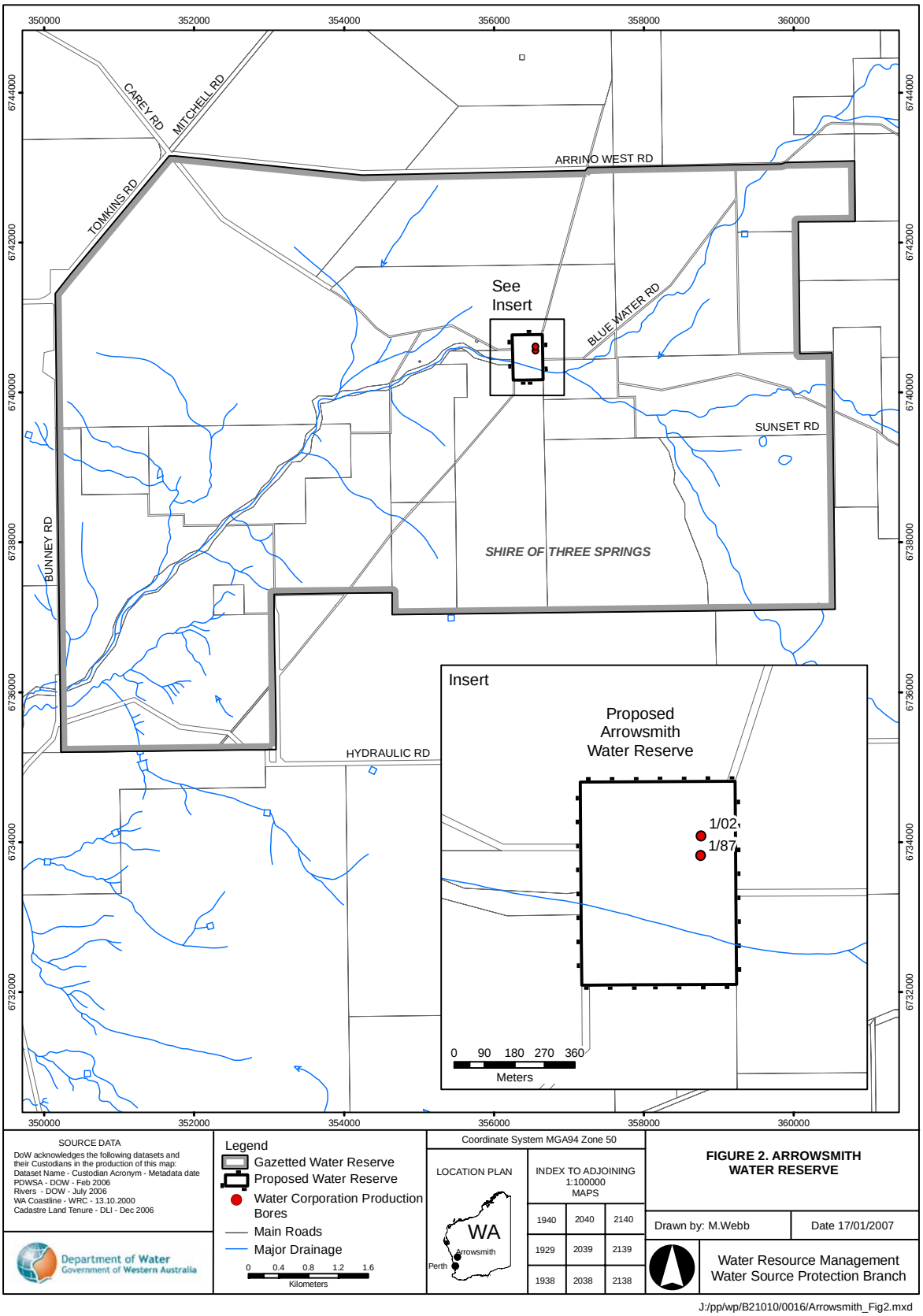


*Figure 2 Arrowsmith Water Reserve*

# 2 Water quality

A wide range of chemical, physical and microbiological properties can impact on water quality and therefore affect the provision of safe, good quality, aesthetically acceptable drinking water to consumers.

The Water Corporation regularly monitors the raw (untreated) water quality from the Arrowsmith wellfield in accordance with Australian Drinking Water Guidelines (ADWG) (NHMRC & ARMCANZ, 2004). The results of this monitoring are then reviewed by an inter government committee, chaired by the Department of Health, called the Advisory Committee for the Purity of Water.

The water is monitored for microbiological contamination, health related chemicals and aesthetic characteristics. It should be noted that testing is conducted on raw water, and that all Australian Drinking Water Guideline limits are met following treatment before supply to consumers.

Further information on water quality monitoring can be found in the Water Corporation's Drinking Water Quality Annual Report, see website www.watercorporation.com.au, select Publications > Water Quality > Annual Reports > Drinking Water Quality Annual Report for 2005-2006.

Details of the typical water quality from Arrowsmith wellfield are presented in Appendix A.

