

# Case studies showing the consequences of historic land use planning processes on unconfined groundwater aquifers used for drinking water supply in Western Australia

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## Introduction

It has only been in the last two decades or so that land-use planning and water-resource management have been integrated to help protect Western Australia's limited public drinking water source areas. Prior to this, some land use planning decisions resulted in detrimental water-quality impacts, especially in areas serviced from unconfined groundwater aquifers vulnerable to contamination.



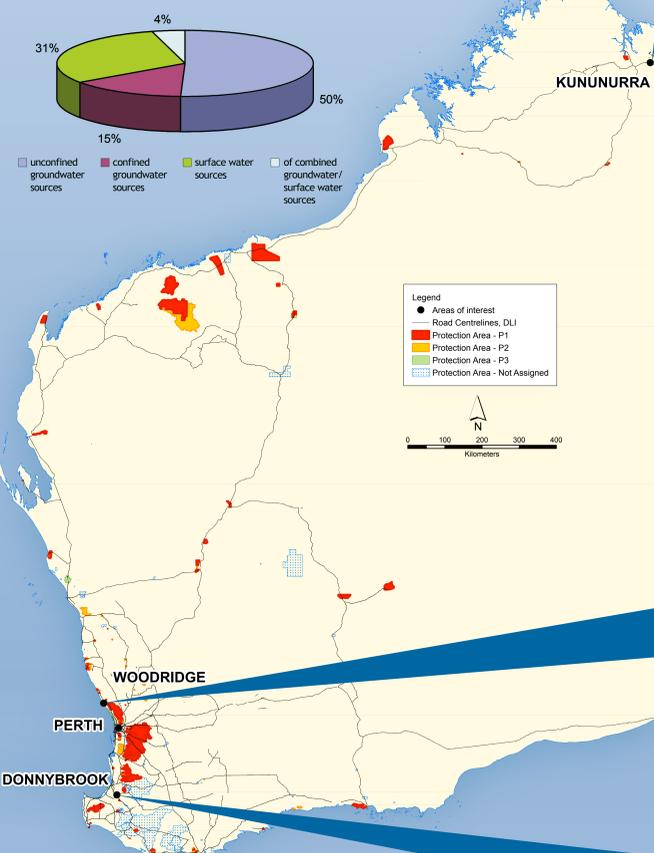
Lake Kununurra - Photo: P Novak

This paper discusses the drinking water protection program in Western Australia, and captures three case studies that demonstrate how land use planning decisions can be integrated with water quality measures to avoid, minimise or manage water quality contamination risks. The key risks in these case studies include: nutrients from household septic tank systems and fertilisers used in intensive horticulture; pesticides from weed control and intensive horticulture, and other chemicals from industrial and commercial land-use activities.

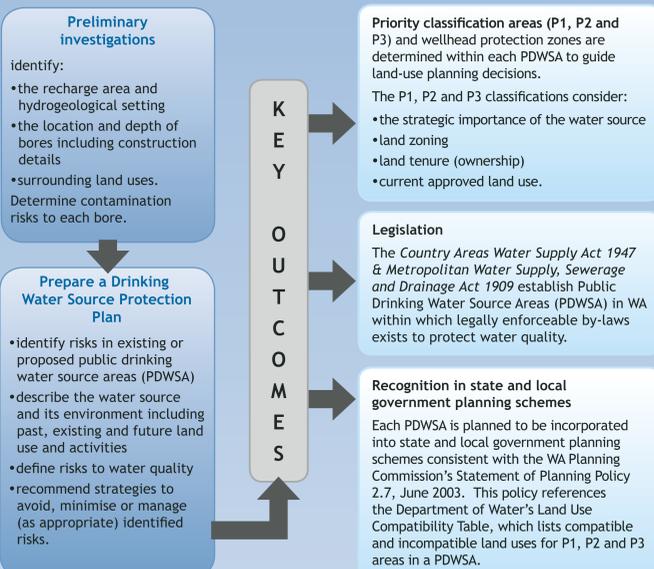
Sandy soils are found widely in Western Australia. These soils are known to have a high hydraulic conductivity range, allowing rainfall to infiltrate easily and recharge unconfined aquifers, making them vulnerable to contamination by a range of land use activities.

