JANDAKOT UNDERGROUND WATER POLLUTION CONTROL AREA
DRINKING WATER SOURCE PROTECTION REVIEW

INTEGRATED WATER SUPPLY SCHEME

WATER CORPORATION

2006

Acknowledgements

This REVIEW was prepared by the Infrastructure Planning Branch of the Water Corporation at the request of the Department of Water.

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Cover Photograph: Urban swamp in Jandakot UWPCA (taken David Boyd)

Purpose of this Review

A safe drinking water supply is critical to the wellbeing of the community. Effective catchment protection is fundamental to minimising risks to public health and the cost of supplying water to consumers.

This document presents a review of the risks to water quality in Jandakot Underground Water Pollution Control Area. It is part of the ongoing process of protecting the quality of the public groundwater supply drawn from the Control Area.

The Water Corporation is committed to supplying the safest drinking water to its customers that is practicable. It recognises protecting Public Drinking Water Source Areas (PDWSAs - i.e. surface water catchments and groundwater reserves) is the most critical component of its Drinking Water Quality Management System. Statutory responsibility for managing PDWSAs in Western Australia belongs to the Department of Water (formerly the Water and Rivers Commission) and for public health with the Department of Health (DoH). The Water Corporation, as water service provider, has a responsibility to work with both organisations to protect drinking water supplies.

The Australian Drinking Water Guidelines (ADWG), developed by the National Health and Medical Research Council, provides a framework for management of drinking water quality, and proposes a multiple barrier ('catchment to consumer') approach as the most effective method of protecting drinking water. Management of the drinking water source catchment is considered the first important barrier and involves:

- Understanding the catchment, and the hazards and events that can compromise drinking water quality; and
- Developing and implementing preventive strategies and operational controls necessary for assuring the safest possible raw water supply (i.e. before treatment).

Western Australia is meeting the ADWG framework by producing Drinking Water Source Protection Plans (DWSPP) for each PDWSA and undertaking review of the risks on a regular basis (currently every 5 years).

The Department of Water requested the Corporation undertake a review of risks and prepare this review document because it is the licensed water service provider for the Integrated Water Supply Scheme, which includes supply from the Jandakot groundwater system. The Corporation has a good understanding of the water quality issues in the Control Area and a strong desire to ensure water quality is protected. The initial assessment of the Jandakot Underground Water Pollution Control Area was completed in 1995 with the release of the Jandakot Land Use and Water Management Strategy.

With the completion of this review, it is essential that water managers continue with and improve upon catchment preventive and management strategies and further develop and implement protection measures to ensure ongoing availability of good quality drinking water. Planning and other land use decision-makers should continue to recognise the significance of drinking water catchments in the decisions they make.

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1 Water supply system overview

Jandakot Underground Water Pollution Control Area (UWPCA – also referred to as the Control Area) is located in the southern suburbs of the Perth Metropolitan Region of Western Australia, about 20 km south of the Central Business District (refer to Figure 1). The UWPCA defines the area of the Jandakot Mound groundwater system that provides public water supply as part of the Integrated Water Supply Scheme (IWSS).

Jandakot UWPCA has an area of about 74 km^2 and is located within the Cities of Canning, Cockburn, Gosnells, Armadale, the Town of Kwinana and the Shire of Serpentine - Jarrahdale.

1.1 Existing water supply system

Groundwater is obtained from regional freshwater aquifers within the Quaternary superficial sediments and Cretaceous sandstones of the Leederville Formation.

Stage 1 of the Jandakot wellfield was commissioned in 1979. Stage 2 was completed in 1993. The scheme currently consists of 26 production bores that draw water from the locally recharged shallow superficial formations aquifer and 2 production bores drilled into the deeper confined Leederville Formation aquifer (refer to Figure 2). Raw water is transferred via collector mains to the Jandakot Groundwater Treatment Plant and then pumped to a service reservoir for distribution in the IWSS (Miotti, In prep.). There is provision to further increase capacity of the scheme by constructing a third stage, consisting of 11 bores, in the southern sector of the Control Area.

1.2 Water treatment

Raw water from the Jandakot wellfield is clarified, filtered, dosed with alum, polyelectrolyte and sodium hydroxide, chlorinated and fluoridated at the Jandakot Groundwater Treatment Plant.

Photo. 1 Jandakot bore J360 (Stargate Shopping Centre in background)

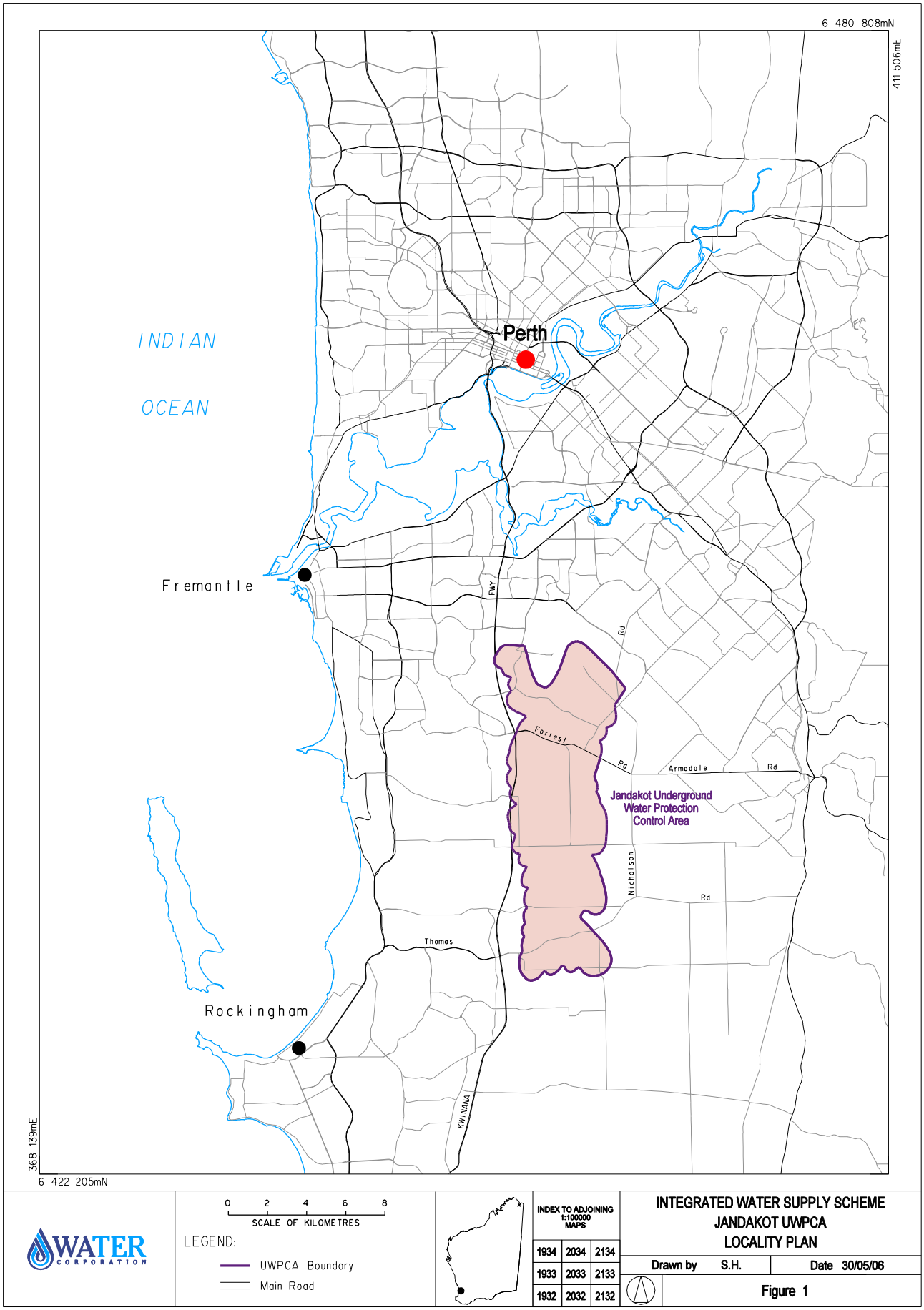

Figure 1 Jandakot UWPCA Locality Plan

1.3 Catchment details

1.3.1 Physiography

The physiography of the Jandakot UWPCA is dominated by the coastal dune system of the Swan Coastal Plain (Davidson, 1995). In the Jandakot area it is characterised by the gently undulating quartz sand plains of the Bassendean Dune System, which range from 10 to 40 m AHD in elevation. Several wetlands occupy the shallow depressions in the land surface and comprise swamp and lacustrine deposits of peat, peaty clay and clay. A small area of Guildford Clay exists on the central eastern boundary of the UWPCA.

Natural vegetation within the Control Area is variable and contains areas of Jarrah-Sheoak-Banksia woodlands on the dunes and Melaleuca sedgelands in the swamps. Large areas have been cleared for rural and urban habitation and contain very little natural vegetation (WAWA, 1991).

1.3.2 Climate

The area has a Mediterranean climate, characterised by hot, dry summers with mild, wet winters.

The long-term average annual rainfall for the Jandakot area is about 830 mm. Most rain results from winter cold front systems that cross the south west of Western Australia between May and October.

1.4 Hydrogeology

Jandakot Mound is located within the southern area of the Dandaragan Trough, in the central part of the Perth Sedimentary Basin (Davidson, 1995). The Quaternary superficial sediments of the mound within the Control Area comprise Bassendean Sands underlain by the Osborne Formation, Leederville Formation, South Perth Shale, Gage Formation, Yarragadee Formation and Cattamarra Coal Measures.

The Jandakot groundwater system draws water from the unconfined aquifer within the superficial formations and the confined Leederville Formation aquifer. The superficial aquifer has a saturated thickness of about 40 metres in the Jandakot area and production bores are drilled between 40 and 63 metres deep. The two Leederville production bores are 217 and 242 metres deep.

In the superficial formations, groundwater flows radially from the crest of the mound discharging into Lake Forestdale, Karnup Drain, Canning River, Swan River and the Indian Ocean (Davidson, 1995). Groundwater flow in the Leederville Formation is westerly to the ocean where it discharges offshore on the ocean floor. Recharge to the superficial aquifer occurs by direct infiltration of rainfall. The Leederville aquifer is recharged to the east of the Control Area where it subcrops beneath the superficial formations adjacent to the Darling Scarp.

Department of Water is currently reassessing sustainable yield of the wellfield. Until the assessment is complete the present annual licensed allocation of 9 812 Megalitres (ML) is considered to be the nominal sustainable yield.

The superficial aquifer at Jandakot is extremely vulnerable to contamination from inappropriate land uses because of the direct recharge that occurs from rainfall across the whole Control Area and the shallow depth to the water table.

1.5 Future water supply requirements

By 2050, it is estimated the IWSS will be required to provide for a demand of about 455 Gigalitres (GL) /year based on a projected population in the order of 2.4 million (Fisher, 2005). The source capacity required to meet this demand is expected to be about 500 GL/year of which groundwater sources could provide about 220 GL/year. Current yield of all existing sources is rated as low as 256 GL/year, based on the "drier 8-year climate and streamflow regime" (1997-2005).

A number of options are being considered by the Water Corporation to meet demand. Short term proposals include construction of a seawater desalination plant (45 GL/year), water trading with Harvey Water (17 GL/year) and development of the South West Yarragadee wellfield (45 GL/year). Commissioning of these options is expected to meet demand until 2017/18. The proposed third stage of the Jandakot groundwater scheme is not one of the options expected to proceed in the short term.

The most likely longer term options for meeting demand to 2050 are development of additional groundwater and surface water sources, desalinated seawater, and use of treated wastewater, drainage water and stormwater.

1.6 Protection and allocation

1.6.1 Existing water source protection

Jandakot Underground Water Pollution Control Area was proclaimed in 1975 under the *Metropolitan Water Supply Sewerage and Drainage Act 1909* for the purpose of protecting the public drinking water source of the Jandakot Mound. It was amended in 2000 following the recommendations of a number of State Government assessments and reports on the impact of Metropolitan development on groundwater supplies. These included:

- Parliamentary Select Committee on Metropolitan Development and Groundwater Supplies (WA Legislative Assembly, 1994)
- Jandakot Land Use and Water Management Strategy (WAPC, 1995)
- Review of Groundwater Protection Priority Area Boundaries Jandakot Mound (Dames & Moore, 1996)
- Jandakot Groundwater Protection Policy - Statement of Planning Policy No.2.3 (WAPC, 1998)
- Metropolitan Region Scheme Amendment 981/33 'Rural - Water Protection' Zone (WAPC, 1998)

The UWPCA is shown in Figure 2. It is divided into planning precincts that reflect the land planning zones in the six local government areas within the UWPCA.

In response to Recommendation 4 of the Select Committee report into groundwater supplies, a study was undertaken to redefine the UWPCA boundary using the most current internationally accepted groundwater modelling software. Priority classifications of Priority 1 (P1), Priority 2 (P2) and Priority 3 (P3) were then assigned to land within the UWPCA as per the recommendations of the Jandakot Land Use and Water Management Strategy. The strategy provided a policy framework for promoting development consistent with protection and management of the groundwater system and key environmental values for the Jandakot Mound. Following release of the strategy and the redefining of the UWPCA boundary and assignment of priority classifications, the groundwater protection policy was produced to set out the principles for ensuring land use changes are compatible with the long-term protection of groundwater for public supply. At the completion of an extensive stakeholder and community consultation process the policy was adopted and the Metropolitan Region Scheme (MRS) was amended to add Water Catchments reservations over P1 areas and to include a new land planning zone (Rural – Water Protection) to protect P2 areas within the UWPCA.

1.6.2 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*. This Act requires a licence to draw water from surface water and groundwater areas proclaimed under the Act (except for domestic and stock use) and all artesian wells throughout the State.

Jandakot Groundwater Area was proclaimed in 1996 under the *Rights in Water and Irrigation Act 1914* to allocate groundwater resources and to manage sustainable use of the Jandakot Mound. It was also proclaimed in 1975 as a Public Water Supply Area under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909*. The 1996 proclamation occurred with the formation of the then Water and Rivers Commission (now Department of Water) and reflected the same area as proclaimed in 1975.

The Water Corporation is licensed by Department of Water to nominally draw 9 812 ML/year from the Jandakot groundwater system as part of the public drinking water supply for the IWSS. The allocation is made up of 7 850 ML/year from the superficial formation aquifer and 1 962 ML/year from the Leederville Formation aquifer. Annual quotas are negotiated with the Department of Water and based on storage capacity of the IWSS surface water sources and levels within the groundwater systems. The quota from Jandakot wellfield for 2004/05 was 5 700 ML and annual production was just over 4 900 ML.

2 Water quality

The quality of raw water from the Jandakot wellfield is monitored in accordance with the Australian Drinking Water Guidelines (ADWG) and the program set out in the IWWS Water Resource Management Operation Strategy (Miotti, In prep.). It is regularly monitored for microbiological contamination, health related chemicals and aesthetic chemicals and parameters.

The ADWG gives guidance on the quality of water that should be provided to consumers at the point of use.

Raw water from Jandakot wellfield has consistently been of good quality, and with the exception of iron and colour, has generally met ADWG values. Monitoring results indicate observed values are within the naturally occurring range for this locality and no trends are evident. There have been no positive thermotolerant coliform counts and no detection of nitrate at the Jandakot Groundwater Treatment Plant raw water sampling point. This indicates there has not been any pathogen or nutrient contamination of the wellfield, despite a large percentage of the Control Area being privately owned.

Wellfield salinity can be variable and is dependant upon the proportion of supply being drawn from the superficial and Leederville aquifer bores. While the average salinity from the superficial aquifer is under 400 mg/L Total Dissolved Solids (TDS), it is closer to 1 000 mg/L from the Leederville aquifer. In recent years, about 20% of the supply has come from Leederville bore J45, resulting in an average salinity of about 600 mg/L at the Jandakot raw water sampling point, which is slightly above the ADWG value of 500 mg/L.

Low levels of barium and boron occur naturally in the superficial aquifer. Traces of arsenic have also been detected in two of the bores (J320 and J410). Readings observed in bore J410 are marginally above the ADWG value. Occurrence of arsenic at these levels may be just natural variation within the aquifer, but there are a few industrial activities nearby that may require assessment to determine their potential to be sources of arsenic.

All other chemical components are generally within guideline values. However, there are occasions when some of the bores have displayed elevated levels of hardness (as $CaCO_3$) and aluminium. These variations relate to natural occurrence and are not a result of land use impacts.

Summary details of water quality from Jandakot wellfield are shown in Appendix 2.