## 2.1 Microbiological contaminants

Microbiological testing of the raw water from Arrowsmith wellfield has been conducted on a monthly basis since December 2000. *Escherichia coli* are used as an indicator of faecal contamination of the water from warm-blooded animals. There have been no detections of *E. coli* in the raw water.

## 2.2 Health related chemicals

The raw water from Arrowsmith wellfield is analysed for health related chemicals, including inorganics, heavy metals, industrial hydrocarbons and pesticides. All health related water quality parameters that have been detected in the water source are within ADWG health guideline values and are at levels which pose no health concern.

## 2.3 Aesthetic characteristics

The raw water from Arrowsmith wellfield is of fair quality complying with ADWG aesthetic guidelines with the exception of pH, chloride and TFSS. Following treatment, the drinking water supplied to the Arrowsmith Scheme complies with ADWG values set for drinking water.

# 3 Land use and contamination risk

## 3.1 Existing land uses

The proposed Arrowsmith Water Reserve is on Crown Reserve land (R 973) managed by Water Corporation and is surrounded by rural land (see Figure 3). The proposed reserve is zoned rural under the Shire of Three Springs Town Planning Scheme. Within the reserve, there is a sand pit operated by the Shire. A vegetated buffer of trees surrounds the bore compound (see Appendix B, Photo 1). Broad acre cereal cropping is the dominant land use in the area, including wheat, lupins, barley and canola (see Appendix B, Photo 2). Broad acre grazing of sheep and cattle is typically secondary to cropping in the area and the stocking rates are generally low.

Potential hazards from cereal cropping include nitrates from fertiliser application and the use of pesticides. Potential hazards from stock grazing include pathogens and nutrients from animal manure. The risk of contamination from these land uses is considered to be low because the bores are properly constructed and the aquifer is confined between non-porous rock formations. In the surrounding area, the depth to the water table is typically greater than 60 m. The sand pit is not considered to pose a significant contamination risk due to its' shallow depth, occasional use and the nature of the aquifer, as detailed above.

## 3.2 Proposed land uses

Land use zonings and activity levels in and around the proposed Arrowsmith Water Reserve are not expected to change in the foreseeable future.

## 3.3 Potential for contamination

Under the provisions of sections 26D and 5C of the *Rights in Water and Irrigation Act 1914,* a license is required to construct a bore or extract water within a proclaimed groundwater area. The Arrowsmith Water Reserve and surrounding areas are within the Arrowsmith Groundwater Area. It should be noted that any future bores drilled in close proximity to a drinking water source bore have the potential to contaminate the drinking water source. Through the Department of Water bore application/assessment process it is important to ensure that private bores are appropriately located and constructed in order to prevent contamination and other impacts on the public drinking water source. All bores should be constructed in accordance with *Minimum Construction Requirements for Water Bores in Australia* Edition 2 (National Minimum Bore Specifications Committee, 2003).

The watertable in this locality is now rising due to the clearing of native vegetation to allow for cropping. This rise has brought naturally occurring salt to the surface in a concentrated form, resulting in some areas of dryland salinity. However, the risk of contamination is considered to be low due to the nature of the aquifer, as detailed above. The salinity of the raw water from Arrowsmith is regularly monitored and is currently within ADWG aesthetic guidelines (see Appendix A).