## Public Drinking Water Source Areas – Western Australia

Active Public Drinking Water Sources in Western Australia 2007



## The Drinking Water Source Protection And Land Use Planning Process For Groundwater Sources In Western Australia



## CASE STUDY 1 – KUNUNURRA WATER RESERVE



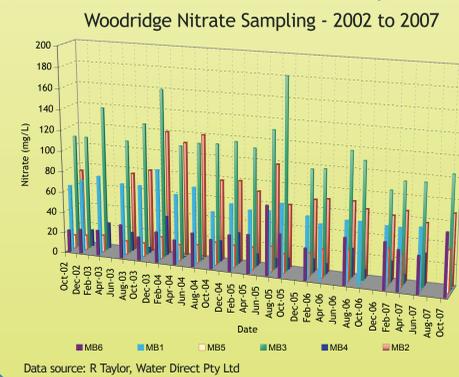
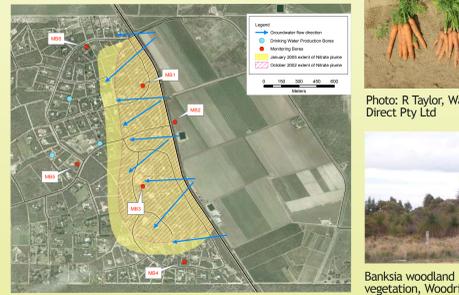
Lake Kununurra at sunset - Photo: P Novak



Kununurra	
Location	On the banks of the Ord River in the Kimberley region of Western Australia
Climate	Tropical
Geology of area	Surficial, highly-transmissive sand and gravel sediments of the Ivanhoe Plain
Aquifer	Unconfined
Recharge	Rapid, via Lake Kununurra and direct rainfall infiltration
Vulnerable to contamination	Yes
Town water supply	Kununurra
No. of production bores	5
Public Drinking Water Source Area	Re-proclaimed in 2004 (original proclamation in 1970) under the <i>Country Areas Water Supply Act 1947</i>
Drinking Water Source Protection Plan	Completed in September 2003 (Interim Report)
Special Control Areas in Town Planning Scheme	Recommended in Drinking Water Source Protection Plan and considered in planning strategy discussion paper
Surrounding land-uses	Agriculture, tourist park, boat cruises and float plane tours with associated refuelling facilities, water-based recreation
Contaminants in groundwater	Herbicides: Dicamba and Dieldrin (these concentrations were at levels well below those recommended in the Australian Drinking Water Guidelines, 2004)
Land-use issues	The Kununurra Water Reserve is located on prime land sought after for development.
Key recommendations of Drinking Water Source Protection Plan	To continue to protect the existing strategic drinking water source from incompatible land-use developments. If a suitable alternative water source was found, the primacy of the existing water reserve over development would be reviewed.
Outcome	The Kununurra Water Reserve is protected from incompatible land development thus continuing to provide good quality drinking water and protecting the community's health. The local shire is investigating alternative drinking water sources.