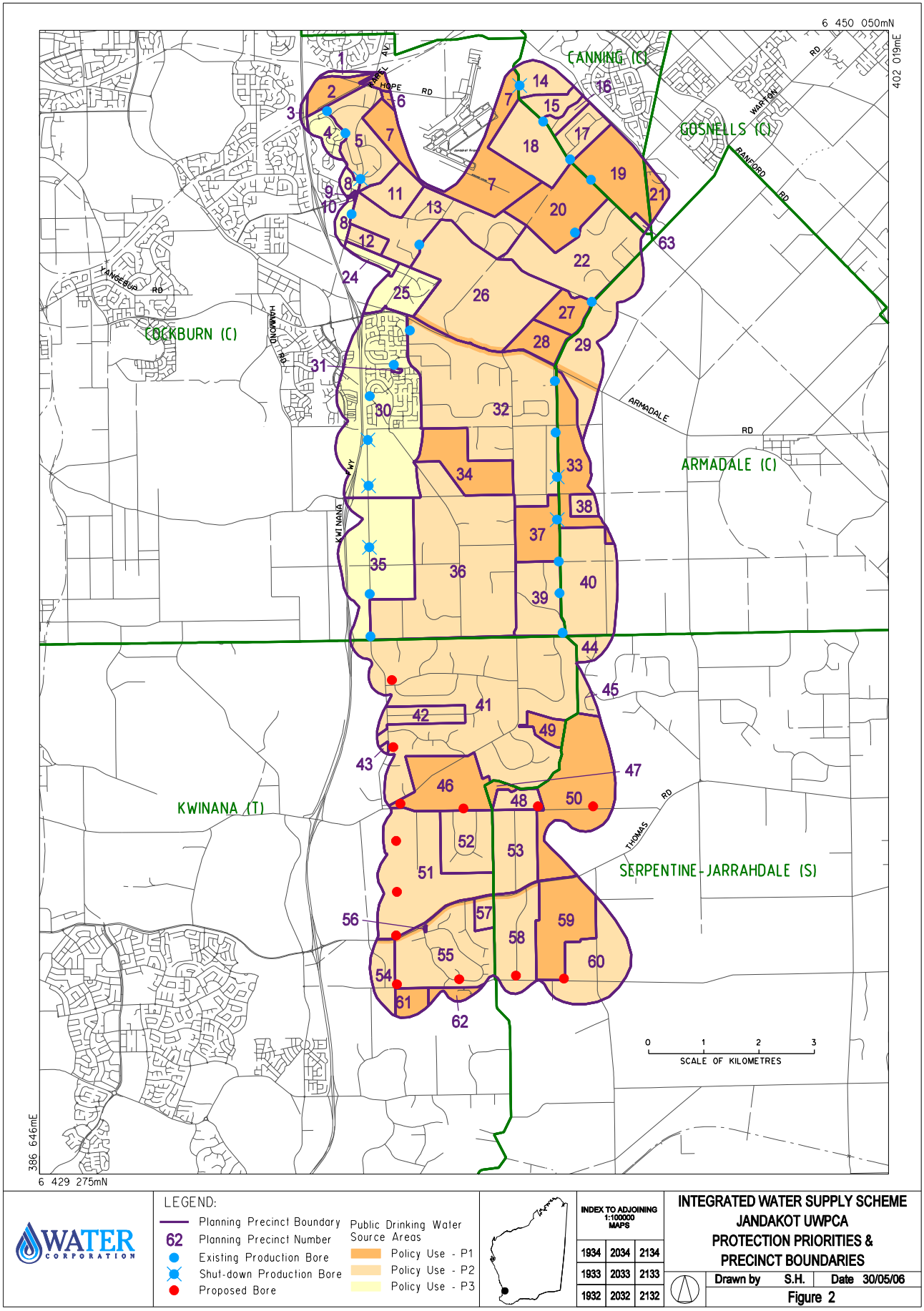

Figure 2 Jandakot UWPCA protection priorities and precinct boundaries

3 Hazard identification and risk assessment

Hazards associated with existing and proposed land uses and activities in the Control Area have been identified as part of the review process. The risk posed by each hazard has been assessed and a catchment management priority of *High, Medium* or *Low* assigned.

The priority level assigned to identified hazards was determined by assessing the likelihood and consequences of the source being contaminated, taking into account current catchment preventive and management strategies. The risk assessment process was conducted in accordance with ADWG 2003 recommendations. All identified hazards were rated against a risk scale of severe, high, major, significant, moderate, low or trivial. Hazards considered a severe or high risk are assigned a high catchment management priority, those considered to be a major or significant risk were given a medium priority, and those with a moderate, low or trivial risk rated a low priority. Department of Water is preparing a document to further explain risk assessment in drinking water catchments. It will soon be available on its website at www.drinkingwater.water.wa.gov.au.

Potentially hazardous land uses and activities are shown in Figure 3 and land uses in planning precincts assigned a high or medium catchment management priority are described in Table 1.

3.1 Land use identification

Information about land uses within the Control Area was compiled from a number of sources. Data was obtained from existing agency and corporate land and water databases, geographic information systems and aerial photography, and added to by undertaking broad scale property surveys and on-site inspection of selected sites. All the information was brought together into a single database, the Land Use Database. Department of Water will use the database as a management tool in the future development of water protection policies and strategies. Water Corporation will incorporate the database into routine operational procedures so water supply operators will have ready access to the data and be able to easily input new information about changes in land uses and activities.

3.2 Land use assessment

Jandakot UWPCA covers four land planning zones within six local government agency boundaries. It also includes Crown Land reserves for Parks and Recreation and for Public Purposes, which are overlain with the Water Catchments reservations.

The majority of the land is in private ownership (77%) and a large portion of the reserved land is incorporated in the Jandakot Regional Park.

Industrial, urban and urban-deferred zoned land is confined to the north western edge of the UWPCA. Private land in the rest of the control area has a Rural - Water Protection zoning.

Risks posed by hazards associated with land uses have been assessed for each of the land planning zones and reserved land categories.

3.2.1 Industrial land

The Industrial zone covers about 1% of the UWPCA, within a Priority 3 (P3) protection area on the north western edge of the Control Area. Many of the land uses within the zone are considered a medium catchment management priority because they pose either a major or significant contamination threat through the possible leakage of stored fuels and chemicals. The potential for an overflow from a Water Corporation sewerage pump station is considered a significant risk and is also rated a medium management priority.

A small goods and meat manufacturer in Knock Place presents a high risk because of its potential to cause pathogen contamination. It is unsewered and therefore rated a high management priority.

Photo. 2 **Motor vehicle repair salvage yard – Jandakot Industrial Area**
Industrial Zone Precinct 25

Photo. 3 **Residential subdivision – Atwell**
Urban Zone Precinct 30

3.2.2 Urban land

About 10% of the UWPCA is zoned Urban. The suburb of Atwell, the Glen Iris estate in Jandakot and parts of Banjup and Success are included in the zone. These urban areas run along the western flank of the Control Area and are located within the City of Cockburn.

Potential overflows from the Water Corporation's Beenyup Rd sewerage pump station are considered the major risk to groundwater quality in the urban area and are rated a medium catchment management priority. Fertiliser and pesticide use on Glen Iris Country Club golf course pose a significant risk. The golf course is within the wellhead protection zones of a number of public water supply bores and the hazards also present a medium management priority. The risk of contamination from fertiliser application at Atwell Primary School is also rated a medium management priority.

There is some potential for chemical contamination from a photo processor located in the shopping centre on Berrigan Drive Jandakot and it is considered a major risk. Other shops within the complex pose a significant risk because they are not sewered. Overall, the shopping complex is rated a medium management priority.

Residential properties in the new subdivisions are sewered and are an acceptable land use in P3 areas, although there is significant potential for contamination from fertiliser application and from spills of stored fuels or chemicals. Parks within the residential areas are a potential risk because of the application of pesticides and fertilisers. Overall, the residential areas are rated a medium catchment management priority.

3.2.3 Urban Deferred land

The Urban Deferred zone, previously part of Banjup, included a piggery, two market gardens and several stables. The area is being redeveloped as part of the residential suburb of Aubin Grove. The piggery and market gardens are currently being dismantled in preparation for urbanisation, but the sites may still pose a risk to groundwater quality if rehabilitation has not been adequate to alleviate any residual contamination. These sites and the newly developed residential properties are located in the wellhead protection zones for production bores J230 and J240. The few stables that remain are rated a medium management priority because of the possible risk from pathogen and nutrient contamination. Some lots are still used for rural living and pose a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals and are also rated a medium management priority.

3.2.4 Rural - Water Protection land

The Rural - Water Protection zone covers 65% of the Control Area. There are in the order of 30 different types of land uses that potentially pose either a severe, high, major or significant risk to groundwater quality. The greatest hazard is pathogens associated with faecal waste from several poultry farms, stockpiling of manures in what remains from a past soil blending operation, and waste deposited in a Class 1 landfill. These operations are all considered severe risks and are incompatible land uses within a Priority 2 (P2) area. They have been rated a high catchment management priority.

Fertiliser application on a large number of intensive agricultural sites provides a potential source of nutrient contamination and is considered a high risk and rated a high management priority. Operations include several market gardens, orchards, plant and seed production nurseries, a turf farm, a tree farm and a vineyard. One of the sites has a scrap metal dump, another several old car bodies, one property undertakes vehicle servicing and stockpiles manures, another appears to have a large distribution business, and a number of properties have stored chemical containers, all of which provide additional potential for contamination.

A group of service industry businesses in Jandakot are high risk operations because of the potential threat from pesticide, hydrocarbon and chemical contamination. They are able to continue as pre-existing non-conforming land uses in a P2 area despite being incompatible under current policy. A soil landscaping business and a farm supply centre pose a risk of nutrient contamination from storage of fertilisers.

Photo. 4 **Glen Iris Country Club golf course – Jandakot Urban Zone Precinct 4**

Photo. 5 **Plant production nursery - Forrestdale Rural Water Protection Zone Precinct 38**

Fertiliser and pesticide use on Marri Park Golf Course poses a high risk because the shallow depth to the water table. Development approval for construction of a service station at a nearby site should be opposed because of the shallow water table and its incompatibility with water quality protection in a P2 area.

There are numerous land uses within the Rural Water Protection zone that pose either a major or significant risk to groundwater quality, which are rated medium catchment management priorities. Properties with stock grazing, catteries, dog kennels, equestrian centres, stables and feedlots have the potential to cause pathogen and nutrient contamination from animal excreta. A number of industry based activities within the zone provide potential for hydrocarbon and chemical contamination. Other land uses include a fertiliser manufacturer and several retail nurseries that could leach fertiliser and pesticides, a tavern, which is a potential source of pathogens and nutrients, and a number of shops, an electric power transmission right-of-way and a warehouse that provide a threat of hydrocarbon and chemical contamination.

Large areas of the Rural – Water Protection zone comprise lots used for rural, semi-rural and special rural living that pose a significant threat because of fertiliser use and possible leakage of stored fuels and chemicals and are rated a medium management priority. There is increasing pressure to subdivide these rural properties into the minimum lot size of 2 ha. This level of intensification is a conditional land use in P2 areas and land planning agencies are required to ensure future development does not increase risk of pollution to groundwater in accordance with the principal of risk minimisation that applies to P2 areas.

3.2.5 Parks and Recreation

The majority of the Parks and Recreation reserved land is incorporated in a series of estates comprising nature reserves and parks. These estates collectively form the Jandakot Regional Park where current activities pose little risk to groundwater quality.

A horse and pony club and trotting training centre on Denis De Young Reserve and the Magenup Equestrian Centre have potential to cause pathogen and nutrient contamination and are considered major risks. These facilities are pre-existing non-conforming land uses in a Priority 1 (P1) area that would be incompatible under current policy. The sites are rated medium catchment management priorities because they overlie a shallow water table and club and training centre are in the wellhead protection zone for production bore J40.

One property in Taylor Rd, still used for stock grazing, poses a significant risk from potential pathogen and nutrient contamination and is considered a medium management priority. A fire brigade station, which poses a major risk of contamination from fuel spills and a rifle range and sand quarry that are considered significant risks from potential leakage of fuels and chemicals, are all rated medium management priorities.

3.2.6 Public Purposes

The majority of the Public Purpose reserved land is located within the City of Cockburn and covers the flight paths for Jandakot Airport. These areas mostly comprise uncleared bushland where little activity occurs. Other Public Purpose land includes the old Bibra Lake Speedway and some vacant land in Warton Road Banjup, which are considered to pose a major risk to water quality. Perth TQ Car Club is based at the speedway site. It is a potential source for fuel spills and is a non-conforming use in a P1 area that is rated a medium catchment management priority. Records indicate there may be potential for contamination from past activities on the two Warton Road lots, and these sites are rated a medium priority.

A rifle range, Western Power and Alinta Gas depots and a sand quarry are considered to pose a significant risk from potential leakage of fuels and chemicals and are also rated a medium management priority.

3.2.7 Formed roads

There is an extensive network of formed roads throughout the Control Area and their use poses a significant risk from potential leakage of fuels and chemicals if a road accident was to occur. Although the likelihood of contamination occurring is low, confirmation there is a well prepared and widely distributed emergency response plan in place is considered a medium management priority.

Photo. 6 **Poultry farm - Jandakot**
Rural Water Protection Zone Precinct 32

Photo. 7 **Stock grazing - Jandakot**
Rural Water Protection Zone Precinct 32

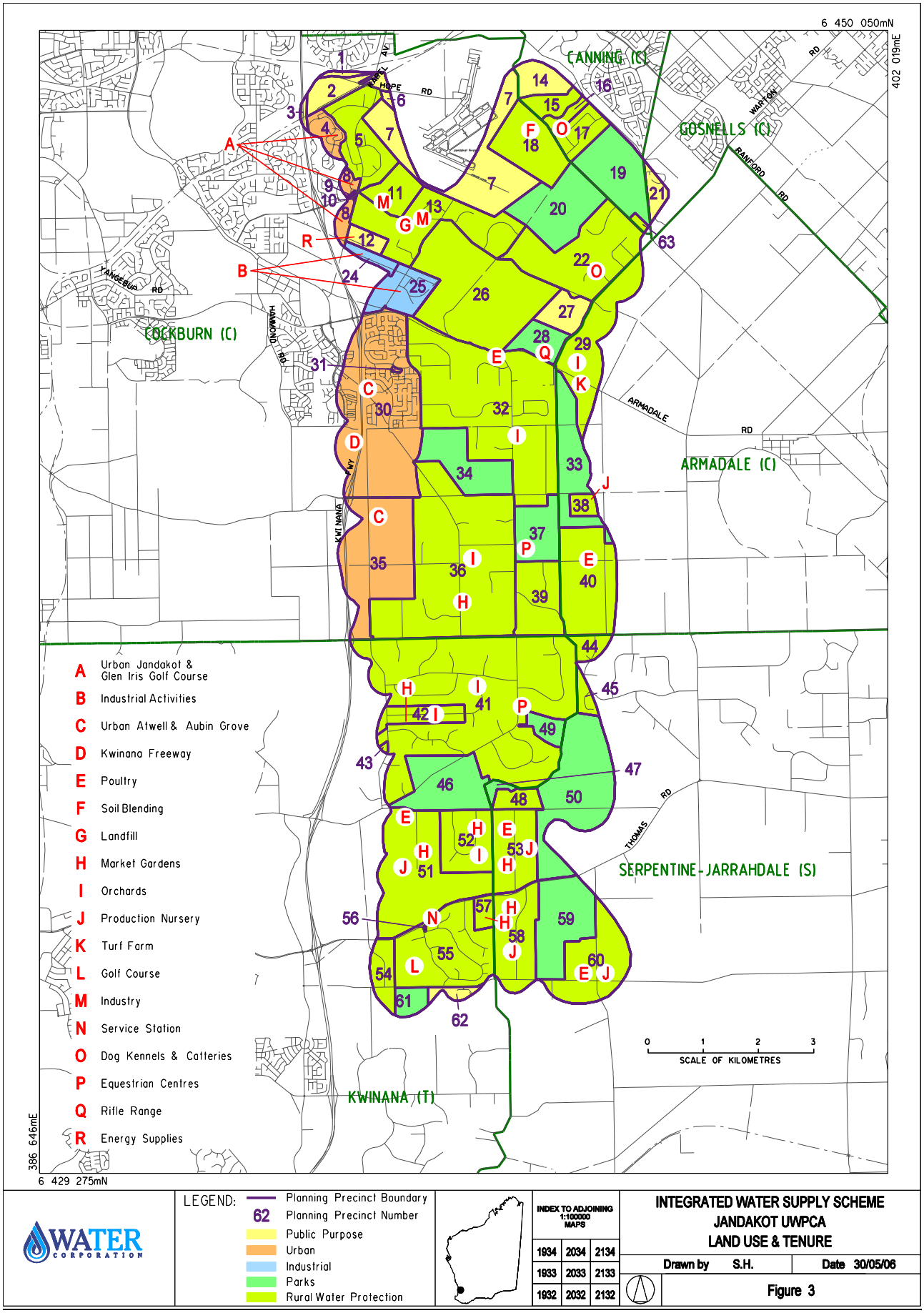

Figure 3 Land use and tenure

Photo. 8 **Stables – Banjup**
Rural Water Protection Zone Precinct 36

Photo. 9 **Magenup Equestrian Centre**
Parks and Recreation Precinct 49

Photo. 10 Dampland – Jandakot Regional Park
Parks and Recreation Precinct 33

Photo. 11 Alinta Gas depot
Public Purposes Precinct 12

Table 1 Drinking Water Quality Risk Assessment

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industrial					
Industry Food processing Precinct 25	Septic systems Chemical spills	Pathogens Nutrients Chemicals	Fresh Food Industries - currently unsewered Conditional land use for P3 area that should be connected to sewer	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Industry Extractive Precinct 25	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P3 area in WPZ for bore J370 Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation Underground storage tanks prohibited Unknown operation - conditional land use - needs to be assessed	Water quality monitoring DoW Sand Mining policy & guidelines Well regulated industry JLUWMS. MWSSD bylaws Land Planning controls	Medium
Industry - General Concrete, cement Precinct 24	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	A Ceramic Goods business Conditional land use in P3 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - General Metal Precinct 24	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	A Metal Coating business Incompatible land uses in P3 area Inadequate storage facilities and disposal of stormwater	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - General Mineral processing Precinct 24	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Cook Industrial Minerals & one other unknown business Conditional land uses in P3 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - General Resin manufacture Precinct 24	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Synthetic resins manufacture - Aust Insulation Supplies Conditional land use in P3 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - Light Precinct 24	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	One Clothing manufacturer, one Industrial machinery manufacturer and a Hardware store Conditional land uses in P3 area that should be connected to sewer	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industry - Light Precinct 25	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	One Plastic products manufacturer Others are Miscellaneous manufacturing businesses All conditional land uses in P3 area	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - Service Precinct 25	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Two Business Services - Very low risk One Plumbing Air Con Business - higher risks All conditional land uses in P3 area	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls	Medium
Motor vehicle repair Precincts	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P3 area that should be connected to sewer	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
24			Mine machinery repairer and Bus repairer		
25			Soltoggio Holdings repairers –storage & wash down water issues		
Sewer pump station Precinct 25	Septic spills Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation sewerage pumping station Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium
Subdivision Industrial Precincts	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Currently acceptable land use in P3 area because undeveloped Potential to be major risk sites if developed for industrial purposes	Water quality monitoring Partly sewered JLUWMS & SPP2.3 Land Planning controls	Medium
24			Vacant industrial lot		
25			Vacant industrial lots partly in WPZ for bore J370		
Warehouses Precincts	Fuel and chemical spills Septic systems	Hydrocarbons Chemicals Pathogens Nutrients	Conditional land uses in P3 area that should be connected to sewer	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
24			Wine warehouse		
25			Several warehouses - various uses	All bar one warehouse sewered	