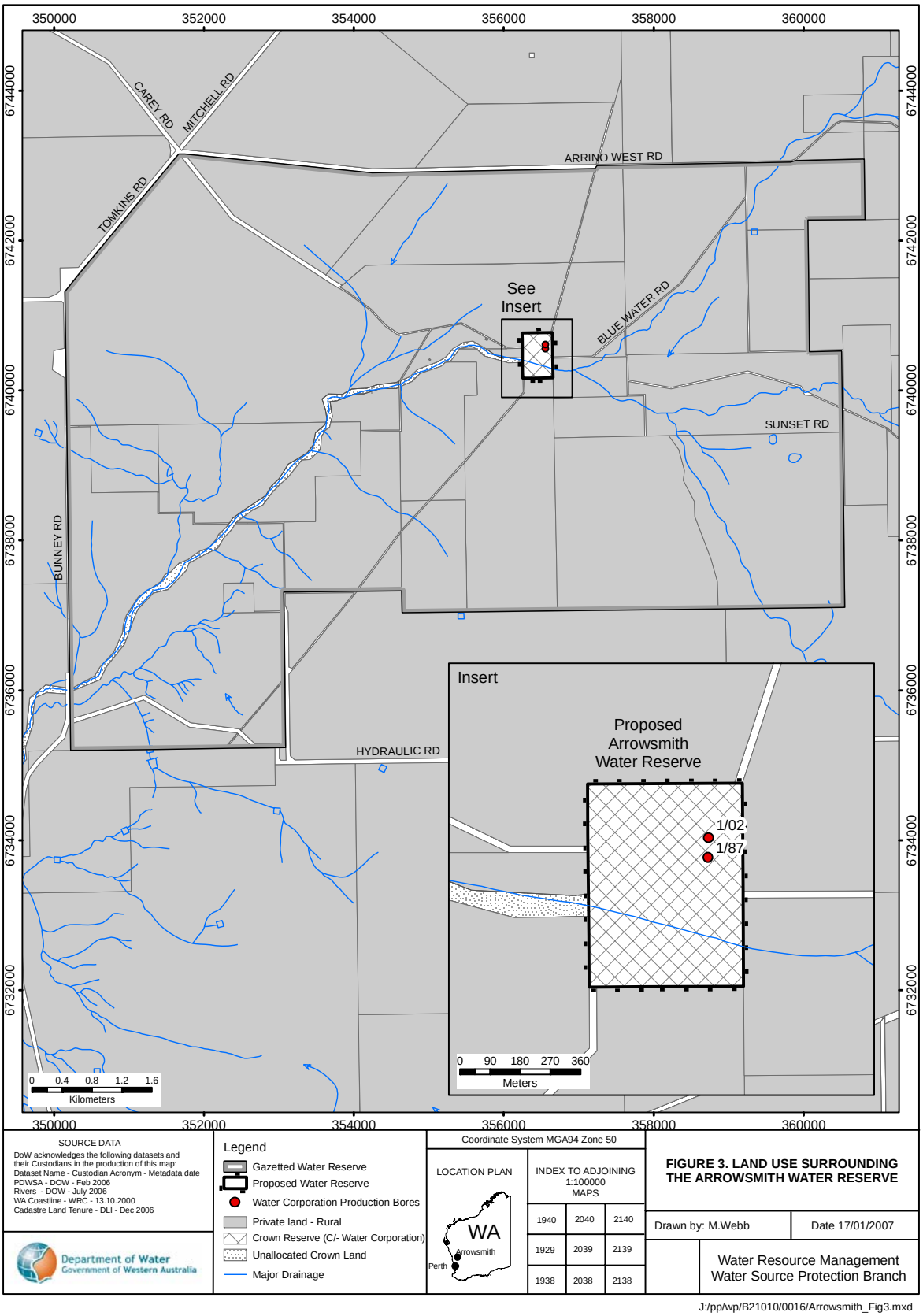


*Figure 3 Land use surrounding the Arrowsmith Water Reserve*

# 4 Catchment protection strategy

## 4.1 Protection objectives

The objective of this plan is to protect the drinking water source in the interest of providing safe drinking water to the towns of Morawa, Arrino, Perenjori, Caron, Bunjil and Latham.

The Priority 1 Classification proposed for the reserve has the fundamental water quality objective of risk avoidance.

## 4.2 Proclaimed area

Arrowsmith Water Reserve was proclaimed in 1990 under the *Country Areas Water Supply Act 1947* for the purpose of protecting the public drinking water source from potential contamination. It is proposed that the boundary of the Arrowsmith Water Reserve should be amended to reflect the low contamination risk. The proposed Arrowsmith Water Reserve consists of Crown Reserve 973 (see Figure 2). A reduction of the Water Reserve will avoid potential land use constraints on private land within the existing Arrowsmith Water Reserve.

## 4.3 Priority classifications

The risk of contamination from existing and proposed land uses is negligible as a result of the artesian bores, depth and construction of the bores, and the confined nature of the aquifer. Accordingly a Wellhead Protection Zone (WHPZ) is not proposed. It is proposed that there will be a Priority 1 (P1) classification within the proposed Arrowsmith Water Reserve. This classification recognises the current land use and tenure surrounding the Water Reserve (see Figure 4).