## CASE STUDY 2 – WOODRIDGE WATER RESERVE

Extent of Nitrate plume at Woodridge estate up to January 2005



Data source: R Taylor, Water Direct Pty Ltd

Woodridge	
Location	On the Gingin coast approximately 100 km north of Perth, Western Australia
Climate	Temperate
Geology of area	Tamala limestone (forms a part of the northern edge of the Gnaragururup Mound)
Aquifer	Unconfined
Recharge	Mostly via direct infiltration from rain and surface water bodies
Vulnerable to contamination	Yes
Town water supply	Woodridge Estate
No. of production bores	3
Public Drinking Water Source Area	Proclaimed in June 1999 under Country Areas Water Supply Act 1947
Drinking Water Source Protection Plan	Completed in September 1997
Special Control Areas in Town Planning Scheme	Yes
Surrounding land-uses	Recent rural residential area located down-gradient of long established horticultural activities
Contaminants in groundwater	Nitrate (most likely source is chicken manure applied as fertiliser and soil improver, and other inorganic fertilisers)
Land-use issues	The decision to develop a rural residential area down gradient of an existing intensive horticulture operation was made before the integrated land and water-planning approach was developed.
Key recommendations of Drinking Water Source Protection Plan	Proclamation of the Woodridge Water Reserve under the Country Areas Water Supply Act 1947 and establishment of a surveillance program for the early detection of any potential contamination risk in the water reserve.
Outcome	A nutrient and irrigation management plan was implemented as part of the operator's water allocation licence. Good quality water from the deeper confined aquifer in the Woodridge Water Reserve was allocated for distribution to the community. The water containing nitrate from the unconfined aquifer was allocated to the horticultural operator for irrigation purposes.

## CASE STUDY 3 – DONNYBROOK TOWN WATER SUPPLY

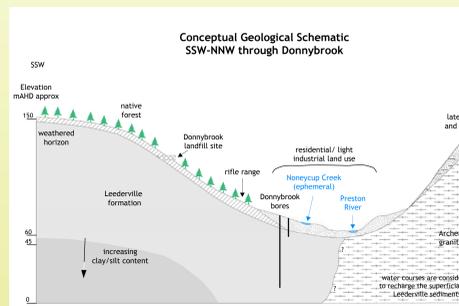


Diagram by L Steffox & M Webb



Donnybrook	
Location	Approximately 200 km south of Perth, Western Australia
Climate	Temperate
Geology of area	Leederville Formation with discontinuous beds of sandstone, siltstone and shale and underlain by the Jurassic Yarragadee Formation.
Aquifer	Unconfined
Recharge	Primarily from direct infiltration of rainfall. Noneycup Creek flows close to the shallow production bores and is considered to be in hydraulic continuity with the Upper Leederville Formation, acting as a recharge body to the aquifer.
Vulnerable to contamination	Yes
Town water supply	Donnybrook
No. of production bores	6
Public Drinking Water Source Area	Not proclaimed
Drinking Water Source Protection Plan	In preparation
Special Control Areas in Town Planning Scheme	No
Surrounding land-uses	Residential, commercial and industrial areas, unlined landfill site, horticulture.
Contaminants in groundwater	Potential risks to the water quality include: heavy metals, pathogens. Other aesthetic water quality parameters: iron, manganese, low pH levels.
Land-use issues	Vulnerable to contamination from surrounding land-uses.
Key recommendations of Drinking Water Source Protection Plan	The Drinking Water Source Protection Plan is currently being prepared. Key recommendations will include: The Donnybrook Water Reserve should be proclaimed under the <i>Country Areas Water Supply Act 1947</i> and a Special Control Area established in the Donnybrook Town Planning Scheme as soon as practicable. It may be necessary to identify a suitable alternative water source.
Outcome	See key recommendations above



## Conclusion

The three case studies above illustrate the need for careful consideration of water quality impacts as part of land-use planning decisions. It is also evident that drinking water source protection measures need to be established at the earliest stages of land-use planning and approval processes. The case studies show that the integrated land-use planning and water resource management process now employed in Western Australia to protect Public Drinking Water Source Areas is proving to be effective.

Drinking water source protection can be achieved by:

- preparing and implementing protection plans
- proclaiming public drinking water source areas
- assigning appropriate priority areas and protection zones within each public drinking water source area
- supporting local government agencies to incorporate public drinking water source areas as 'special control areas' in their town planning schemes.

These actions will ensure the quality of a drinking water source is managed and protected now and in the future to meet the Australian Drinking Water Guidelines' "catchment to consumer" approach and protect public health. This is particularly important for unconfined groundwater sources that are vulnerable to contamination.