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Urban					
Education facilities School Precinct 30	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Atwell Primary School Acceptable land use in P3 area in WPZ for bore J360 Conditions should apply to use of fertiliser and pesticides There is also a future high school site in Beenyup Rd	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls	Medium
Golf course Precincts	Human activity & litter Fertiliser use Pesticide use Animal excreta Fuel and chemical spills	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P3 area that should be connected to sewer Conditions on fertiliser and pesticide application	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls Fertiliser and pesticide use controls	Medium
4, 8			Glen Iris Country Club in WPZ for bores J320, J390 & J410		
Industry Photo processing Precinct 9	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	In shopping complex Conditional land use in P3 area in WPZ for bore J410	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
National & regional parks - Recreation parks Precincts	Human activity & litter Fertiliser use Pesticide use Animal excreta Septic systems Fuel and chemical spills	Pathogens Nutrients Pesticides Pathogens Nutrients Pathogens Nutrients Hydrocarbons Chemicals	Recreational parks are a conditional land uses in P3 area Conditions on fertiliser and pesticide application	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
8			Community parks in urban setting in WPZ for bores J320 and J410		
30			Several community parks managed by City of Cockburn Partly in WPZ for bores J360 and J370	Sewered	

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Residential building Precincts	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land uses in P3 area	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls	Medium
4			Glen Iris subdivision - some lots in WPZ for bores J390 and J400		
8			Sewered residential estate plus 3 lots rural living (1 ha) Some lots in WPZ for bores J320 and J410		
30			Residential estates of Success and Atwell Some lots in WPZ for bores J250, J270, J360 and J370		
Residential building Precinct 35	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Aubin Grove residential estate - "The Sanctuary" subdivision Acceptable land use in P3 area if sewered Some lots in WPZ for bores J220 and J230 Shallow depth to water table	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls	Medium
Sewer pump station Precinct 30	Septic spill Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Water Corporation sewerage pump station adjacent to compensating basin which forms part of local drainage system Also in WPZ for bore J270 Conditional land use in P3 area	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium
Shop Shopping Centre Precinct 9	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	12 retail outlets in shopping complex Acceptable land uses in P3 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Subdivision Urban Precinct 35	Fertiliser use Pesticide use Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Aubin Grove residential estate - "The Sanctuary" subdivision Acceptable land use in P3 area if sewered Currently vacant land under development	Water quality monitoring Sewered JLUWMS & SPP2.3 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Urban Deferred					
Animal husbandry (Intensive) Ex Piggery Precinct 35	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Ex piggery was incompatible land use for P3 area Unclear if site rehabilitation will remove risk from old piggery waste In WPZ for bore J240 Proposed urban development is an acceptable land use in P3 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Agriculture - intensive Ex Market gardens Precinct 35	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Ex mixed horticulture lots in WPZ for bore J230 Currently undergoing redevelopment for urban residential No evidence of site remediation in preparing urban development Sewered urban development is an acceptable land use in P3 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Animal establishment Stables Precinct 35	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Several stables Acceptable land use in P3 area in WPZ for bore J230 End land use likely to be urban	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Residential building Precinct 35	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Existing rural living Fuel storage and chemical drums exist on a few lots End land use likely to be urban Acceptable land uses in P3 area Some lots in WPZ for bores J210, J220 and J230	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Rural - Water Protection					
Animal husbandry (Intensive) Poultry Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	All incompatible land uses in P2 area Existing land uses that preferably should be outside area Majority of sites dispose of faeces off-site	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
32			Poultry Egg Farm next to bore J70 – storage & disposal issues		
40			Poultry Egg Farm next to bore J20		
51			One Intensive housed Egg Farm One Poultry meat farm One in future WPZ		
53			One Egg Farm One Poultry meat farm with emus as well		
60			One Poultry meat farm		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industry - Rural Soil blending Manure Stockpiling Precinct 18	Septic systems Manures Fuel and chemical spills	Pathogens Nutrients Pathogens Nutrients Hydrocarbons Chemicals	Remnants of soil blending operation in WPZ for bore J140 Incompatible land use for P2 area that has been required to relocate Unclear on current level of operation DoW to investigate & implement closure Includes Lukin Swamp Shallow depth to groundwater	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Landfill Class 1 Precinct 13	General waste	Pathogens Nutrients Chemicals	Landfill owned by DT Huynh in P2 area Incompatible land use - Assess for relocation or closure Includes stockpiles of soil conditioner, scrap metal and cars	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Agriculture - intensive Market gardens Precincts	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Incompatible land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
36			Three properties with mixed horticulture		
42			Three properties with mixed horticulture (one lot in future WPZ) One property also has scrap metal dump		
44			One property with mixed horticulture		
51			Several lots with mixed horticulture Lots partly in future WPZ. One also has old car bodies		
53			Two lots with mixed horticulture (partly in future WPZ) One lot with vegetables and ground crops		
58			One mixed horticulture lot. May no longer be in use.		
Agriculture - intensive Market gardens Precinct 52	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Two lots with mixed horticulture (partly in future WPZ) One with large distribution warehouse One with large workshed and chemical containers Incompatible land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Agriculture - intensive Market garden Precinct 57	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Market garden that is no longer operational May have nutrient loadings from past use Incompatible land use in P2 area Less than 1 metre to water table and partly in future WPZ	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Agriculture - intensive Orchards Production nurseries Precincts	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
29			One Tree farm & One Plant production nursery		
32			Several Citrus Orchards & One Plant production nursery		
36			Four Citrus Orchards & One Plant production nursery		
41			Two Citrus Orchards		
Agriculture - intensive Orchards Precinct 42	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Two Citrus Orchards Chemical drums on-site Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Agriculture - intensive Orchard Precinct 52	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	One Citrus Orchard Conditional land use in P2 area in future WPZ	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Agriculture - intensive Production nurseries Precinct 38	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Floraco plant & seed production nursery Conditional land use in P2 area in WPZ for bore J40	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Agriculture - intensive Orchards Production nurseries Vineyard Precincts	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
51			Two Plant production nurseries, one Seed production nursery and one Citrus Orchard (two lots in future WPZ)		
53			Three Plant production nurseries, four Seed production nurseries and one Macadamia Nut farm (two lots in future WPZ)		
58			Four Plant production nurseries (two are large operations) and one Seed production nursery (two lots in future WPZ)		
60			Plant & seed production nurseries, one Citrus Orchard, one Vineyard Vineyard has manure stockpile, vehicle servicing with storage issues		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Agriculture - intensive Turf farm Precinct 29	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Evergreen Turf farm Incompatible land use in P2 area in WPZ of bore J90 Inadequate bunding of stored chemicals	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Golf course Irrigated Precinct 55	Human activity & litter Fertiliser use Pesticide use Animal excreta Fuel and chemical spills	Pathogens Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Marri Park Golf Course (partly in future WPZ) Incompatible land use in P2 area Very shallow depths to water table (<1 metre in some places) Existing non-conforming land use	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Industry Soil landscaping Precinct 11	Septic systems Fertiliser use Fuel and chemical spills	Pathogens Nutrients Nutrients Hydrocarbons Chemicals	Soils City - soil landscaping mulch & soil conditioner supply Conditional land use in P2 area in WPZ for bore J410 Stores on unsealed ground Used oil and chemical drums in carpark	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Industry - Rural Farm supply centre Precinct 11	Septic systems Fertiliser use Fuel and chemical spills	Pathogens Nutrients Nutrients Hydrocarbons Chemicals	Bizzy Beez farm supply centre Conditional land use in P2 area in WPZ for bore J410	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Industry - Service Precinct 13	Septic systems Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	3 rural lots with incompatible land uses in P2 area Water well drilling business - On-site servicing & storage Clark Tile Cutting and Paving on-site Lawnmowing & Garden Bag Service - includes pesticide storage	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High
Service station Proposed petrol Precinct 56	Fuel and chemical spills Septic systems	Hydrocarbons Chemicals Pathogens Nutrients	Proposed Petrol Station Incompatible land use in P2 area Development of site for proposed purpose should be opposed Less than 1 metre to water table	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	High

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Agriculture - extensive Stock grazing Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
29			Several lots with various mixes of livestock		
32			Rural subdivision with variety of livestock including cattle, sheep, alpacas, chickens, geese (1 lot in WPZ for bore J70)		
36			One rural lot running cattle another variety of livestock Including horses, sheep, alpacas, goats, emus One has scrap metal dump car bodies & large workshop		
41			2 rural lots running sheep - 1 lot with alpacas (small scale)		
44			One semi-rural lot running about 12 sheep		
60			1 lot with cattle (14) - 1 lot with sheep (30) (In future WPZ)		
Agriculture - intensive Garden centre Precinct 36	Fertiliser application Pesticide application Septic systems Fuel and chemical spills	Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	John Cole Nursery Conditional land use in P2 area Includes carpark & tea rooms - permit expired	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Agriculture - intensive Nurseries Precincts	Fertiliser application Pesticide application Fuel and chemical spills	Nutrients Pesticides Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
11			Retail Nursery in WPZ for bore J410		
51, 58			Retail Nursery		
Animal establishment Catteries Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Acceptable land uses in P2 area Operated under regulations controlled by local government agencies	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls LGA regulations	Medium
17			Two properties operate as catteries in Canning Vale Kennel Zone	Regulated by City of Canning	
22			Several catteries in Banjup Kennel Zone	Regulated by City of Cockburn	
53			Boarding cattery		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Animal establishment Dog kennels Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P2 area Operated under regulations controlled by local government agencies Best management practices prescribed by DoW Conditions apply to kennel size and waste disposal	Targeted water quality monitoring Regulated by DoW guidelines for kennel waste disposal management DoW Kennel Advisory Committee JLUWMS & SPP2.3 Land Planning controls	Medium
17			Canning Vale Kennel Zone (partly in WPZ for bore J130)	Regulated by City of Canning	
22			Banjup Kennel Zone	Regulated by City of Cockburn	
Animal establishment Equestrian centre Precinct 41	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Academy of Natural Horsemanship 260 De Haer Use bridal trails near Magenup Lake (<1 metre to water table) Incompatible land use in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Animal establishment Stables Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
29			One property with stables (5-10 horses) One property with horse training centre (10 horses)		
32			Several stables with some lots in WPZ for bores J50 & J70 One property has scrap metal dump		
36			Several stables - a few have rubbish stockpiles of metal, cars, chemical & oil drums, general scrap		
38			Stables		
40			Several stables (One lot in WPZ for bore J10) One property has scrap metal dump and car bodies		
41			Several stables (One lot in future WPZ) One property has large shed (25 De Haer Rd)		
45			Two properties with stables		
48			One rural property with stables		
51			Rural lot with stables		
54			Rural lot with stables in future WPZ		
60			Several rural lots with stables (Some lots in future WPZ)		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Animal establishment Feedlots Precinct 54	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Feed sheds Incompatible land uses in P2 area Risk dependant on level of use Existing non-conforming land use	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Forestry Tree farm Precinct 32	Fertiliser use Pesticide use Fuel spills	Nutrients Pesticides Hydrocarbons	Small Tree Farm Conditional land use in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry Extractive Precincts 15	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P2 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation Underground storage tanks prohibited City of Canning gravel & sand quarry in WPZ for bores J140 & J150	Water quality monitoring DoW Sand Mining policy & guidelines Well regulated industry JLUWMS & SPP2.3 Land Planning controls	Medium
18			Sand and gravel quarry in WPZ for bore J140 Shallow depth to water table (Includes Lukin Swamp)		
26	Septic systems	Pathogens	Several sand quarry sites Fraser Rd quarry has storage issues – expected to close in 2 years		
29	Septic systems	Pathogens	Sand quarry site		
Industry Photo processor Precinct 32	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Photographic studio in rural setting Incompatible land use in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - General Concrete, cement Precincts	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Incompatible land uses in P2 area Existing non-conforming land uses	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
11			Delta Urbanstone - cement products partly in WPZ for bore J410		
26			Boral Besser & Palmerino Ronci masonry & clay brick makers		
36			Concrete products		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Industry - General Energy Precinct 41	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Electric generation plants Incompatible land use in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - General Fertiliser manufacture Precinct 18	Septic systems Fertiliser use Fuel and chemical spills	Pathogens Nutrients Nutrients Hydrocarbons Chemicals	Richgro fertiliser manufacturing plant Incompatible land use in P2 area in WPZ for bore J130 Existing no-conforming land use Regulated by DoW licence Less than 1 metre to water table – inadequate bunding of hardstand	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - General Metal Precinct 40	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Iron & steel basic products manufacturing - small scale Incompatible land use in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry - Service Precincts	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Incompatible land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
39			Construction services in small workshops in WPZ for bore J10		
41			Construction services workshops in WPZ for bore J10 & future bore One property Pothole masters with large trucks & shed		
45			Swimming pool construction		
53			Swimming pool transporter - workshop, trucks, cranes, chemicals Dual Transport Company		
60			Rural living with large workshop, chemicals & machinery Includes Darling Downs Drilling Co (water well drillers)		
Industry - Service Precinct 55	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	2 lots Repair Service businesses one may have home store Incl. workshops, trucks, car bodies, chemical & diesel containers Incompatible land uses in P2 area (1 lot in future WPZ) Less than 1 metre to water table	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Motor vehicle repair Precincts	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Incompatible land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
51			Large workshop trucks forklift with chemical drums on-site		
60			Motor vehicle repair workshop		
Residential building Precinct 5	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Special Rural lots 1 ha to >2 ha Generally acceptable land uses in P2 area Existing lots <2 ha are incompatible non-conforming land uses One lot has unbunded above ground fuel storage One lot incorporates private sports centre (Incompatible) Some lots in WPZ for bores J390 and J410	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Residential building Precinct 13	Septic systems Fertiliser use Pesticide use Animal excreta Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Pathogens Nutrients Hydrocarbons Chemicals	Special rural subdivision >2 ha Several properties with large sheds A few properties with stored chemicals and containers One property may include kennels - 34 Pepperworth Acceptable land uses in P2 area (some lots in WPZ for bore J320)	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Residential building Precinct 26	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Several rural lots with housing under construction Acceptable land use in P2 area provided lot sizes not < 2 ha	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Residential building Precincts	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Semi rural & rural lots with common associated activities Acceptable land uses in P2 area (some lots in future WPZ) Shallow depth to water table	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
51			Semi rural & rural lots. One lot with small scale sheep grazing. One lot with commercial bee hives. Two lots with old car bodies.		
54			4 properties cleared, 3 properties with natural vegetation		
55	Fuel and chemical spills	Hydrocarbons	Semi rural estate of Casuarina		
57			Two rural properties		
Residential building Precincts	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Rural subdivisions with common associated activities Acceptable land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
17			Special rural lots without kennels (partly in WPZ for bore J130)		
29			Rural lots		
39			Semi rural lots. Some lots in WPZ for bores J10 and J20.		
40			Rural lots		
42			Rural lots. One lot has car bodies & disused market garden Several lots have horses		
44			Rural lots. One lot appears to have poor management practices Mainly relating to rubbish stockpiles of wood, landfill metal, trucks, chemical & oil drums, general scrap Another property (309 Foxton) has chemical drums on-site		
53			Several rural lots with common associated activities		
58			Oakford rural estate. Some lots in future WPZ. 1 lot with ostriches.		
63			Two semi rural lots		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Residential building Precincts	Septic systems Fertiliser use Pesticide use Fuel and chemical spills	Pathogens Nutrients Nutrients Pesticides Hydrocarbons Chemicals	Acceptable land uses in P2 area Rural subdivision with common associated activities Some properties appear to have poor management practices Mainly relating to rubbish stockpiles of metal, cars, chemical & oil drums, general scrap	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
32			Rural lots. Small numbers of sheep & chickens on some properties Some lots in WPZ for bores J50, J60 and J70		
36			Rural lots. Small numbers of sheep & chickens on some properties		
41			Semi rural & rural lots with common associated activities Chickens on 10 Robinson, possible horticulture on 61 Wandi		
45			Semi rural & rural lots		
48			Four rural lots. Two lots have chemical drums & car bodies		
52			Rural lots (partly in future WPZ). Two properties with old car bodies A number of properties had large workshops		
60			Rural lots (partly in future WPZ). One lot with old car bodies (>10) 3 lots with chemical drums (>300L). 1 of these has workshop, truck, machinery, general materials and scrap metal		
Shop Precinct 22	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Motor vehicle used parts retail outlet (motor wreckers) Conditional land use in P2 area Large amounts of car bodies & parts, & chemical drums	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Shop Precincts	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land uses in P2 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
32			Spray-on-tan sales		
51			1 General grocery shop & 1 Equipment hire outlet with stored fuels		
58			Hardware and farm equipment retail outlet		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
State Energy	Pesticide use	Pesticides	Electric transmission right-of-way	Water quality monitoring	Medium
	Fuel and chemical spills	Hydrocarbons	Acceptable land use in P2 area	JLUWMS & SPP2.3	
Precinct 26		Chemicals	Fuel & oil containers on-site Clean up organised	Land Planning controls	
Tavern	Septic systems	Pathogens	Tavern associated with Marri Park Golf Course	Water quality monitoring	Medium
		Nutrients	Also golf clubhouse	JLUWMS & SPP2.3	
	Fuel and chemical spills	Hydrocarbons	Incompatible land use in P2 area in future WPZ	Land Planning controls	
Precinct 55		Chemicals	Shallow depth to water table		
Vacant land	Septic systems	Pathogens	Several vacant rural lots	Water quality monitoring	Medium
Uncleared land		Nutrients	Acceptable land use in P2 area (1 lot in WPZ for bore J210)	JLUWMS & SPP2.3	
	Fertiliser use	Nutrients	One property formerly a floriculture lot	Land Planning controls	
	Pesticide use	Pesticides	Another property has scrap metal dump		
	Animal excreta	Pathogens	Possible likelihood of nutrients on ex floriculture lot		
		Nutrients	Likelihood of nutrient contamination on rest of lots is rare		
	Fuel and chemical spills	Hydrocarbons	Possible likelihood of chemicals on lot with metal dump		
Precincts		Chemicals	Likelihood of chemical contamination on rest of lots is rare		
36			One lot formerly a floriculture lot. One lot has scrap metal dump Possible likelihood of nutrients on ex floriculture lot Possible likelihood of chemicals on lot with metal dump		
43			Disused farm sheds on 574 Lyon Rd Possible contaminated site in future WPZ Requires further assessment to determine compatibility in P2 area		
60			Parts of two rural lots with activities outside UWPCA No infrastructure on land within UWPCA One lot has market garden the other a poultry farm Although land use within UWPCA acceptable in P2 area there may be impacts of activities outside which could be incompatible May require closer assessment		
Warehouse	Septic systems	Pathogens	Small scale workshop on large semi cleared lot	Water quality monitoring	Medium
		Nutrients	Conditional land use in P2 area	JLUWMS & SPP2.3	
	Fuel and chemical spills	Hydrocarbons		Land Planning controls	
Precinct 29		Chemicals			