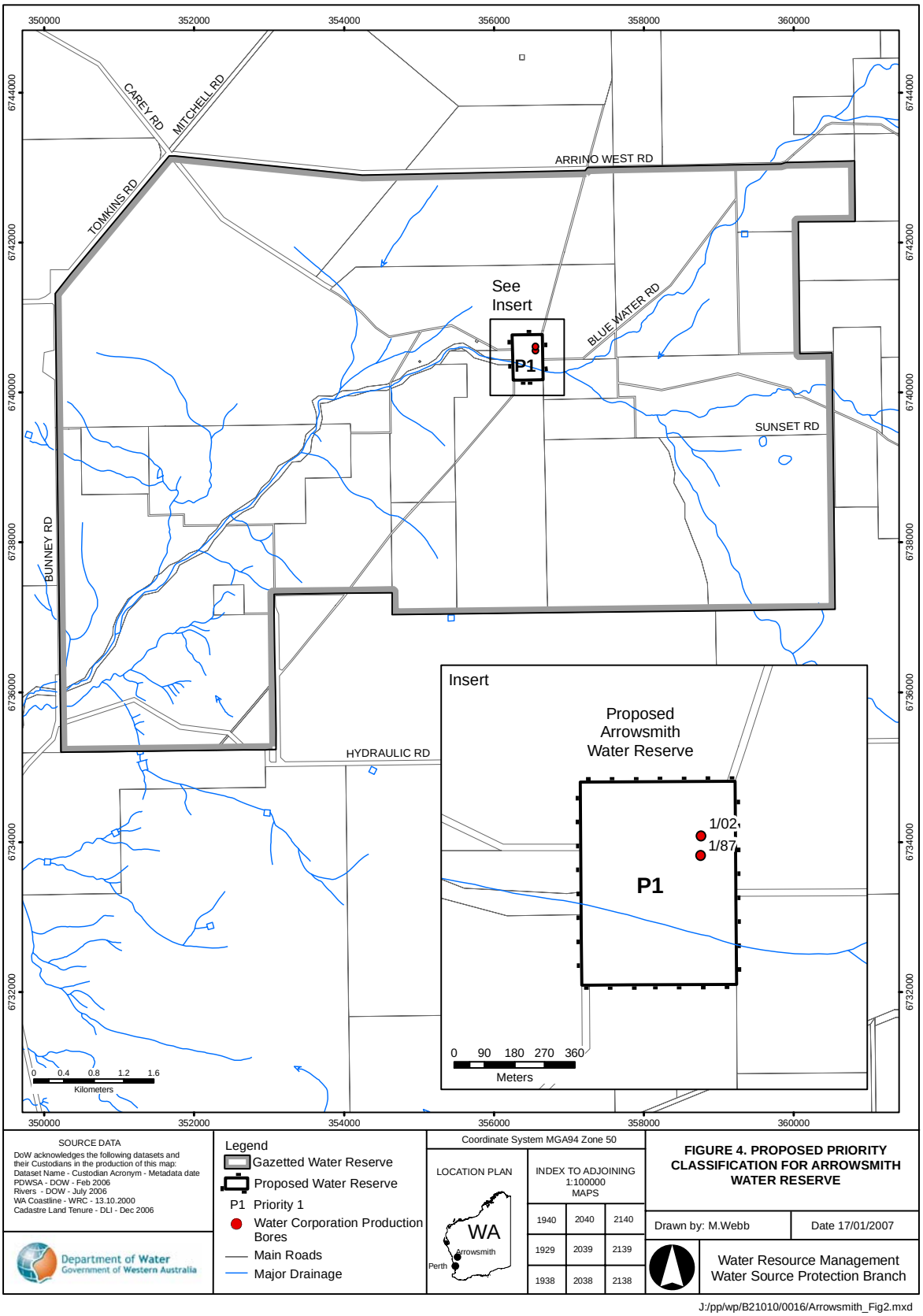


*Figure 4 Priority classification for Arrowsmith Water Reserve*

## 4.4 Land use planning

It is recognised under the State Planning Strategy (Western Australian Planning Commission, 1997) that the establishment of appropriate protection mechanisms in statutory land use planning processes is necessary to secure the long-term protection of drinking water sources. As outlined in *Statement* of Planning Policy No.2.7 *Public Drinking Water Source Policy* (Western Australian Planning Commission, 2003) it is therefore appropriate that the proposed Arrowsmith Water Reserve be recognised in the Shire of Three Springs' Town Planning Scheme. Any development proposals within the Arrowsmith Water Reserve that are inconsistent with the Department of Water's Water Quality Protection Note *Land Use Compatibility in Public Drinking Water Source Areas* should be referred to the Department of Water for advice and recommendations.

## 4.5 Best management practices

The adoption of best management practices for land uses will continue to be encouraged to help protect water quality. On freehold land, the Department of Water aims to work with landowners to achieve best management practices for water quality protection through the provision of management advice, and assistance to seek funding if required.

There are guidelines available for many land uses in the form of industry codes of practice, environmental guidelines or Water Quality Protection Notes. These have been developed in consultation with stakeholders such as industry groups, producers, state government agencies and technical advisers. Examples include *Agriculture – dryland crops near sensitive water resources* and *Stockyards*, which are listed in the References. The guidelines help managers reduce the risk of their operations causing unacceptable environmental impacts. They are recommended as best practice for water quality protection.

Education and awareness (eg signage and information material) is a key mechanism for water quality protection, especially for those people visiting the area who are unfamiliar with the Arrowsmith Water Reserve. A brochure will be produced once this Plan is endorsed, describing the Arrowsmith Water Reserve, its location and the main threats to water quality protection. This brochure will be made available to the community and will serve to inform people in simple terms about the drinking water source and its protection.

## 4.6 Surveillance and By-law enforcement

The quality of public drinking water sources within country areas of the State is protected under the *Country Areas Water Supply Act (1947)*. Declaration of these areas allows existing By-laws to be applied to protect water quality.

The Department of Water considers By-law enforcement, through on-ground surveillance of land use activities in Public Drinking Water Source Areas as an important water quality protection mechanism.

Signs are erected around PDWSAs to educate the public and to advise of activities that are prohibited or regulated. This Plan recommends delegation of surveillance and By-law enforcement to the Water Corporation.