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Parks & Recreation					
Agriculture - extensive Stock grazing Precinct 33	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Part of rural lot to be to be incorporated into Jandakot Regional Park Current owner grazes small number of cattle Less than 1 metre to water table – cattle have access to wetland Existing incompatible land use in P1 area	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Animal establishment Equestrian centres Precincts	Animal excreta Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Incompatible land uses in P1 area Less than 1 metre to water table	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
37			Horse & Pony club and Trotting training centre In WPZ for bore J40		
49			Magenup Equestrian Centre 288 De Haer Use bridal trails near Magenup Lake		
Community purposes Rifle range Precinct 28	Septic systems Fuel and chemical spills Leadshot	Pathogens Nutrients Hydrocarbons Chemicals Chemicals	Cockburn & Fremantle Pistol Club - Incompatible land use in P1 area Existing non-conforming land use	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry Extractive Precinct 28	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Rocla Sand Quarry Conditional land use in P1 area Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation Underground storage tanks prohibited	Water quality monitoring DoW Sand Mining policy & guidelines Well regulated industry JLUWMS & SPP2.3 Land Planning controls	Medium
Storage - Fire Brigade Precinct 37	Fuel and chemical spills	Hydrocarbons Chemicals	Fire brigade storage Conditional land use in P1 area in WPZ for bore J40 Inadequate bunding Fuel wash down storage tank has potential to overflow	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Public Purposes					
Club premises Motor sports club Precinct 6	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Perth TQ Car Club - Bibra Lake Speedway Existing incompatible land use in P1 area Refuelling likely to occur on-site Needs assessing for use of best management practices	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Community purposes Rifle range Precinct 14	Septic systems Fuel and chemical spills Leadshot	Pathogens Nutrients Hydrocarbons Chemicals Chemicals	Crown Reserve 33289 Canning Small Bore Rifle & Pistol Club Incompatible land use in P1 area in WPZ for bores J140 and J150 Existing non-conforming land use	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
Industry Extractive Precinct 14	Septic systems Fuel and chemical spills	Pathogens Nutrients Hydrocarbons Chemicals	Conditional land use in P1 area in WPZ for bores J140 and J150 Conditions on storage of fuels and chemicals Criteria for excavation depth and site rehabilitation Underground storage tanks prohibited	Water quality monitoring DoW Sand Mining policy & guidelines Well regulated industry JLUWMS & SPP2.3 Land Planning controls	Medium
State Energy Electric power supply Gas supply Workshops & Depots Precincts	Septic systems Pesticide use Fuel and chemical spills	Pathogens Nutrients Pesticides Hydrocarbons Chemicals	Power depots & storages incompatible land uses in P1 & P2 areas Transmission line right of ways acceptable land use in P1 area (Only potential for pesticide use, fuel and chemical spills in ROWs)	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium
2			Western Power Depot and Offices - includes outdoor storage In WPZ for bore J400 (P1 area)		
12			Western Power Network Division - includes outdoor storage Maintenance depot HAZCHEM - shared services Alinta Gas and Epic Energy (P1 & P2 areas) (1 lot in WPZ for bore J320)		
27			Electric transmission right-of-way in WPZ for bore J90 (P1 area)		
Vacant Crown Land Precinct 27	Fertiliser use Pesticide use Chemicals	Nutrients Pesticides Chemicals	Two lots in P1 area partly in WPZ for bore J90 One lot managed by WA Police Service Owner of second lot unknown compatibility both lots unclear Possibly contaminated from past uses See DoW records	Water quality monitoring JLUWMS & SPP2.3 Land Planning controls	Medium

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Roads					
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an incompatible land use in P1 areas Existing non-conforming land use	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium
21			Nicholson Rd		
27			Jandakot Rd & Warton Rd in WPZ for bore J90		
28			Armadale Rd & Warton Rd		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are a conditional land use in P2 areas Existing non-conforming land use	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium
26			Armadale Rd & Jandakot Rd partly in WPZ for bore J380		
29			Warton Rd & Armadale Rd partly in WPZ for bore J70		
32			Armadale Rd		
36, 39, 40, 41, 44			Rowley Rd		
47,48			Anketell Rd in future WPZ		
51, 53			Anketell Rd & Thomas Rd partly in future WPZ		
52			Anketell Rd partly in future WPZ		
54, 58			Thomas Rd		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an incompatible land use in P1 areas Existing non-conforming land use	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium
46, 49			Anketell Rd in future WPZ		
50			Anketell Rd & Thomas Rd in future WPZ		
59			Thomas Rd		

Land Use / Activity	Hazard Event / Source	Hazard [1]	Considerations	Current Preventive Measures	Catchment Management Priority [2]
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are a conditional land use in P2 areas Shallow depth to water table	Water quality monitoring HAZMAT emergency response JLUWMS & SPP2.3 Land Planning controls	Medium
55			Thomas Rd partly in future WPZ		
56, 57			Thomas Rd		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an acceptable land use in P3 areas	Water quality monitoring HAZMAT emergency response Signage JLUWMS & SPP2.3 Land Planning controls	Medium
1			Proposed Roe Hwy extension		
3			Kwinana Freeway		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an acceptable land use in P3 areas	Water quality monitoring HAZMAT emergency services JLUWMS & SPP2.3 Land Planning controls	Medium
8			Berrigan Drive partly in WPZ for bores J320 and J410		
9			Part of Berrigan Drive in WPZ for bore J410		
Major transport routes Precincts	Fuel and chemical spills	Hydrocarbons Chemicals	Formed roads are an acceptable land use in P3 areas	Water quality monitoring HAZMAT emergency services JLUWMS & SPP2.3 Land Planning controls	Medium
25			Armadale Rd		
30			Kwinana Freeway partly in WPZ for bores J250, J270, J360 & J370 Armadale Rd partly in WPZ for bore J370		
35			Kwinana Freeway partly in WPZ for bores J210, J220 and J230		

1. See Water Quality Hazards and Potential Impact on Consumer table.
2. Catchment Management Priority Scale Used: *High, Medium* and *Low*.

Table 2 Water Quality Hazards and Potential Impact on Consumer

Water Quality Hazards and Potential Impact on Consumer	
Hazard	**Potential Impact on Consumer**
Health	
Hydrocarbons and Chemicals	May have poor taste and smell. Some may cause cancer after prolonged exposure. Harmful by-products may be formed when combined with chlorine.
Nutrients	Nitrate is toxic to humans at high levels, with infants less than three months old being most susceptible. Nutrients can cause algal blooms.
Pathogens (Bacteria, Viruses, Protozoa)	Can cause disease such as gastro-enteritis or even death.
Pesticides	Most modern pesticides readily degrade in the environment, however in the past, pesticides containing organochlorides could bio-accumulate in humans/ animals causing toxic affects.
Toxins eg Cyanobacteria (blue green algae)	Can result in nerve damage.
Aesthetic	
Colour	Not a health consideration if derived from natural organics. Harmful by-products may be formed when combined with chlorine.
Total Dissolved Solids / Salinity	Poor taste and corrosion to pipe work and household appliances.
Turbidity	Discolouration and cloudiness of water. May reduce the effectiveness of disinfection.

Refer to the ADWG for further information about water quality hazards, available via www.health.gov.au/nhmrc/publications/pdf/eh19.pdf.

4 Implementation of 1995 management strategy recommendations

The Jandakot Land Use and Water Management Strategy completed by the Western Australian Planing Commission in 1995 provided a list of recommendations for implementation of the strategy.

Tasks relating to water source protection recommendations in the strategy have been effectively completed.

The most significant of the achieved tasks are:

- Gazettal of amended Control Area, including the southern extension and priority protection areas
- Amendment of the Metropolitan Regional Scheme to apply the Water Catchments reservation to Priority 1 areas and to incorporate the new Rural – Water Protection Zone for Priority 2 areas
- Adoption of protection areas and classifications in local government agency town planning schemes
- Assessment of subdivision and development proposals in accordance with the strategy and protection principles set out in the ensuing *Jandakot Groundwater Protection Policy of 1998*
- Communication of protection strategies to landowners and promotion of strategy to gain acceptance at all levels of government

5 Conclusion

Current risks to water quality from activities within Jandakot Underground Water Pollution Control Area have been identified and reviewed.

There has been no observed increase in the overall risk to drinking water quality of the Jandakot wellfield since the initial assessments undertaken about a decade ago as part of the Jandakot Land Use and Water Management Strategy. Groundwater has consistently been of good quality and no trends are evident. Even with a large portion of the Control Area in private ownership (77%) there has been no evidence of any pathogen or nutrient contamination of the wellfield. It would appear amendment of the Metropolitan Regional Scheme and implementation of the Jandakot Groundwater Protection Policy in 1998 have been a significant influence in improving the protection of groundwater resources of the Jandakot Mound. The new zone and controls and principles of the protection policy have been successfully incorporated into local government agency town planning schemes and local rural strategies.

The current greatest potential risks to drinking water quality within the Control Area are the intensive animal husbandry and agricultural activities within the Urban Deferred and Rural – Water Protection zones. The stockpiling of manures in what remains from a past soil blending operation, and waste deposited in a Class 1 landfill pose a similar threat. These land uses are all considered severe or high risks and have been rated ***High*** catchment management priorities. Pathogens associated with faecal waste from the piggeries and poultry farms pose a potentially severe risk to groundwater quality. Market gardens, orchards, plant and seed production nurseries, turf and tree farms and a vineyard are potential sources of nutrients from fertiliser application and are considered high risk sites. The old Soils Aint Soils soil blending site in Acourt Road and the Class 1 Landfill in Jandakot Road are potential sources of pathogen and nutrient contamination.

A food processing plant in the Industrial zone is also considered to be a high risk because of its potential to cause pathogen contamination. It is unsewered and therefore rated a ***High*** management priority.

Fertiliser and pesticide use on Marri Park Golf Course poses a high risk because the shallow depth to the water table. The site is considered a ***High*** catchment management priority for the future southern extension of the wellfield.

A group of Jandakot service industry businesses in the Rural - Water Protection zone are considered a ***High*** management priority with the potential to cause pesticide, fertiliser, hydrocarbon and chemical contamination from leakage of stored chemicals, fuel and oil.

There are a number of activities within the Industrial zone considered ***Medium*** management priorities because they present potential risks for hydrocarbon and chemical contamination through the possible leakage of stored fuels and chemicals. Potential sewerage overflows from the Water Corporation's sewerage pumping station, also located within the Industrial zone, is considered a significant risk and continuation of current preventive measures is rated a ***Medium*** management priority.

Although there has been no evidence of contaminants reaching the groundwater, many activities throughout the Control Area are considered ***Medium*** management priorities because of their potential to transmit nutrients, pesticides, hydrocarbons and chemicals to the water table. These include irrigated ovals, parks and golf courses, some commercial retail centres and the uncontrolled domestic activities on residential properties. Stables, kennels, catteries and broadacre stock grazing located throughout the Rural – Water Protection zone pose the additional risk associated with management of faecal waste. There are also a number of industry based businesses in this zone with the potential to cause hydrocarbon and chemical contamination from leakage of stored fuel, oil and chemicals.

Activities on Crown Land rated ***Medium*** management priorities because there is potential for leakage of stored fuels and chemicals include rifle ranges, sand quarries, equestrian, horse club and training facilities, Western Power Corporation (WPC) depots, a fire brigade station and the Bibra Lake speedway site. Activities associated with the WPC depots and other land uses within the wellhead protection zones of bores J320 and J410 require closer assessment because of the detection of low levels of arsenic in these bores.

There is potential for hydrocarbon and chemical contamination from vehicular movement along the high volume traffic routes in the Control Area and continued operation of HAZMAT emergency procedures is a ***Medium*** management priority.

Other activities in the Control Area are considered to be a ***Low*** management priority.

It is essential that water managers continue with and improve upon catchment preventive and management strategies and further develop and implement protection policies and guidelines to ensure ongoing availability of good quality drinking water. Efforts should be focussed on directing landowners to improve management of their activities, especially relating to storing fuels and chemicals, containing wastewater and disposing of waste to reduce the risk of potential contaminants entering the groundwater. Examples of potential strategies used in other PDWSAs for managing drinking water quality risks can be found in Appendix 3.

Planning and other land use decision-makers should continue to recognise the significance of drinking water catchments in the decisions they make. Advice is available from Department for Planning and Infrastructure, the Water Corporation, Department of Water and Department of Health, if there is uncertainty about the importance of the drinking water source in relation to other values of the resource (e.g. recreational, communal, residential, industrial or agricultural).

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Glossary and Acronyms

ADWG	Australian Drinking Water Guidelines, published by the National Health and Medical Research Council and Natural Resource Management Ministerial Council under rolling review.
Aesthetic	Relating to the physical characteristics of water (taste, clarity, smell and feel).
Allocation	The quantity of water permitted to be abstracted by an allocation licence, usually specified in kilolitres/year (kL/a).
Catchment	The area of land which intercepts rainfall and contributes the collected water to surface water (streams, rivers, wetlands) or groundwater.
Control Area	Abbreviation for Underground Water Pollution Control Area.
Diffuse Source Pollution	Pollution originating from a widespread area, e.g. urban stormwater runoff, agricultural runoff.
DWSPA	Drinking Water Source Protection Assessment
DWSPP	Drinking Water Source Protection Plan
Effluent	The liquid, solid or gaseous wastes discharged by a process, treated or untreated.
Health Related Chemical	Water quality characteristic that may pose a health risk to consumers.
Leaching / Leachate	The process by which materials such as organic matter and mineral salts are washed out of a layer of soil or dumped material by being dissolved or suspended in percolating rainwater; the material washed out is known as leachate. Leachate can pollute groundwater and waterways.
m AHD	Australian Height Datum. Height in metres above Mean Sea Level +0.026 m at Fremantle.
Microbiological Contaminant	Micro-organisms which can either directly cause disease (pathogens) or indicate the possible presence of other pathogens.
Nutrient Load	The amount of nutrient reaching the waterway over a given time (usually per year) from its catchment area.
Nutrients	Minerals dissolved in water, particularly inorganic compounds of nitrogen (nitrate and ammonia) and phosphorus (phosphate) which provide nutrition (food) for plant growth. Total nutrient levels include the inorganic forms of an element plus any bound in organic molecules.
PDWSA	Public Drinking Water Source Area
Pesticides	Collective name for a variety of insecticides, fungicides, herbicides, algaecides, fumigants and rodenticides used to kill organisms.