## 4.7 Emergency response

Escape of chemicals during unforeseen incidents and use of chemicals during emergency responses can result in water contamination. The Shire of Three Springs' Local Emergency Management Advisory Committee (LEMAC) through the Mid West-Gascoyne Emergency Management District should be familiar with the location and purpose of the Arrowsmith Water Reserve. A locality plan should be provided to the Fire and Rescue Services headquarters for the Hazardous Materials Emergency Advisory Team (HAZMAT). The Water Corporation should have an advisory role to any HAZMAT incident in the Arrowsmith Water Reserve.

Personnel who deal with WESTPLAN – HAZMAT (Western Australian Plan for Hazardous Materials) incidents within the area should have access to a map of the Arrowsmith Water Reserve.

## 4.8 Recommended protection strategies

Table 1 identifies the potential water quality risks associated with existing land uses within and surrounding the Arrowsmith Water Reserve and recommends protection strategies to minimise these risks.

Following publication of the final Arrowsmith Water Reserve Drinking Water Source Protection Plan, an Implementation Strategy will be drawn up based on the recommendations in Table 1. It will describe timeframes for the recommended protection strategies and identify responsible stakeholders. This is reflected in the Recommendations section of this plan.

*Table 1 Land use, potential water quality risks and recommended strategies*

| Land use / activity | Potential water quality risks | | Consideration for management | Current preventative measures | Recommended protection strategies |
|---|---|---|---|---|---|
| | **Hazard** | **Management priority** | | | |
| Broad Acre Cropping including:<br>• Wheat<br>• Lupins<br>• Barley<br>• Canola | Nutrients (nitrate) from fertiliser application<br><br>Pesticides | Low<br><br>Low | Cereal cropping is the dominant land use in the area. All farms would apply nitrogen and phosphorous with soil and plant testing often used to optimise application rates. A number of different herbicides are used in the area, including glyphosate, simazine and atrazine. Application rates are approximately 500 g per ha at seeding and 4 to 8 weeks later if required. Pesticides used include cypermethrin and alphamethrin. Application is usually via misting with rates ranging from 140 to 700 mL per ha.<br><br>The aquifer is confined in the vicinity of the bores (artesian). Elsewhere depth to the water table is typically greater than 60 m and unconfined to semi-confined in nature, with long groundwater travel times to the bores. | • Water quality monitoring<br>• Sealed bores and fenced bore compound<br>• Signage at wellfield<br>• Confined aquifer in the vicinity of bores | • Continuation of water quality monitoring program<br>• Best management practices as recommended in the DoW water quality protection note *Agriculture – dryland crops near sensitive water resources*<br>• Best management practices as recommended in *Statewide Policy No.2 Pesticide use in Public Drinking Water Source Areas* and PSC 88 *Use of Herbicides in Water Catchment Areas.* |
| ***Private land*** | | | | | |
| Broad Acre Grazing:<br>• Sheep<br>• Cattle | Nutrients (nitrate) from animal manure | Low | Sheep and cattle grazing is typically secondary to cropping in the area. Stocking rates are generally low. | • Water quality monitoring<br>• Sealed bores and fenced bore | *Acceptable activity*<br>• Best management practices<br>• Continuation of water |

| Land use / activity | Potential water quality risks | | Consideration for management | Current preventative measures | Recommended protection strategies |
|---|---|---|---|---|---|
| | **Hazard** | **Management priority** | | | |
| | Pesticides | Low | The aquifer is confined in the vicinity of the bores (artesian), elsewhere depth to the water table is typically greater than 60 m and unconfined to semi-confined in nature.<br><br>Pathogens from stock have not been considered a risk due to the distance to groundwater, semi-confined nature of the aquifer, long groundwater travel times to the bores and low stocking rates. | compound<br>• Signage at wellfield<br>• Confined aquifer in the vicinity of bores | quality monitoring program. |
| Cattle Feedlot | Nutrients (nitrate) from cattle manure<br><br>Pesticides | Low<br><br>Low | Nebru Plains, a 2755 ha Department of Environment and Conservation licensed feedlot is located along Nebru Road, 10 km south of the wellfield. The feedlot is licensed to carry 10000 head of cattle. There may be localised contamination of the aquifer due to intensive land use however, Department of Environment and Conservation licence conditions, distance to groundwater and the separation distance of the feedlot from the wellfield, are considered to significantly mitigate the risks to drinking water quality.<br><br>Guidelines jointly prepared by the Department of Agriculture WA and DoE for Beef Cattle Feedlots provide best | • Water quality monitoring<br>• Distance to bores<br>• Department of Environment and Conservation Licence<br>• Sealed bores and fenced bore compound | *Acceptable activity*<br>• Best management practices as recommended in the DoW water quality protection note S*tockyards* and Dept of Agriculture and DoE *Guidelines for the Environmental Management of Beef Cattle Feedlots in Western Australia*<br>• Continuation of water quality monitoring program. |

| Land use / activity | Potential water quality risks | | Consideration for management | Current preventative measures | Recommended protection strategies |
|---|---|---|---|---|---|
| | **Hazard** | **Management priority** | | | |
| | | | environmental management practice options for the industry.<br><br>Pathogens from stock have not been considered a risk due to distance to groundwater and the semi-confined nature of aquifer in the vicinity of the feedlot. | | |
| Farm Residences | Nutrients from septic systems | Low | There are very few farm residences in the area surrounding the Water Reserve, with the closest located more than 1.3 km from the wellfield.<br><br>Pathogens from septics have not been considered a risk due to the distance to groundwater and the semi-confined nature of the aquifer in the vicinity of the residences. | • Water quality monitoring<br>• Distance to bores<br>• Sealed bores and fenced bore compound<br>• Signage at wellfield | *Acceptable activity*<br>• Continuation of water quality monitoring program. |
| Farm Infrastructure | Hydrocarbons from fuel leaks or spills<br><br>Pesticides from leaks or spills<br><br>Nutrients from fertiliser leaks or spills | Low<br><br>Low<br><br>Low | There is limited farm infrastructure in the area surrounding the Water Reserve, with the closest located more than 1.3 km from the wellfield. Significant spills and leaks of hydrocarbons, pesticides or fertiliser are expected to be rare. | • Water quality monitoring<br>• Distance to bores<br>• Signage at wellfield<br>• Dangerous Goods Storage requirements for bulk fuel and chemicals | *Acceptable activity*<br>• Best management practices<br>• Continuation of water quality monitoring program. |

| Land use / activity | Potential water quality risks | | Consideration for management | Current preventative measures | Recommended protection strategies |
|---|---|---|---|---|---|
| | **Hazard** | **Management priority** | | | |
| ***Crown land*** | | | | | |
| Roads | Hydrocarbons from accidents or leaks<br><br>Pesticides from accidents or leaks<br><br>Nutrients from accidents or leaks | Low<br><br>Low<br><br>Low | Bulk haulage on roads in the area is mainly associated with servicing farms i.e. haulage of grain, fertiliser and chemicals. Accidents and spills are rare with the Local Emergency Management Advisory Committee (LEMAC) responding to incidents.<br><br>The aquifer is confined in the vicinity of the bores, with long groundwater travel times to the bores. | • Water quality monitoring<br>• Sealed bores and fenced bore compound<br>• Signage at wellfield<br>• LEMAC response<br>• Confined aquifer in the vicinity of bores | *Acceptable*<br>• Continuation of water quality monitoring program<br>• Continuation of LEMAC response. |
| Shire sand pit | Hydrocarbons from fuel and oil spills | Low | The sand pit is located west of the bore compound, within the proposed reserve. It is used by the Shire to supply sand for construction to Eneabba. Approximately 80 tonnes of sand is extracted per year. The depth of the sand pit is currently 1 m below ground level. | • Water quality monitoring<br>• Signage at wellfield | *Acceptable with best management practices*<br>• Best management practices as recommended in *Statewide Policy No. 1 Policy and Guidelines for Construction and Silica Sand Mining in Public Drinking Water Source Areas*<br>• Continuation of water quality monitoring program. |

# 5 Recommendations

1 Implement the recommended protection strategies as detailed in *Table 1: Land use, potential water quality risks and recommended strategies* of this Plan *(Applicable stakeholders).*

2 The boundary of the Arrowsmith Water Reserve should be amended under the *Country Areas Water Supply Act (1947)* to encompass Crown Reserve 973 only *(Department of Water).*

3 Prepare an implementation strategy for this Plan describing responsible stakeholders and timeframes for the recommended protection strategies *(Department of Water).*

4 The Shire of Three Springs' Town Planning Scheme should incorporate this Plan and reflect the proposed Arrowsmith Water Reserve boundary and its' Priority 1 classification *(Shire of Three Springs).*

5 Applications to construct a bore and/or extract groundwater in close proximity to the Arrowsmith Water Reserve should be assessed to ensure that the bore is appropriately located. Best management practices should be recommended for the maintenance and construction of new or existing bores to prevent potential contamination or reduction in water availability to the public drinking water source bores (*Department of Water*).

6 Incidents covered by WESTPLAN – HAZMAT in the Arrowsmith water Reserve should be addressed through the following:

- The Mid West-Gascoyne LEMAC should be aware of the location and purpose of the Arrowsmith water Reserve.
- The locality plan for the Arrowsmith Water Reserve is provided to the Fire and Rescue headquarters for the HAZMAT Emergency Advisory Team.
- The Water Corporation provides an advisory role during incidents in the Arrowsmith Water Reserve.
- Personnel dealing with WESTPLAN – HAZMAT incidents in the area have ready access to a locality map of the Arrowsmith Water.

(*Department of Water, Water Corporation)*

7 Pursuant to Section 13(1) of the *Water and Rivers Commission Act (1995)*, the Department of Water should consider delegating responsibility for the surveillance and enforcement of the Arrowsmith Water Reserve to the Water Corporation (*Water Corporation*).