Point Source Pollution	Specific localised source of pollution, e.g. sewage or effluent discharge, industrial waste discharge.
Pollution	Water pollution occurs when waste products or other substances, e.g. effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.
Runoff	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 or private company and supplied via a distribution network to customers for urban, industrial or irrigation use.
Storage Reservoir	A major reservoir of water created in a river valley by building a dam.
Stormwater	Rainwater that has run off the ground surface, roads, paved areas etc and is usually carried away by drains.
TDS	Total Dissolved Solids, a measure of salinity, calculated from TFSS (Total Filterable Suspended Solids) and measured in accordance with ADWG.
Treatment	Application of techniques such as settlement, filtration and chlorination to render water suitable for specific purposes including drinking and discharge to the environment.
UWPCA	Underground Water Pollution Control Area.
Wastewater	Water that has been used for some purpose and would normally be treated and discarded. Wastewater usually contains significant quantities of pollutant.
Water Quality	The physical, chemical and biological measures of water.

Appendices

Appendix 1 Department of Water - Water Quality Protection Note:
Land use compatibility in Public Drinking Water Source Areas.

Appendix 2 Water Quality

Appendix 3 Example protection strategies used in drinking water catchments in Western Australia.

Appendix 4 Department of Water -Water Quality Protection Note:
Overview on protecting Public Drinking Water Source Areas.

Appendix 1 DoW - Water Quality Protection Note
Land use compatibility in Public Drinking Water Source Areas

Refer to website http://drinkingwater.water.wa.gov.au, for latest version.

Water Quality Protection Note

Department of Environment

Land use compatibility in Public Drinking Water Source Areas

Purpose

The Department of Environment (DOE) is responsible for managing and protecting the State's water resources. This note provides advice on the acceptability of land uses and activities within specific catchments that are the water source for schemes supplying cities and towns. These are termed Public Drinking Water Source Areas (PDWSAs). These areas require comprehensive water resource quality and land planning protection measures to ensure the ongoing availability of a safe, good quality drinking water supply to protect the health of consumers.

The note also forms an integral part of the Western Australian Planning Commission's *Statement of Planning Policy No. 2.7- Public Drinking Water Source Policy* 2003 (relevant to approximately 140 existing PDWSAs in Western Australia) prepared by the Department for Planning and Infrastructure under Section 5AA of the *Town Planning and Development Act 1928*. It is also intended to support the proposed Statement of Planning Policy for *Water Resources* designed to guide planning decisions in future PDWSAs. This note should be used by Local Government when developing local planning strategies, structure plans and town planning schemes. It should also be used in the assessment of subdivision and other development applications. The note will also assist the development of formal guidelines on land use activities in PDWSA prepared in liaison with key stakeholders such as the Water Corporation, Department of Health, Department of Conservation and Land Management, Department of Agriculture, Department of Industry and Resources, Department for Planning and Infrastructure and local government.

A review of this note may occur within 12 months (depending on feedback) to reflect DOE's policy position (which is influenced by public consultation undertaken for PDWSAs), advances in technology or land use activity standards, and Government decisions made concerning drinking water quality protection. This note may not consider all the circumstances that exist for planning strategies, plans and schemes across the State. Accordingly, changes to this note will only be considered if they apply broadly across the State. Other means of addressing localised special circumstances may be employed and the DOE will assist in achieving this outcome provided those changes do not place the PDWSA at a higher contamination risk.

The *Department of Environmental Protection* and *Water and Rivers Commission* are presently being combined to form the *Department of Environment.* This process will not be complete until enabling legislation has been passed by Parliament and proclaimed. This note aims to present a generic 'combined agency' position on the nominated topic.

Scope

This note provides the DOE's position on a range of land uses assessed against the Department's water quality protection strategy and management objectives within PDWSAs. Where a specific land use has not been covered in the accompanying tables, it should be referred to the Department's Water Source Protection Branch for assessment and a written response concerning its acceptability or any necessary water resource protection measures.

Public Drinking Water Source Area in Western Australia is the collective description for:

- Underground Water Pollution Control Areas,
- Water Reserves, and
- Catchment Areas,

declared under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947*.

This note is intended to complement the statutory role and policy of State and local government authorities, but it does not override Government policy or the need for proponents to fulfil their legal responsibilities for land use planning, and environmental, health, building or other necessary approvals.

PDWSA protection framework

The protection of PDWSAs relies on statutory measures available in water resource management and land use planning legislation. The DOE policy for the protection of PDWSAs includes three risk management based priority classification areas and two types of protection zones. The priority classification areas and protection zones are determined via specific Drinking Water Source Protection Plans (DWSPP) that are prepared in consultation with State government agencies, landowners, local government, and key industry and community stakeholders. Where a fully consulted DWSPP does not exist for a PDWSA, the DOE initially prepares Drinking Water Source Protection Assessment (DWSPA) documents to reflect readily available information for use in land use planning assessments and decision making.

Priority classification areas

Priority 1 (P1) classification areas are managed to ensure that there is **no degradation** of the drinking water source by preventing the development of potentially harmful activities in these areas. The guiding principle is **risk avoidance**. This is the most stringent priority classification for drinking water sources. P1 areas normally encompass land owned or managed by State agencies, but may include private land that is strategically significant to the protection of the drinking water source (e.g. land immediately adjacent to a reservoir). Most land uses create some risk to water quality and are therefore defined as "**Incompatible**" in P1 areas.

Priority 2 (P2) classification areas are managed to ensure that there is **no increased risk** of water source contamination/ pollution. For P2 areas, the guiding principle is **risk minimisation.** These areas include established low-risk land development (e.g. low intensity rural activity). Some development is allowed within P2 areas for land uses that are defined as either "**Compatible with conditions**" or "**Acceptable**".

Priority 3 (P3) classification areas are defined to **manage the risk of pollution** to the water source from catchment activities. Protection of P3 areas is mainly achieved through guided or regulated environmental (risk) management for land use activities. P3 areas are declared over land where water supply sources co-exist with other land uses such as residential, commercial and light industrial development. Land uses considered to have significant pollution potential are nonetheless opposed or constrained.

Wellhead and reservoir protection zones

In addition to the three Priority Classification Areas, specific protection zones are defined to protect drinking water sources from contamination in the immediate vicinity of water extraction facilities. Within these zones by-laws may prohibit, restrict or approve defined land uses and activities to prevent water source contamination or pollution. Special conditions, such as restrictions on storage and use of chemicals, may apply within these zones. The legislation is currently being reviewed to simplify and enhance the protection of public drinking water sources.

Wellhead protection zones (WHPZ) are used to protect underground sources of drinking water. They are circular (unless information is available to determine a different shape), with a radius of 500 metres in P1 areas, and 300 metres in P2 and P3 areas. WHPZ do not extend outside PDWSA boundaries. Reservoir

protection zones (or '**prohibited zones'** as they are called in the by-laws) consist of a statutory 2 kilometre wide buffer area around the top water level of storage reservoirs in the Perth water supply area, and include the reservoir water-body. The reservoir protection zones (RPZ) apply over Crown land and prohibit public access to prevent contamination (physical, chemical and biological) of the source water. RPZ do not extend outside PDWSA boundaries. The DoE is currently considering a provision for RPZ buffer areas of less than 2 kilometres, and creation of consistent by-laws for country and Perth PDWSAs.

Special protection measures apply in WHPZ and RPZ (prohibited zones) as described in the By-laws under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* and the *Country Areas Water Supply Act 1947*.

The determination of priority classification areas or protection zones over land in a PDWSA is based on:

- the strategic importance of the land or water source,
- the local planning scheme zoning,
- form of land tenure, and
- existing approved land uses/activities.

The land use tables in this protection note directly apply to the three types of priority classification areas identified in DWSPP or agreed in specific *Land Use and Water Management Strategy* documents. Currently there are 45 DWSPPs available to guide land use planning decisions in PDWSAs, and (nearly 100) others are in development. In the absence of a DWSPP, the DOE recommends that planning decisions within any gazetted or proposed PDWSA are guided by DWSPA documents (where they exist) and the '**potential'** priority classification area or protection zone status of a proposal identified using **Diagram 1: Assessment of potential priority classification areas and protection zones** (overleaf).

Compatibility of land uses within PDWSAs

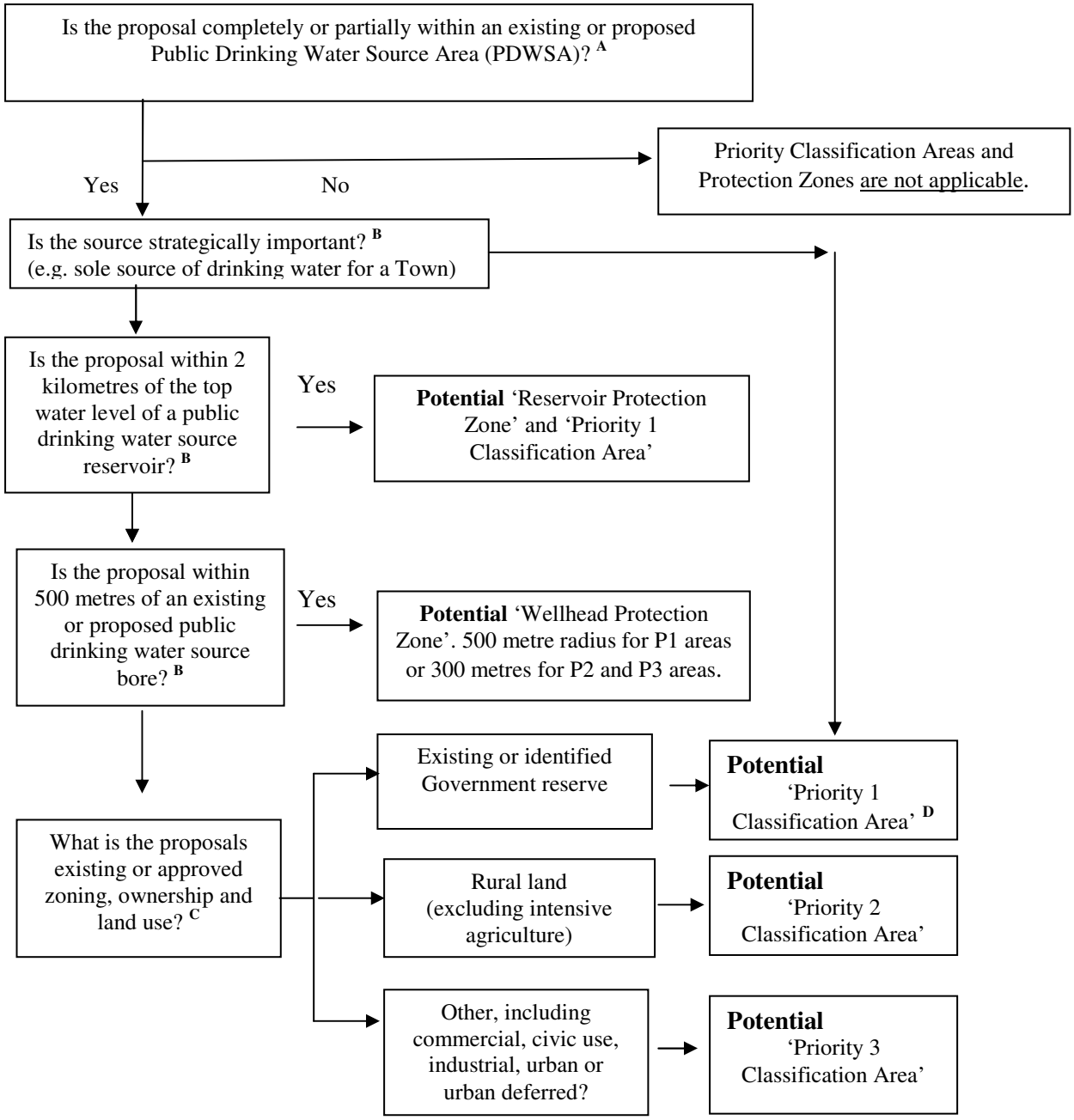
The tables in this note have been prepared for use by local governments, State planners and other agencies as a basis for regulating land use within PDWSAs. The note complements the Western Australian Planning Commission's *Statement of Planning Policy Number 2.7 (June 2003) Public Drinking Water Sources*. These tables define land uses in terms of their compatibility with the sustainable use of the drinking water source. They promote a priority for protection of the environmental value: 'drinking water' within a PDWSA over other values that may exist. The three definitions used are '**Incompatible**', '**Compatible with conditions'** and '**Acceptable**'. In previous versions of this note the definitions were 'Incompatible', 'Conditional' and 'Compatible'.

The DOE recognises that there may be special circumstances which may occasionally result in an '**Incompatible'** land use receiving approval. Where planning decisions result in this outcome it is important for project proponents to have demonstrated an overriding community benefit and that the land use will not increase the risk of contamination to the PDWSA. The DOE expects to have significant, early involvement in planning decisions of this nature to maximise the protection of the drinking water resource. It should be noted that where a water source is the sole supply for a community, or has a particularly high strategic value for the supply of drinking water, then it would be difficult to understand how that source might be put at any risk of contamination.

Detailed information on water quality protection issues and recommended best management practices for '**Compatible with conditions'** land uses are being developed in approved environmental policy, codes of practice, management guidelines and water quality protection notes. These documents, along with the most recent version of this note, can be found on the DOE Internet site <*http://www.environment.wa.gov.au*>. Information on land use and development regulation within PDWSAs can also be obtained from DOE's regional offices.

The DOE's Water Source Protection Branch, presently located in East Perth, is custodian of this water quality protection note and will provide detailed advice on its application and coordinate any suggested amendments.

Diagram 1: Assessment of potential priority classification areas and protection zones



Legend

A. The location of PDWSAs can be found in DOE's Drinking Water Source Protection Assessments and Plans or through your regional DOE office, Local Government office, Water Corporation or from the Department for Planning and Infrastructure.

B. Strategically significant sources and potential contamination from land uses close to drinking water reservoirs or abstraction bores are considered first, due to these involving the highest risk of contamination reaching consumers.

C. Current zoning or land use information is available from your Local Government office.

D. Government land is protected to achieve the highest level of safety for drinking water in all parts of a catchment through a Priority 1 classification, wherever this is reasonable and practicable.

Existing approved land uses

Many land uses covered in this note may have been legally established prior to establishment/ gazettal of the PDWSA or modern protection measures being required. The DOE policy is that existing approved land uses/ activities can continue at their presently approved level, provided they operate lawfully. Where necessary, negotiations may be arranged with land owners to acquire property rights in P1 source protection areas. Where practical, this agency will also negotiate with the operators of existing '*Incompatible*', or '*Compatible with conditions'* activities to implement environmental management practices that minimise risks to water sources.

Proposed land uses

After reading this protection note, please view the DOE Internet site and/ or contact your nearest DOE Regional Office for advice on the location of PDWSAs, priority classification areas, and reservoir or wellhead protection zones. You may discuss with DoE staff any proposed land use activities that may affect water resources. The early identification of water resource protection issues in development stages of land use planning proposals is recommended in both the June 2003 *Statement of Planning Policy for Public Drinking Water Sources* and proposed *Water Resources Policy* by the Western Australian Planning Commission.

Definition of terms used in the following tables

'**Acceptable** ' (equivalent to 'compatible' in previous version of this note)- means the land use is accepted by DoE as not likely to harm the drinking water source, and is consistent with the management objectives of that priority classification. The adoption of best practice environmental management methods for new proposals to protect water quality is expected. Existing land users are also encouraged to adopt best practice environmental management methods to help protect water quality. These land uses generally do not need referral to the DOE.

'**Compatible with conditions**' (equivalent to 'conditional' in previous version of this note) **-** means the land use is likely to be accepted by DoE as not likely to harm the drinking water source, (and is consistent with the management objectives of the priority classification) <u>provided</u> best environmental management practices are used. This may result in the application of 'specific conditions' (via the planning or environmental approval processes) that must be complied with to ensure the water quality objective of the priority area is maintained.

Land uses described as 'Compatible with conditions' need ONLY to be referred to DOE for assessment and a written response if the activity does not follow recommendations endorsed by DOE such as those made in policy, environmental management guidelines, protection notes; Ministerial Conditions, Works Approvals, Licenses or agreements (e.g. a 'Memorandum of Understanding' developed between any Local Government and DOE).

'Incompatible'- means the land use is UNACCEPTABLE to DOE as it does not meet the management objectives of the priority classification area. DOE will normally oppose approval of these land uses through the planning decision making process and under legislation administered by DOE. If planning decisions are made to approve these land uses (e.g. as a consequence of a planning appeals process), then DOE should be advised of that decision and have been directly involved in providing advice to the planning decision makers on water quality protection issues. It should be noted that contentious proposals may be referred to the EPA for Environmental Impact Assessment under the *Environmental Protection Act 1986.*

'Extensive'- means <u>limited</u> additional inputs beyond those supplied by nature are required to support the land use, e.g. for agriculture- animal feed supplements only during seasonal dry periods, or during the final preparation of stock for the market.