8 The signs located along the boundary of the Arrowsmith Water Reserve should be maintained to define the location and promote awareness of the need to protect drinking water quality. Signs should include an emergency contact telephone number (*Water Corporation*).

9 A full review of this Plan should be undertaken after five years (*Department of Water*)

# Appendices

## Appendix A - Water quality

The Water Corporation has monitored the raw (source) water quality from Arrowsmith Water Reserve in accordance with the Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health. The raw water is regularly monitored for:

a. **Aesthetic related characteristics**– (Non-Health Related)

b. **Health related characteristics**

- Health Related Chemicals
- Microbiological Contaminants

Following is data representative of the quality of raw water in Arrowsmith borefield. In the absence of specific guidelines for raw water quality, the results have been compared with ADWG values set for drinking water, which defines the quality requirements at the customers tap. Results that exceed ADWG have been shaded to give an indication of potential raw water quality issues associated with this source.

It is important to appreciate that the raw water data presented does not represent the quality of drinking water distributed to the public. Barriers such as storage and water treatment, to name a few, exist downstream of the raw water to ensure it meets the requirements of ADWG. For more information on the quality of drinking water supplied to Morawa, Arrino, Perenjori, Caron, Bunjil and Latham refer to the most recent Water Corporation Drinking Water Quality Annual Report at <http://www.watercorporation.com.au/W/waterquality_annualreport.cfm?uid=2377-9937-9579-7091>.

**Aesthetic Related Characteristics**

Aesthetic water quality analyses for raw water from Arrowsmith borefield are summarised in Table 1.

The values are taken from ongoing monitoring for the period January 2002 to May 2007. All values are in milligrams per litre (mg/L) unless stated otherwise. Any water quality parameters that have been detected are reported, those that have on occasion exceeded the ADWG are shaded.

*Aesthetic related detections for Arrowsmith borefield*

| Parameter | Units | ADWG Aesthetic Guideline Value* | Range of Monitored Values<br>Min-Max<br>Med | | |
|---|---|---|---|---|---|
| | | | Borefield Raw Source | Bore 1/02 | Bore 1/87 |
| **Aluminium unfiltered** | mg/L | na | <0.008 - 0.028<br><0.008 | <0.008<br><0.008 | <0.008 - 0.28<br><0.008 |
| **Chloride**† | mg/L | 250 | 285 - 290<br>287.5 | 255 - 300<br>272.5 | 265 - 295<br>270 |
| **Colour - True** | TCU | 15 | <1 - 2<br><1 | <1<br><1 | <1<br><1 |
| **Conductivity at 25ºC** | mS/m | na | 68 - 120<br>105 | 93 - 135<br>104 | 93.4 - 112<br>104.3 |
| **Hardness as $CaCO_3$**† | mg/L | 200 | 64 - 65<br>64.5 | 55 - 68<br>60 | 60 - 68<br>62 |
| **Iron unfiltered** | mg/L | 0.3 | <0.003 - 0.104<br>0.004 | 0.006 - 0.42<br>0.275 | <0.003 - 0.34<br>0.045 |
| **Manganese unfiltered** | mg/L | 0 - 0.1 | 0.06 - 0.09<br>0.075 | 0.05 - 0.085<br>0.0725 | 0.06 - 0.085<br>0.075 |
| **pH** | - | 6.5 - 8.5 | 5.24 - 5.98<br>5.705 | 5.67 - 5.78<br>5.755 | 5.63 - 5.86<br>5.67 |
| **Sodium**† | mg/L | 180 | 175 - 180<br>177.5 | 165 - 190<br>182.5 | 170 - 190<br>175 |
| **Sulphate**† | mg/L | 250 | 41 - 44<br>42.5 | 40 - 47<br>43.5 | 41 - 45<br>42 |
| **TFSS**† | mg/L | 500 | 600 - 600<br>600 | 550 - 624<br>588 | 575 - 621<br>584 |
| **Turbidity** | NTU | 5 | <0.1 - 1<br><0.1 | <0.1 - 1.6<br><0.55 | <0.1 - 11<br><0.1 |

* An aesthetic guideline value is the concentration or measure of a water quality characteristic that is associated with good quality water.

† Water quality data observed from 5 or less sampling occasions

## Health Related Characteristics

## Health Parameters

Raw water from Arrowsmith borefield is analysed for health related chemicals including inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the source between January 2002 and May 2007 are summarised in the Table 2. Any parameters that have on occasion exceeded the ADWG are shaded.

*Health related detections for Arrowsmith borefield*

| Parameter | Units | ADWG Health Guideline Value* | Borefield Raw Source¥ | |
|---|---|---|---|---|
| | | | Range | Median |
| **Barium** | mg/L | 0.7 | 0.07 - 0.075 | 0.07 |
| **Boron** | mg/L | 4 | 0.12 - 0.14 | 0.12 |
| **Nitrite plus nitrate as N** | mg/L | 11.29 | 0.13 - 0.14 | 0.135 |

* A health guideline value is the concentration or measure of a water quality characteristic that, based on present knowledge, does not result in any significant risk to the health of the consumer over a lifetime of consumption (NHRMC & ARMCANZ, 1996).