'Intensive'- means <u>regular</u> additional inputs are required to support the desired land use, e.g. for agriculture- irrigation, fertilisers, pesticides, or non-forage animal feeding dominates.

Interpretation of land use recommendations for planning schemes and development approvals

When using the following land use compatibility tables to guide planning schemes and development approval decisions, the following relationships should be used:

a) Where the table identifies a land use as '**Acceptable**', this use is permitted by DOE within that priority classification area. It may be identified as a '**P**' (permitted) use in a scheme, providing the use complies with the relevant development standards and requirements of the planning scheme.

b) Where the table identifies a use as '**Compatible with conditions'**, this use should be a discretionary use within the priority classification area and should be identified as either a '**D**' or '**A**' (after special notice) use in the scheme. Proposals for '**Compatible with conditions'** uses should ONLY be referred to DOE for assessment and response if they do not meet existing agency policy, guidelines or protection note measures, unless prior agreement has been made between a specific local government and DOE on alternative measures.

c) Relevant environmental management guidelines, codes of practice, water quality protection notes or agreements should be used in the first instance to define DOE's position on any land-use and limit the need to refer proposals to the DOE. Where these do not exist, site specific advice may be provided by the DOE.

d) Where the table identifies a use as '**Incompatible**', that use should not be permitted within that priority source protection area, and should be identified as an '**X**' (unacceptable use) in the scheme.

Where the table does not include a proposed land use that could affect water quality, that use should be considered to be '**Incompatible**' until the proponent can demonstrate that it meets the drinking water quality protection objective of the designated priority classification area. Specific advice on the proposed land use should be obtained from the DOE's Water Source Protection Branch.

If the land use planning approval process supports a proposal that is inconsistent with this water quality protection note, then DOE Water Source Protection Branch should be advised of this situation and the reasons for that decision. This advice will trigger DOE's assessment of the significance/ consequence of that decision to the drinking water source and the outcome will be considered in future strategies for water quality protection, and in the periodic review and update of this note. A means to ensure the DOE's effective early involvement with such cases is currently being developed.

Tables defining compatibility of various land uses within PDWSA

It is important to note that this table provides the DOE's recommended compatibility of land uses for the current zoning of land. It must not be used to support rezoning of land to provide for more intensive land uses. For example, although P3 areas provide for high density urban development when the land is already zoned Urban or Urban deferred, this Table must not be read to justify a zoning change within P3 areas to allow for high density urbanisation of rural zoned land.

Model Scheme Text (MST) land uses are shown in **bold** in the first column. Definitions covered in the MST (see note 23) can also be found in the *Town Planning Amendment Regulations 1999*.

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Agriculture– extensive			
- pastoral leases	Compatible with conditions	Acceptable	Acceptable
- floriculture (non irrigated), stock grazing (excluding pastoral leases) and broad hectare cropping,	Incompatible	Compatible with conditions (see notes 11, 12)	Acceptable
Agriculture- intensive			
- aquaculture (fish, plants and crustaceans)	Incompatible	Compatible with conditions	Compatible with conditions
- orchards; production nurseries– potted plants; viticulture– wine and table grapes	Incompatible	Compatible with conditions	Acceptable
- floriculture; market gardens (see note 24); turf farms	Incompatible	Incompatible	Compatible with conditions
- hydroponic plant growing	Incompatible	Compatible with conditions	Compatible with conditions
- plant nurseries / garden centres	Incompatible	Compatible with conditions (see note 2)	Acceptable
Agro-forestry	Incompatible	Compatible with conditions	Acceptable
Amusement parlour	Incompatible	Incompatible	Acceptable (see note 1)
Animal establishment			
- animal saleyards and stockyards (see note 13)	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 2)
- apiaries	Compatible with conditions	Acceptable	Acceptable
- catteries	Incompatible	Acceptable	Acceptable
- dairy sheds	Incompatible	Compatible with conditions (see notes 2, 3, 12)	Compatible with conditions (see note 3)
- dog kennels	Incompatible	Compatible with conditions	Compatible with conditions
- equestrian centres (see note 17)	Incompatible	Incompatible	Acceptable
- feedlots, intensive outdoor livestock holding	Incompatible	Incompatible	Compatible with conditions
- stables (see note 18)	Incompatible	Compatible with conditions	Acceptable
Animal husbandry- intensive			
- piggeries	Incompatible	Incompatible	Incompatible
- poultry farming - housed	Incompatible	Compatible with conditions	Compatible with conditions
Bed and breakfast (accommodating a maximum of 6 guests)	Compatible with conditions (see notes 6, 16)	Acceptable (see note 23)	Acceptable
- farm stay accommodation, rural chalets)	Compatible with conditions (see notes 6, 16)	Compatible with conditions (see note 4)	Acceptable
Betting agency	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Caravan park	Incompatible	Incompatible	Compatible with conditions (see note 1)
Caretakers dwelling	Compatible with conditions (see note 2)	Compatible with conditions	Acceptable

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Car park	Incompatible	Compatible with conditions (see note 2)	Acceptable
Cemeteries	Incompatible	Incompatible	Compatible with conditions
Child care premises	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Cinema/ theatre	Incompatible	Incompatible	Acceptable (see note 1)
Civic use	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Club premises			
- sporting or recreation clubs	Incompatible	Compatible with conditions	Acceptable (see note 1)
- health centres	Incompatible	Incompatible	Acceptable (see note 1)
Community purpose			
- community halls	Incompatible	Compatible with conditions (see note 2)	Acceptable
- irrigated golf courses or recreational parks	Incompatible	Incompatible	Compatible with conditions (see note 11)
- motor-sports (permanent racing facilities)	Incompatible	Incompatible	Compatible with conditions
- public swimming pools/ aquatic centres	Incompatible	Incompatible	Compatible with conditions
- rifle ranges	Incompatible	Compatible with conditions	Acceptable
Consulting rooms	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Convenience store	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Corrective institution	Incompatible	Incompatible	Compatible with conditions (see note 1)
Educational establishment			
- community education centres, scientific research institution	Compatible with conditions (see note 2)	Compatible with conditions (see note 2)	Acceptable (see note 1)
- primary / secondary schools, tertiary education facilities	Incompatible	Incompatible	Acceptable (see note 1)
Exhibition centre	Incompatible	Incompatible	Acceptable (see note 1)
Family day care	Incompatible	Acceptable (see note 19)	Acceptable (see note 1)
Fast food outlet	Incompatible	Incompatible	Acceptable (see note 1)
Forestry (native forest/ silviculture/ tree farming)	Compatible with conditions (see note 11)	Compatible with conditions (see note 11)	Acceptable
Fuel depot (storage/ transfer)	Incompatible	Incompatible	Compatible with conditions
Funeral parlour	Incompatible	Incompatible	Acceptable (see note 1)
Home business	Incompatible	Acceptable (see note 20)	Acceptable (see note 1)

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Home occupation	Compatible with conditions (see note 15)	Acceptable (see note 21)	Acceptable (see note 1)
Home office	Compatible with conditions (see note 15)	Acceptable	Acceptable
Home store	Incompatible	Compatible with conditions	Acceptable (see note 1)
Hospital	Incompatible	Incompatible	Compatible with conditions (see note 1)
Hotel (includes hotels, hostels, resorts)	Incompatible	Incompatible	Acceptable (see note 1)
Industry			
- abattoirs	Incompatible	Incompatible	Incompatible
- cottage	Compatible with conditions	Compatible with conditions	Acceptable
- drinking water treatment plant	Compatible with conditions	Compatible with conditions	Compatible with conditions
- extractive, includes construction/ mining camps (see note 10)	Compatible with conditions	Compatible with conditions	Compatible with conditions
- food processing, dairy product factories, breweries	Incompatible	Incompatible	Compatible with conditions (see note 1)
- general (chemical manufacture/ formulation, dry cleaners, dye works, laboratories, photo-processors)	Incompatible	Incompatible	Compatible with conditions (see note 1)
- general (metal production/ finishing, pesticide operator depots, heavy or energy industry, petroleum refineries)	Incompatible	Incompatible	Incompatible
- general (concrete batching, cement products, fertiliser manufacture/ bulk storage, wrecking)	Incompatible	Incompatible	Compatible with conditions
- general (mineral processing)	Incompatible	Incompatible	Compatible with conditions (see note 9)
- light industry	Incompatible	Incompatible	Compatible with conditions (see note 1)
- milk transfer depots	Incompatible	Incompatible	Compatible with conditions
- mining (includes mineral and energy exploration, oil or gas extraction / decontamination for transport)	Compatible with conditions (see note 9)	Compatible with conditions (see note 9)	Compatible with conditions (see note 9)
- mining (tailings dams)	Incompatible	Incompatible	Compatible with conditions (see note 9)
- mining (includes construction/ mining camps), (see note 10)	Compatible with conditions	Compatible with conditions	Compatible with conditions
- rural (animal product rendering works, tanneries, wool scours)	Incompatible	Incompatible	Incompatible
- rural (farm supply centres, manure stockpiling/ processing facilities)	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions
- rural (forestry products processing– chip mills, pulp/ paper, timber preservation, wood/ fibre works, composting/ soil blending - commercial)	Incompatible	Incompatible	Compatible with conditions
- service industry	Incompatible	Incompatible	Compatible with conditions
Landfill (solid waste disposal)			
- class I (refer also to 'Storage - used tyres' advice)	Incompatible	Incompatible	Compatible with conditions
- class II or III	Incompatible	Incompatible	Incompatible
- class IV or V	Incompatible	Incompatible	Incompatible

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Lunch bar	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Major transport infrastructure (roads, railways)	Incompatible	Compatible with conditions (see note 14)	Acceptable
Marina (includes boat moorings and servicing)	Incompatible	Incompatible	Compatible with conditions
Marine filling station (boat fuelling)	Incompatible	Incompatible	Compatible with conditions
Market (food; general produce; second–hand goods)	Incompatible	Incompatible	Acceptable (see note 1)
Medical centre	Incompatible	Incompatible	Acceptable (see note 1)
Motel	Incompatible	Incompatible	Acceptable (see note 1)
Motor vehicle, boat or caravan sales (sales yards)	Incompatible	Incompatible	Acceptable (see note 1)
Motor vehicle repair	Incompatible	Incompatible	Compatible with conditions
Motor vehicle wash	Incompatible	Incompatible	Compatible with conditions
National and regional parks and nature reserves	Acceptable	Acceptable	Acceptable
Night club	Incompatible	Incompatible	Acceptable (see note 1)
Office	Incompatible	Compatible with conditions	Acceptable (see note 1)
Park home park	Incompatible	Incompatible	Compatible with conditions (see note 1)
Place of worship	Incompatible	Incompatible	Acceptable (see note 1)
Plantation	Compatible with conditions (see note 11)	Compatible with conditions (see note 11)	Acceptable
Reception centre	Incompatible	Incompatible	Acceptable (see note 1)
Recreation– private (within non-designated recreation areas on Crown land)	Incompatible	Incompatible	Acceptable
Residential building			
- house	Compatible with conditions (see note 16)	Acceptable (see note 4)	Acceptable (see note 1)
- group dwellings (aged and dependent persons)	Incompatible	Incompatible	Acceptable (see note 1)
Restaurant	Incompatible	Incompatible	Acceptable (see note 1)
Restricted premises (adult interests)	Incompatible	Incompatible	Acceptable (see note 1)
Rural pursuit	See Agriculture, Animal establishment or husbandry		
Service station (includes aircraft, automotive repairs, boats, mechanical plant, service stations at transport and municipal works depots)	Incompatible	Incompatible	Compatible with conditions (refer to note 1)
Shop	Incompatible	Compatible with conditions (see note 2)	Acceptable (see note 1)
Showroom	Incompatible	Incompatible	Acceptable (see note 1)

Model Scheme Text & interpreted type of land use	P1 areas	P2 areas	P3 areas
Storage			
- used tyres (see note 22)	Incompatible	Incompatible	Incompatible
- chemical storage in under ground tanks	Incompatible	Incompatible	Compatible with conditions
- chemical storage in above ground tanks	Incompatible	Compatible with conditions	Compatible with conditions
Tavern	Incompatible	Incompatible	Acceptable (see note 1)
Telecommunications infrastructure	Compatible with conditions	Compatible with conditions	Compatible with conditions
Toilet blocks and change rooms	Compatible with conditions (see note 2)	Compatible with conditions	Acceptable
Trade display	Incompatible	Incompatible	Acceptable (see note 1)
Veterinary centre	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 1)
Warehouse	Incompatible	Compatible with conditions (see note 2)	Compatible with conditions (see note 1)
Waste transfer station (includes recycling depots)	Incompatible	Incompatible	Compatible with conditions
Wastewater infrastructure			
- sewerage – gravity sewers	Incompatible	Incompatible	Acceptable
- sewerage – pressure mains	Incompatible	Compatible with conditions	Acceptable
- sewer pump stations	Incompatible	Compatible with conditions	Compatible with conditions
- treatment plants, wastewater disposal to land	Incompatible	Incompatible	Compatible with conditions
- wastewater injection into the ground (see note 25)	Incompatible	Incompatible	Incompatible
Water treatment plants (drinking)	See Industry		
Winery (includes wine tasting facilities)	Incompatible	Compatible with conditions (see notes 3 & 5)	Compatible with conditions (see note 3)

Table recommending compatibility of land subdivision within PDWSA: Note - This table reflects the recommended size of a subdivision based on the existing zoning and the priority classification area status of land. It should be noted that Town Planning Scheme provisions for specific zones and reserves will take precedent over the following recommended lot sizes.

Form of subdivision (specific to current zoning)	P1 areas	P2 areas	P3 areas
Rural subdivision			
- to a lot size of 4 hectares or greater	Incompatible	Acceptable	Acceptable
- to a lot size less than 4 hectares	Incompatible	Incompatible	Incompatible
Special rural subdivision			
- to a lot size of 2 hectares or greater	Incompatible	Compatible with conditions (see notes 7 & 8)	Compatible with conditions (see note 8)
- to a lot size between 1 and 2 hectares	Incompatible	Incompatible	Compatible with conditions (see notes 7 & 8)
- to a lot size less than 1 hectare	Incompatible	Incompatible	Compatible with conditions (see note 7)
Urban subdivision	Incompatible	Incompatible	Acceptable (see note 1)
Industrial subdivision	Incompatible	Incompatible	Acceptable (see note 1)

Explanatory notes related to land uses described the tables:

The following notes provide interpretive information based on the scale or type of development described in the preceding tables. They do not list all the conditions that could apply to any activity or development.

1. Must be connected to deep sewerage, except where exemptions apply under State Government Sewerage Policy. The Policy recognises that sewer connection may be impractical in some areas. Under these circumstances maximum wastewater loadings (based on people/ hectare) apply linked to the management Priority of the site.

2. The land use is normally incompatible, but may be conditionally approved where this facility is consistent with approved State and local government planning strategies or schemes.
3. The land use must incorporate best environmental management practices compatible with the management strategy for the designated priority area defined in the relevant source protection plan.
4. In Priority 2 areas: conditions may apply to density of dwellings (i.e. hectares per dwelling).
5. Size of the grape crush shall not exceed 500 tonnes per year.
6. May be approved if occupancy is of equivalent size to a single dwelling household (i.e. less than 10 people– defined by capacity of a septic tank based on-site wastewater treatment system).
7. An average, rather than minimum, lot size may be accepted if the proponent can demonstrate that the water quality objectives of the source protection area are met, and caveats/memorials are placed on titles of specified blocks stating that further subdivision shall not occur.
8. Lots should only be created where land capability assessment shows that effective on-site soakage of treated wastewater can be achieved. Conditions apply to siting of wastewater disposal systems in areas with poor land drainage and/ or a shallow depth to groundwater, animals are held or fertiliser is applied. Alternative wastewater treatment systems, where approved by the Department of Health, may be accepted with ongoing maintenance requirements.
9. Conditions are likely to be placed via a Department of Industry and Resources mineral tenement lease, and / or as a result of Minister for the Environment's approval after an Environmental Impact Assessment.
10. Conditions apply to the storage of fuels and chemicals, the depth of excavation related to the water table and rehabilitation criteria. Underground fuel or chemical storage tanks are prohibited via DOE by-laws in Priority 1 and 2 areas within Underground Water Pollution Control Areas.
11. Conditions apply to regulate fertiliser and pesticide application.
12. Can be approved if animal stocking levels (animals per hectare, guided by the Department of Agriculture's stocking rate guidelines) are consistent with the priority source protection area objectives.
13. This does not include stockyards occasionally used on farms or pastoral leases for animal husbandry.
14. Conditions may be imposed to cover design, construction of infrastructure and the types of goods.
15. May only be approved if *Home Occupation* relates to an existing residence.
16. Limited to one residential building per property.
17. Includes land or buildings dominantly used for the showing, competition or training of horses, and riding schools.
18. Includes any land, building or structure used for equine (e.g. horses, asses, mules and donkeys) housing, keeping and feeding and associated activities.
19. In accordance with *Community Services (Child Care) Regulations 1988*: *A child care service provided to a child in a private dwelling in a family of or domestic environment. No more than 5 children of pre-school age and no more than 7 children under 12 years old, including the children of the licensee or permit holder.*

20. No more than 2 employees, and the home business occupies an area up to 50 square metres. Compatible if only an office/ administrative business (i.e. overnight parking of only one commercial vehicle, no refuelling or repair/ maintenance of business vehicles, and no activities involving on-site use storage or disposal of chemicals or process wastewater).

21. Employees shall be members of the household, and the home business occupies an area of up to 20 square metres. No provision for refuelling, repair or maintenance of commercial/ business vehicles or on-site use or storage of chemicals.

22. Used tyre use, storage and disposal are subject to *Used Tyre Regulations 1996*, administered by this agency.

23. As defined in the *Model Scheme Text* (1997) or the *Residential Design Codes of Western Australia* (2002) prepared by the Western Australian Planning Commission, and covering local government planning schemes.

24. Applies to the commercial production of horticultural crops e.g. vegetables, flowers and fruit crops grown in contact with the ground. Does not apply to cereal or oil seed crops, perennials e.g. orchards, vineyards, nuts; or any crop grown separate from contact with soils in the natural environment e.g. hydroponics.

25. The use of recycled (reclaimed) water to address the diminishing level of scheme water supply in Western Australia is currently being investigated by Government. The social, environmental, health and economic issues related to this option are significant and need to be further progressed before its applicability in PDWSA is reconsidered.

More information or feedback

More information about recommended best management practices is available in Environmental Management Guidelines and Water Quality Protection Notes for some of the listed land uses. These are available on DOE's Internet site <http://www environment.wa.gov.au> or by contacting DOE regional offices.

We welcome your comments on this note. The note will be updated from time to time as feedback is received or land-use activity standards change. If you wish to discuss this note, please contact DOE Water Source Protection Branch at the Hyatt Centre in East Perth. Phone: (08) 9278 0300 (business hours); Fax: (08) 9278 0585; or E-mail: use {feedback} section at DOE Internet address <*http://www.environment.wa.gov.au*>, citing the topic and version.

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Appendix 2 Water Quality

The Water Corporation has monitored water quality from Jandakot wellfield in accordance with Australian Drinking Water Guidelines (ADWG) and interpretations agreed to with the Department of Health (DoH). Drinking water criteria that have been monitored together with ADWG health and aesthetic guideline values are available from the Water Corporation on request.

MICROBIOLOGICAL CONTAMINANTS

Microbiological testing of the raw water from Jandakot wellfield is conducted weekly. Thermotolerant coliform counts are used as an indicator of the degree of faecal contamination of the raw water from warm-blooded animals. A count less than 20 colony forming units (cfu) per 100 mL is typically associated with low levels of faecal contamination from indigenous animals and is used as a microbiological contamination benchmark (WHO, 1996).

There have been no thermotolerant coliform counts recorded in raw water samples from Jandakot wellfield.

Raw water from the Jandakot wellfield is clarified, filtered, dosed with alum, polyelectrolyte and sodium hydroxide, chlorinated and fluoridated at the Jandakot Groundwater Treatment Plant.

HEALTH RELATED CHEMICAL WATER QUALITY DATA

Raw water from Jandakot wellfield is analysed for health related chemicals. Health related chemicals include inorganics, heavy metals, industrial hydrocarbons and pesticides. Health related water quality parameters that have been measured at detectable levels in the sources for the five years to December 2005 are summarised in the following table. All values are in milligrams per litre (mg/L).

Parameter	Range of Monitored Values Min-Max Median Jandakot Raw Water	ADWG Health Value*
Metals		
Barium	0.065 – 0.085 0.070	0.7 mg/L
Boron	No Detection – 0.090 0.078	0.3 mg/L

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

Barium and boron have been detected in raw water samples from Jandakot wellfield, but at concentrations well below ADWG.

Although arsenic has not been detected at the raw water sampling point, it has been observed in bores J320 and J410. The two readings from bore J410 of 0.008 and 0.009 mg/L are marginally above the ADWG value. Occurrence of arsenic at these levels may be just natural variation within the aquifer, but further assessment is required to determine if there are potential sources of arsenic associated with nearby activities.

Nitrate was not detected at the raw water sampling point and was observed at very low concentrations (generally <0.01mg/L) in individual bores.

All health related water quality parameters from Jandakot wellfield raw water sampling point did not exceed health guideline values and no trends are evident, and therefore present no significant health risk. These parameters will continue to be routinely monitored.

AESTHETIC WATER QUALITY DATA

Aesthetic water quality analyses for raw water from Jandakot wellfield are summarised in the following table. The values are taken from ongoing raw water monitoring for the five year period to December 2005. All values are in milligrams per litre (mg/L) unless stated otherwise. The water quality parameters that have on occasion exceeded the ADWG aesthetic guideline for supplied drinking water are shaded. Observed values are considered to be within the naturally occurring range for this locality and no trends are evident. The Jandakot Groundwater Treatment Plant reduces the level of concentration of these parameters to within the aesthetic guideline values.

Parameter	Range of Monitored Values Min-Max Median	ADWG Aesthetic Value
	Jandakot Raw Water	
Salinity (TFSS – CO_2)	447 – 731 610	500 mg/L
Hardness ($CaCO_3$)	157 – 179 162	200 mg/L
Turbidity	3 – 24 NTU 10 NTU	5 NTU
pH	6.5 – 6.9 6.7	6.5-8.5
Colour	35 – 70 TCU 44 TCU	15 TCU
Iron (unfiltered)	0.6 – 2.6 1.6	0.3 mg/L
Manganese (unfiltered)	0.016 – 0.036 0.030	0.1 mg/L
Aluminium (unfiltered)	0.12 – 2.40 0.56	0.2 mg/L

Appendix 3 Examples of Protection Strategies (Used in existing Drinking Water Source Protection Plans)

Activity	Recommended Protection Strategies
State owned (public) Land (P1 source protection)	
Reserves State Forest Unallocated	*Acceptable with best management practices* • Encourage government agency that manages the land to include provisions for water quality protection. • Review agency management plans regularly to ensure water quality protection objectives met. • Inspect protection measures on-site.
Timber Production (State Forest)	*Acceptable with best management practices* • Ensure compliance with the Contractor's Timber Harvesting Manual for water quality protection. • Review 1 year and 5 year harvesting plans to ensure water quality protection objectives are met. • Inspect protection measures on-site.
Apiarists Wildflower picking Seed collection Firewood collection	*Acceptable activity with conditions* • Activities to be restricted to outside proposed RPZ and away from feeder streams. • Apply conditions for Apiarists, Wildflower Picking and Seed collection that meet water quality protection objectives. • Promote casual firewood collection areas outside catchment area. • Firewood collection is not authorised in vested Reserves.
Roads	*Acceptable with best management practices* • Review road maintenance practices and develop a plan to minimise risk to water quality. • Conduct risk assessment survey for transport of fuel and chemicals. Place signs along road with an emergency contact number for spills. • Construct sumps at major stream crossings. • Ensure emergency response process is in place and local emergency management advisory committee is aware of management requirements for drinking water catchment.
Off-road vehicle use	*Unacceptable activity* • Remove site as a destination in CALM "4WD Days Out of Perth" publication. • Recognise activity in regional recreation plan and look at alternative sites. Encourage involvement in organised events. • Use signage to promote awareness that off-road driving is not permitted. • Undertake surveillance to control off-road driving in the catchment.
Bushwalking	*Acceptable activity with conditions* • Ensure trails outside RPZ, away from streams feeding into reservoir, and cross-streams where culverts and / or bridges are established. • Compliance with the Department of Environment's Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land (Recreation Policy), available via www.drinkingwater.water.wa.gov.au. • Promote bushwalking opportunities as part of a regional recreational plan. • Use signage as education tool. • Undertake surveillance. • Require organised groups to obtain approval for events
Picnicking	*Acceptable activity with conditions* • Locate picnic sites outside the proposed RPZ. • Promote use of controlled picnic away from watercourses. • Promote picnicking opportunities as part of a regional recreational plan. • Prohibit dogs through education/signs, promotional material and surveillance. • Compliance with the Department of Water's Recreation Policy available via . www.drinkingwater.water.wa.gov.au.
Horse riding events	*Acceptable with Best Management Practices* • An environmental management plan developed for each event, addressing water quality protection measures. Approval for each event subject to implementation and review of plan. • Camping will be restricted to specific sites as developed in regional recreation plan. • All events to be staged on roads and trails. Stream crossings to be on made roads at culverts or bridges. • Monitor existing events to identify water quality risks to be addressed in the environmental management plan. • No new events to operate in the catchment. • Refer to Environmental Guidelines for Horse Facilities and Activities, available via http://drinkingwater.water.wa.gov.au

Activity	Recommended Protection Strategies
Hunting	*Unacceptable activity* • Catchment to be closed to hunting through the CAWS Act and MWSSDB 1909 By-Laws. • Place signs throughout catchment indicating uncontrolled hunting is illegal. • Undertake surveillance of the catchment. • Control feral animal through managed program.
Swimming	*Unacceptable activity* • Make public aware that swimming is prohibited under the CAWS Act By-laws. • Signs in the catchment • Undertake surveillance & by-law enforcement. • Compliance with Department of Water's Recreation Policy, available via http://drinkingwater.water.wa.gov.au
Fishing Marroning	*Unacceptable activity* • Make public aware that fishing and marroning is prohibited under the CAWS Act By-laws. • Place signs throughout catchment indicating fishing and marroning is not permitted. • Undertake surveillance & by-law enforcement. • Signs in the catchment • Compliance with Department of Water's Recreation Policy, available via http://drinkingwater.water.wa.gov.au
Boating	*Unacceptable activity* • Make public aware that boating is prohibited under the CAWS Act By-laws. • Undertake surveillance & by-law enforcement. • Signs in the catchment • Compliance with the Department of Water's Recreation Policy available via http://drinkingwater.water.wa.gov.au
Motor vehicle rallies Including: Rally Australia Motor bike events	*Acceptable with best management practices* • No new rallies to operate in the catchment. • An environmental management plan developed for each event, addressing water quality protection measures. Approval for each event subject to implementation and review of plan. Compliance with Department of Water's Recreation Policy available via http://drinkingwater.water.wa.gov.au
Military activities	*Acceptable activity with conditions* • Restrict military training to outside of the RPZ. • Ensure approval for military activities contains conditions for water quality protection. • Undertake discussions with military to investigate the use of alternative areas. • Undertake surveillance to ensure compliance with approval.
Water supply construction	*Acceptable with Best Management Practices* • Ensure water quality risk addressed in EMP. • Work with contractors on-site and advice on issues related to water quality protection. • Monitor turbidity and undertake remediation if monitoring shows adverse impact.
Private Land (P1 source protection)	
	Long term goal of crown ownership of private land • Landowners can continue current activities with best practices being encouraged (refer to Quality Protection information. http://drinkingwater.water.wa.gov.au, select publications> Water Quality Protection Notes. • Oppose intensification of land uses through planning approval process. • Offer landowners opportunity to sell or swap their land. Purchased land to become Crown Reserve and re-vegetated. Long-term Crown ownership is preferable
Private Land - Rural (P2 source protection)	
Cropping and grazing Tree farming Viticulture	*Acceptable with best management practices* • Landowners continue current activities with best practices being encouraged (refer to Quality Protection information http://drinkingwater.water.wa.gov.au • Ensure Town Planning Scheme adequately controls development. • Oppose intensification of land uses through planning approval process. • Promote water quality protection.

Activity	Recommended Protection Strategies
Land clearing for broadacre farming in Clearing Control Catchments	*Manage as non-conforming land use* • Landowner can continue current activities (consistent with *Environmental Protection Act 1986* and *Country Area Water Supply Act* 1947 approvals), with best management practices being encouraged • Continue to support changes in land use within existing approvals that reduce salinisation. • Oppose intensification of land uses through planning approval process. • Continue re-vegetation initiatives under clearing control legislation. Land transferred to Crown ownership to be re-vegetated.
Rural residential	*Maintain existing planning controls* • Ensure the Special Provisions for the Rural Residential Zone control development. • Encourage landowners to adopt best management practices for permitted activities (refer to Quality Protection information http://drinkingwater.water.wa.gov.au • Oppose intensification of land use through planning approval process. • Support changes within existing approvals that reduce groundwater contamination risks. • Encourage connection to deep sewerage through planning approval process. • Promote water quality protection.
Rural development Including: Special rural zones Rural retreats Hobby farms Cottage industries Chalets Bed and breakfasts and farmstays	*Conditional with best management practices* • Landowners can continue current activities with best practices being encouraged (refer to Quality Protection information http://drinkingwater.water.wa.gov.au • Ensure Town Planning Scheme adequately controls development. • Oppose intensification of land uses through planning approval process.
Private Land - (P3 source protection)	
	Acceptable with controls • Landowners can continue current activities, with best practices being encouraged (refer to Quality Protection information http://drinkingwater.water.wa.gov.au) • Ensure Town Planning Scheme adequately controls development. • Further subdivision and land use to be consistent with water quality objectives. • Oppose incompatible land uses through planning approval process. • Encourage connection to deep sewerage through planning approval process.
Power stations	*Manage as non-conforming land use* • Landowner can continue current activities, with best management practices being encouraged. • Support changes in land use within existing approvals that reduce groundwater contamination risks.
Disused depots Including: Water Corporation Western Power Shire	*Unacceptable in current condition* • Remove all infrastructure and contaminant threats including septic system and decontaminate site. • Return site to natural bushland.
Rubbish disposal	*Unacceptable activity* • Encourage local council to close site and undertake remediation to decontaminate site. • Return site to natural bushland.
Horticulture	*Maintain existing planning controls* • Landowners can continue current activities with best management practices being encouraged (refer to environmental guidelines for horticulture and/or viticulture via http://drinkingwater.water.wa.gov.au • Oppose intensification of land use through planning approval process. • Support changes in land use within existing approvals that reduce groundwater contamination risks.
Residential	*Acceptable activity with controls* • Ensure Town Planning Scheme adequately controls development (refer to Quality Protection information http://drinkingwater.water.wa.gov.au • Encourage connection to deep sewerage through planning approval process. • Further subdivision to be consistent with Draft Country Sewerage Policy 2003. • Promote water quality protection.

Activity	Recommended Protection Strategies
Industrial and commercial sites.	*Acceptable activity with controls* • Landowner can continue current activities. They are also encouraged to upgrade existing facilities to meet DoE recommendations (refer to Quality Protection information http://drinkingwater.water.wa.gov.au • Oppose intensification of land use through planning approval process (eg those activities not acceptable in P3 areas). • Support changes in land use within existing approvals that reduce contamination risks.

Appendix 4 DoW WQPN Overview on protecting Public Drinking Water Source Areas

Note WQPN subject to change. Refer to the Department of Water website http://drinkingwater.water.wa.gov.au for latest version.

Water Quality Protection Note

Department of Environment

Overview on protecting Public Drinking Water Source Areas

Introduction

This agency is the custodian of all of the State's water resources. Our role is to ensure the State's water resources are managed to support sustainable development and conservation of the environment for the long-term benefit of the community.

Next to food, water is the most essential element for life, and our aim is to protect Public Drinking Water Source Areas (PDWSA) so that they consistently contain high quality water. This should yield reliably 'safe, good quality drinking water' to protect public health for now and into the future at a reasonable cost to consumers.

This note provides an overview of the present strategy used to protect public drinking water supply sources in Western Australia. The former State Government agencies the *Department of Environmental Protection* and *Water and Rivers Commission* are presently being combined to form the *Department of Environment.* This process will not be complete until enabling legislation has been passed by Parliament and proclaimed. This note aims to present a generic 'combined agency' position on the nominated topic.

Who is involved in protecting our drinking water supplies?

Responsibility for the condition (quality) and availability (quantity) of our drinking water must be shared by the community, land owners/developers, industry, agriculture, local government, water service providers and the State government. All of these groups play a significant role in the development of Drinking Water Source Protection Plans (DWSPP) for PDWSAs (also called drinking water catchments in this note). They also may be involved in the implementation of the recommendations in those plans. Their direct and ongoing involvement in the protection of our drinking water catchments is essential to achieve a successful outcome.

The Department of Environment (DOE), is primarily responsible for defining, proclaiming and protecting the catchments of Public Drinking Water Source Areas (PDWSAs). The PDWSAs are made up of any area proclaimed to protect public drinking water source catchments. These areas are proclaimed as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909,* and Water Reserves or Catchment Areas under the *Country Areas Water Supply Act 1947*.

The DOE has responsibility to administer the State's catchment protection legislation. This administration includes:

- undertaking and facilitating effective by-law enforcement and catchment surveillance;
- the assessment and permitting of land use developments or activities;
- negotiating protection mechanisms in the land use planning process; and
- advising on the compatibility of land development and use activities.

The DOE also has responsibility for preparing policies and guidelines, drinking water source protection assessments and plans and advising other decision-making agencies on source protection requirements. The Department promotes a coordinated approach to catchment protection encompassing a variety of related measures including regional and local land use planning; health; and environmental legislation.

Where public health is concerned, the Department of Health has primary responsibility. The Department of Health's role is to minimise human exposure to environmental health hazards that pose or have the potential to pose a health risk and to reduce the incidents and impact of communicable disease. To safeguard against unhealthy drinking water, the Department of Health works closely with the DOE and individual Water Service Providers. The Department of Health also chairs an inter-agency committee, called the *"Advisory Committee for the Purity of Water"*, established in 1925 and charged with the ongoing responsibility of advising the State on drinking water protection issues. The Office of Water Regulation is another government agency with a key role in regulating drinking water supply issues. It issues licences to individual Water Service Providers such as the Water Corporation, Aqwest (Bunbury) and Busselton Water Board.