¥ Water quality data observed from 3 or less sampling occasions

**Microbiological Contaminants**

Microbiological testing of raw water samples from Arrowsmith borefield is currently conducted on a monthly basis. *Escherichia coli* counts are used as an indicator of the degree of recent faecal contamination of the raw water from warm-blooded animals. A detection of *Escherichia coli* in raw water abstracted from any bore may indicate possible contamination of faecal material through ingress in the bore, or recharge through to the aquifer (depending on aquifer type).

During the reviewed period of January 2002 to May 2007, no positive *Escherichia coli* counts were recorded in any raw water samples collected from the borefield. This low occurrence of *Escherichia coli* detections is indicative of minimal contamination of the groundwater from faecal sources.

# Appendix B - Photographs

*Photo 1 Bore 1/87 and surrounding vegetation*

*Photo 2 Rural land use in the Arrowsmith region*

# Glossary

| | |
|---|---|
| **Abstraction** | The pumping of groundwater from an aquifer. |
| **ADWG** | The Australian Drinking Water Guidelines, outlining guideline criteria for the quality of drinking water in Australia. |
| **Aesthetic guideline** | NHMRC guideline level ascribed to acceptable aesthetic qualities of drinking water such as taste, smell, colour and temperature. |
| **Allocation** | The quantity of water permitted to be abstracted by a licence, usually specified in kilolitres per year (kL/a). |
| **ANZECC** | Australian and New Zealand Environment Conservation Council. |
| **Aquifer** | A geological formation or group of formations able to receive, store and transmit significant quantities of water. |
| **ARMCANZ** | Agriculture and Resource Management Council of Australia and New Zealand. |
| **Artesian** | An aquifer in which the water is under sufficient pressure to cause it to rise above the bottom of the overlying confining bed. An artesian well is free-flowing. |
| **Bore** | A narrow, lined hole, also known as a well, drilled to monitor or draw groundwater. |
| **Borefield** | A group of bores to monitor or withdraw groundwater. |
| **Catchment** | The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater. |
| **Confined aquifer** | An aquifer that is confined between non-porous rock formations (such as shale and siltstone) and therefore contains water under pressure. |
| **Dryland salinity** | Dryland salinity is caused by the removal of deep-rooted plants, trees, shrubs and grasses and their replacement with annual crops and pastures that don't use as much water. This results in a rise in the water table, which brings naturally occurring salt to the surface in a concentrated form. |
| **ha** | Hectares (a measure of area) |
| **HAZMAT** | Hazardous Materials |

| | |
|---|---|
| **Hydrogeology** | The study of groundwater, especially relating to the distribution of aquifers, groundwater flow and groundwater quality. |
| **kL** | Kilolitres (1000 litres) |
| **km** | Kilometres (1000 metres) |
| **LEMAC** | Local Emergency Management Advisory Committee |
| **m** | Metres |
| **mg/L** | Milligrams per litre (0.001 grams per litre) |
| **ML** | Megalitres (1 000 000 litres) |
| **mm** | Millimetres |
| **MPN** | Most probable number (a measure of microbiological contamination). |
| **NHMRC** | National Health and Medical Research Council. |
| **NTU** | Nephelometric turbidity units are a measure of turbidity in water. |
| **Nutrients** | Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorous (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules. |
| **Pesticides** | Collective name for a variety of insecticides, fungicides, herbicides, algicides, fumigants and rodenticides used to kill organisms. |
| **Public Drinking Water Source Area (PDWSA)** | Includes all underground water pollution control areas, catchment areas and water reserves constituted under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*. |
| **Recharge** | Water infiltrating to replenish an aquifer. |
| **Recharge area** | An area through which water from a groundwater catchment percolates to replenish (recharge) an aquifer. An unconfined aquifer is recharged by rainfall throughout its distribution. Confined aquifers are recharged in specific areas where water leaks from overlying aquifers, or where the aquifer rises to meet the surface. |
| **Run-off** | Water that flows over the surface from a catchment area, including streams. |
| **Scheme supply** | Water diverted from a source or sources by a water authority of private |

| | |
|---|---|
| | company and supplied via a distribution network to customers for urban, industrial or irrigation use. |
| **TCU** | True colour |
| **Treatment** | Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment. |
| **Water quality** | The physical, chemical and biological measures of water. |
| **Water Reserve** | An area proclaimed under the *Country Areas Water Supply Act 1947* or the *Metropolitan Water Supply Sewerage and Drainage Act 1909* for the purposes of protecting a drinking water supply. |
| **Watertable** | The upper saturated level of the unconfined groundwater. |
| **Well field** | A group of bores to monitor or withdraw groundwater. |
| **Wellhead** | The top of a well (or bore) used to draw groundwater. |
| **WESTPLAN HAZMAT** | Western Australian Plan for Hazardous Materials. |

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