The Water Corporation is the largest Water Service Provider in WA, and it was formed in the mid 1990's after the split of the former Water Authority of Western Australia as part of the COAG Water Industry Reform initiatives. The Corporation is the major licensed Water Service Provider in Western Australia, supplying the Perth metropolitan area as well as a further 230 towns across the State. It is a corporation, with the state government being the sole shareholder, and is subject to corporation law. It is managed by a board of directors including the Managing Director (its CEO). The Corporation is required to return a dividend on the Government's investment in the Corporation's assets and in return receives Customer Service Obligation (CSO) payments to subsidise uneconomic services that are required to be provided by the Government. The Corporation also pays federal tax equivalents to the State Government in accordance with the COAG reform agreement.

Source Protection Operational Agreements exist between the DOE and the Water Corporation, which assign roles in catchment protection, clarify responsibilities in catchment protection and ensure the process is carried out effectively. Under the legislation, the DOE may delegate certain catchment management functions to the Water Corporation (or other water service providers). Delegation is appropriate as the Corporation has a strong vested interest in assuring high quality drinking water from the catchments and is also prepared to resource catchment management functions. Currently, delegated functions relate to catchment surveillance, enforcing by-laws regarding transient catchment activities, entry onto land and catchment management planning. The extent of delegated responsibilities may vary between catchments.

Why should we protect our drinking water supplies?

Drinking water should be safe to drink and aesthetically pleasing. Ideally, it should be clear, colourless, pleasant tasting and contain no harmful chemicals or disease-causing microbes. To keep drinking water clean it is important to protect both our surface and underground drinking water sources (e.g. surface dams and groundwater) and the catchments in which they are located.

This advice deals with the water consumed in homes and provided by licensed Water Service Providers (often referred to as 'scheme' supplies). These WSP are responsible for water treatment (including disinfection) and distribution services to the community. Advice on alternative (potentially less safe) drinking water sources, such as private bores or rainwater tanks, is available in other documents. As a rule neither the Department of Health or DOE recommend the use of rainwater or private bore water for drinking water purposes where a scheme water source is available. This is because the catchments of these other sources are generally not protected from contamination and they are not analysed or treated to meet the relevant health guidelines for drinking water. Such sources can however be useful for non-potable uses such as in washing machines, toilets or for gardens. If a scheme supply is not available, then it is important that the consumer implements the necessary measures to ensure their drinking water source is safe to drink (i.e. arrange water analyses and treatment as required).

In the mid 1990's, the Council of Australian Government reforms process took an initiative to pursue the sustainable use of water resources by protecting and enhancing their quality, while maintaining economic and social development. This was achieved through the development of a National Water Quality Management Strategy (NWQMS) presently comprising 21 national guideline documents. Two of these focused on drinking water, the *Australian Drinking Water Guidelines-Summary* and the *Australian Drinking Water Guidelines,* 1996 (an update of the 1987 *Guidelines for Drinking Water Quality in Australia*).

The *Australian Drinking Water Guidelines, 1996* (ADWG) recognised water source protection through catchment management as an effective approach to preventing contamination of drinking water sources and undertook to investigate this issue further.

In May 2001, Western Australia supported the NWQMS (including the ADWG) through the launch of its own State Water Quality Management Strategy (SWQMS). In late 2002, the ADWG were updated and released for public comment. The ADWG 2003 have now been finalised and are planned to be released in late 2003. A 'consumer guide' to the ADWG 2003 called *Water made clear* has also been developed to raise awareness of the need to protect drinking water catchments from 'catchment to consumer'.

Roughly half of Perth's water supplies come from surface sources with the remainder harvested from groundwater. In 1994, a Parliamentary Select Committee reported on the issue of Perth's development and groundwater supplies. The Select Committee considered experience from around the world and overwhelmingly concluded, "*an ounce of prevention is worth a pound of cure"*. In his foreword, the chairman of the Select Committee noted: ***"experts around the world expressed their envy of our relatively pristine water supply and advised us to protect our groundwater supply at all costs"***.

In 2000, the State Legislative Council's *Standing Committee on Ecologically Sustainable Development in relation to the Quality of Perth's Water Supply* expressed confidence in the system managing and operating Perth's water supply. The Standing Committee noted, however, that various activities posed a contamination risk to water supplies. It found as a ***"first priority that water sources be protected through good land use planning.*** **It also noted that** "*Using treatment to deal with contamination is a second-best option. The Committee found support for adopting catchment protection as the major weapon in preventing contamination of water supplies"*. In November 2001, in support of this finding, the Western Australian Planning Commission (in consultation with the Water and Rivers Commission) released a *Public Drinking Water Source Policy* for public comment. The Policy was gazetted in June 2003. This policy will guide State and Local Government land use planning decisions in public drinking water catchments.

Although the above committees were reporting on Perth's water supplies, their findings apply to all public drinking water sources in Western Australia. This is especially true when a community is reliant upon a single drinking water resource (such as the groundwater bore network in Kununurra or surface water dam in Quinninup) rather than an integrated series of sources (such as those that supply Perth). Contamination of a single resource from inappropriate land use planning or polluting activities within the catchment can have significant health and economic impacts, which should be avoided.

In February 2003, the Western Australian Government released its State-wide water strategy. Although prepared in response to a number of forums around State focusing on drought, it did however make a significant statement about protecting our public drinking water sources. It stated unequivocally that ***recognition of the primacy of water quality in the management of drinking water catchments, to protect the long term sustainability of the resource, will be used to guide catchment management decisions.***

This is interpreted to mean, when managing and protecting any public drinking water source catchment, the dominant consideration must be maintenance of water resource quality and the prevention of contamination risk. This objective in most cases may prevent or constrain further land development.

More recently in September 2003, the Western Australian Government also released its State-sustainability strategy document – "Hope for the future". Drinking water catchments are now recognised as important 'natural resources' together with the other more common natural resources (eg. agriculture, fisheries, forestry, mining, tourism, aquatic systems, coastal and marine environments and rangelands). The 'Vision' in the Strategy is that "Drinking water sources are fully protected for future generations.". The Strategy lists the following 'Actions': (number 3.48) that we "Work to ensure all present and future drinking water sources are protected."; and (number 3.51) that we "Ensure the activities in catchments are actively managed and sustainable…" through "…investigation of the impact of active catchment management strategies that enhance water quality and quantity outcomes…".

What are we protecting the drinking water supplies from?

Land use planning decisions and recreational or business activities occurring in drinking water catchments can impact on the quality and quantity of drinking water. Where catchments remain covered with native vegetation with little human activity, the risk of contamination is low. However, contamination risks increase with increased human activity.
Potential contaminants may include:

- physical contaminants e.g. colour, foaming agents and suspended solids;
- chemical contaminants e.g. salts, heavy metals and poisons; or
- microbiological contaminants e.g. bacteria, protozoa and pathogenic viruses.

Although many contaminants can be removed by treatment processes, such treatment increases the cost of the water supply, and continuous effective removal of all contaminants is not considered technically or economically feasible. If contamination does occur, the opportunity to locate and develop a replacement source is often limited, and the provision of alternatives, e.g. bottled drinking water, is costly and can only be considered a short-term solution. Stopping contamination before it occurs prevents the need for costly treatment or the development of often more costly alternative sources. It should also be appreciated that there is a substantial ongoing financial cost to be borne in sampling and testing for contaminants if they become prevalent in drinking water sources. The benefits (environmental, social and economic) of avoiding contamination through best management decisions and practices are recognised in the ADWG 2003.

Clearly drinking water quality and safety cannot be taken for granted. Appropriate State and Local Government controls are required in consultation with, and the support of the community and other stakeholders. These controls are needed to manage a number of threats to drinking water areas, including inappropriate:

- land use planning processes and decisions resulting in high risk developments in catchments;
- recreational activities where the impact of human wastes and damage to natural protective measures associated with higher intensity land use is often underestimated; and
- use and/or disposal of chemicals, animal and domestic wastes and pesticides.

We should also appreciate that beyond the actual catchment and water storage area, drinking water that is not properly treated, or which travels through an inadequately maintained distribution system, also poses a serious public health risk.

Several recent events that have occurred nationally and internationally that highlight the importance of protecting drinking water, especially at the source.

The main finding of an inquiry into the well-publicised Sydney Water Crisis in 1998 was that the catchments were seriously compromised by many possible sources of contamination, and that there was insufficient regulatory control to guarantee safe drinking water. The Sydney Water Catchment Authority was set up in response to this event which transferred responsibility for land use decisions within the catchment from the Planning Authority to the new catchment Authority.

In Walkerton (Canada), in 2000 a drinking water catchment related tragedy unfolded where a pathogenic E-coli outbreak resulted in over 2300 cases of illness amongst 4,800 residents, 70 people were hospitalised and 7 deaths were attributed to the outbreak. A judicial inquiry concluded that the likely initial cause of the outbreak was from manure application on farmland (a common practice even in WA) that resulted in bacterial contamination finding its way into the shallow underground water-body which was used to supply drinking water. Other contributing factors to the outbreak included a high rainfall event just prior to the contamination outbreak, and an inadequate disinfectant dose rate and monitoring issues related to the distribution system. It is important to appreciate that the drinking water system at Walkerton operated for more than 8 years without major incident up until the year 2000. The over-reliance on treatment to provide a safe drinking water supply was highlighted and a new approach adopted that considered both catchment protection and improved treatment (in combination) to provide a more reliably-safe supply to consumers.

How do we protect public drinking water source areas in WA?

A 'catchment to consumer' multiple barrier approach is used in the management of drinking water quality in Western Australia. Catchment management for protection of the water source (held in storage in surface dams or underground aquifers) is considered the first important barrier. Historically, a heavy reliance was placed on treating water to achieve the desired level of safety, but it is now recognised that treatment alone does not remove all hazards to public health. Therefore, to maximise public health safety effective catchment protection is also essential. Other barriers include:

- selection of an appropriate safe high quality source (where alternatives exist);
- controls over land uses and high risk human activities in catchments underpinned by statutory measures;
- protective undeveloped buffer zones to supply bores, reservoirs and feeder streams;
- catchment protection strategies for education, surveillance, enforcement and monitoring/reporting;
- pre-treatment of drinking water, for example use of detention and settling in reservoirs to induce microbes to die off;
- protection of water storage works, for example water tanks and reservoirs;
- disinfection of drinking water before it enters the distribution system and provision to ensure an adequate disinfectant residual throughout that system;
- maintaining the distribution system as a whole including the pipe system, vermin-proofing of water tanks and preventing back-flow; and
- Promotion of source protection measures in local government planning schemes using the WA Planning Commission's *Statement of Planning Policy– Public Drinking Water Source Policy* (June 2003).

A key process employed by this agency to protect drinking water sources involves the preparation of Drinking Water Source Protection Plans (DWSPP) for the State's PDWSAs.

Drinking Water Source Protection Plans (and Drinking Water Source Protection Assessments)

Drinking Water Source Protection Plans are a key component of the 'catchment-to-consumer' protection strategy for Western Australia's drinking water supplies. This is reflected in the Government's report "*Securing our water future - A State Water Strategy for Western Australia (2003)"* which states that **water source protection plans should be completed for all public drinking water supply catchments throughout the State.** A DWSPP aims to identify existing and potential threats to a drinking water source and to provide risk management strategies and programs for the ongoing management/protection of that source. They are prepared in consultation with the community, potentially affected stakeholders (especially landowners), local government and the State government. Stakeholders are strongly encouraged to consider the risks and potential consequences of inappropriate land-use planning or human activities in the catchment (e.g contamination of the resource and costs to clean-up or establish a new drinking water source). It should be noted that decisions made following consultation may result in some land use/activity restriction in order to achieve a safe, good quality drinking water supply.

Providing a basis for establishing compatible land uses within PDWSAs, the DWSPP is only one of a suite of measures used by this agency to meet its drinking water protection responsibilities. As at June 2003, there were approximately 139 plans listed for completion. Of this number, 50 are complete and 89 are in production.

While the full suite of DWSPPs await completion, land planners and developers need to be aware of the location of and risks to existing drinking water catchments. To this end the DOE is preparing Drinking Water Source Protection Assessments (DWSPA). These Assessments will provide a broad overview of catchment risks, planning and land uses; and a basic understanding of the drinking water catchment and supply system. They are not intended to include extensive data, but to characterise the drinking water system by providing useful information for decision makers. Generally, the DWSPA will be a desktop assessment followed by a site visit and discussions with local government. In some circumstances the DWSPA may be all that is required to achieve good land planning/activity controls (e.g. through planning schemes or strategies) for the protection of drinking water source areas. Otherwise, the DWSPA will be considered base information for development of the DWSPP described above.

Priority classification system

This agency has also implemented policies to protect public drinking water source areas that includes a differential '*priority classification area'* system that includes special 'protection zones' around bores and reservoirs. Through development of a DWSPP (or possibly the DWSPA), land in a PDWSA is identified as a mix of Priority 1 (P1), Priority 2 (P2) or Priority 3 (P3) classification areas, with appropriate protection zones.

Priority 1 (P1) source protection areas are defined to ensure that there is **no degradation** of the water source. P1 areas are declared over land where the provision of high quality public drinking water is the prime beneficial land use. P1 areas would typically include land under public ownership but may in a limited number of cases include private land.
P1 areas are managed in accordance with the principle of **risk avoidance,** and hence land development is generally not permitted. Where P1 land is in private ownership this agency may make an offer to the owner to sell their land at agreed market values subject to available funding and priority order purchasing rules. There is no obligation on the owner to sell their land.

Priority 2 (P2) areas are defined to ensure that there is **no increased risk of pollution** to the water source. P2 areas are declared over land where low intensity development (such as rural) already exists. Protection of public water supply sources is a high priority relative to other land use values in these areas.

P2 areas are managed in accordance with the principle of **risk minimisation,** and as such only limited conditional development is supported. Such development must be consistent with the protection of waters within the drinking water catchment. A proposed change in land use from a relatively low to a more intensive use may result in contamination of the PDWSA, and would not be supported.

Priority 3 (P3) areas are defined where it is practical to **manage the risk of pollution** to the water source, and where water supply sources need to co-exist with other generally existing land uses such as residential, commercial and light industrial developments.

Protection of P3 areas is achieved through **management guidelines** rather than restrictions on land use. Key elements in protection of P3 areas are the provision of deep sewerage and land users using best environmental management practices for their activities. In P3 areas, compared to P1 and P2 areas, it is likely that the direct cost of providing the drinking water to consumers is greater, given the need to monitor and treat the water more comprehensively due to the variety of existing and allowable land uses/risks. If water from P3 areas becomes contaminated, then that water may need to be further treated or an alternative water source found.

In these priority areas there is a strong reliance on landowners, developers, regulators and other users to be acutely aware of the drinking water resource and risks, such that the adoption and implementation of best management practices will help protect the drinking water source . Existing lawfully established but non-conforming land uses in PDWSAs are allowed to continue, however land users will be encouraged to adopt environmentally responsible/best practice land use practices. This agency has prepared a "*Water Quality Protection Note -Land Use Compatibility table in PDWSAs*" that provides guidance on the type of land uses appropriate within P1, P2 and P3 areas.

Reservoir and wellhead protection zones

As noted above, reservoir protection zones (RPZ) are also defined to protect the surface water source from contamination in the immediate vicinity of reservoirs. Reservoir protection zones consist of up to a 2 kilometre buffer around the top water level of a reservoir and includes the reservoir itself. These zones do not extend outside the catchment area (i.e. downstream from a dam wall). This agency provides a high level of protection in these zones and does not support land uses or activities that may add to add to the risk of contamination of the water source. Generally conditions apply in these zones aimed at preventing people from entering the RPZ to avoid the risk of contamination (consistent with the P1 areas).

For underground water sources, well-head protection zones are defined around the abstraction bores and allowable activities/ land uses in these areas are also restricted and subject to approval processes. Well-head protection zones in P1 areas are set at a 500 metre radius around a bore, and in P2 or P3 areas they are set at a 300 metre radius around a bore.

Conclusion

We can improve the availability of 'safe, good quality drinking water' to protect public health if we continue to combine catchment protection and water treatment approaches. This 'catchment to consumer' approach to drinking water protection is the basis of the recently updated *Australian Drinking Water Guidelines 2003*.

Many land uses and activities can pose a risk to water quality, so in undeveloped drinking water catchments strict management controls are proposed to 'avoid the risk' of contaminating the source. In catchments with some level of development, management controls recognise the existing development but may place restrictions on alternative land uses or expansion of existing land uses. This approach looks to 'minimise' or 'manage the risk' of contamination in the catchment. These management controls help protect public health, lower the costs of supplying drinking water to consumers and provide a long term source of safe, good quality drinking water.

More information

We welcome your thoughts on this note. Feedback on this topic is retained our file No. 13256. The note will be updated from time to time as comments are received, or industry standards change.

If you wish to comment on the note or require more information, please contact our Program Manager, Protection Planning (Stephen Watson) at the Resource Quality Branch in our head office in the Hyatt Centre. Phone: (08) 9278 0454 (business hours), Fax: (08) 9278 0585.

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