

The NSW Groundwater Quality Protection Policy

A Component Policy of the
NSW State Groundwater Policy

*To manage the State's groundwater
resources so that they can sustain
environmental, social and economic uses
for the people of NSW.*



Prepared by:

Department of Land & Water Conservation



ISBN 0 7313 0379 2

HO/37/98

First printed December 1998

3000 printed on recycled paper

CONTENTS

Foreword	
1. Policy Summary	7
1.1 The NSW State Groundwater Policy	8
1.2 How Groundwater Quality Protection Will Be Implemented	9
1.3 Reporting and Review	9
2. Scope of the Policy	10
2.1 The Water Cycle	11
2.2 Groundwater Quality in NSW	12
2.3 Threats to Groundwater Quality	13
3. Policy Framework	14
3.1 Context	14
3.1.1 Ecologically Sustainable Development	14
3.1.2 National Water Quality Management Strategy (NWQMS)	14
3.1.3 Integrated approach	14
3.1.4 Community Involvement	15
3.2 Legislation and Responsibilities	15
4. Quality Protection Concepts	16
4.1 Beneficial Use and Water Quality Objectives	16
4.2 Groundwater Vulnerability	16
4.3 The Conduit Effect	17
4.4 Compatibility of Groundwater	17
5. Objectives and Principles	18
5.1 Policy Objectives for Groundwater Protection	18
5.2 Policy Principles	18

6. How Groundwater Quality Protection Will Be Implemented	23
6.1 Beneficial Use (Environmental Value) Classification	23
6.2 Groundwater Management Plans	23
6.3 Guidelines for Industry	23
6.4 Education	24
6.5 Planning Instruments	24
6.6 Groundwater Vulnerability Mapping	24
6.7 Wellhead Protection Plans	24
6.8 Research	25
6.9 Monitoring	25
7. Reporting	26
8. Coordination and Review	26
Appendix A - Suggested Further Reading	27
Appendix B - Groundwater Contacts	27
Appendix C - Wellhead Protection Zones	28
Appendix D - Groundwater Protection Levels	30
Appendix E - List Of Acronyms	32
List of Figures	
Figure 1: The Water Cycle	11
Figure 2: Polluted Groundwater Impacting on a Surface Water Stream	17
Figure 3: Diagram of Wellhead Protection Zones for a Public Water Supply	28
List of Maps	
Map 1: Groundwater Availability in New South Wales	12

FOREWORD

Groundwater is an important natural resource in NSW. It is a source of drinking water for many rural towns and is essential for several major industries, especially agriculture. It also keeps some of our life-supporting aquatic ecosystems, such as wetlands, alive. Groundwater is vital to both urban and rural industries, and to our economic and social framework.

Groundwater is present everywhere beneath our feet. Many of our activities, both past and present, affect the quality of our groundwater. In recent years, there has been growing concern about the declining quality of the State's groundwater and its dependent ecosystems. Contaminated groundwater has been found in both rural and urban areas. In a number of cases, this has created a serious threat to human and animal health. Important wetlands, which are fed by groundwater, have been degraded or lost altogether. Rising groundwater tables have caused salinity problems, especially in the south of the State, and this has degraded the quality of soil and river water.

These problems are caused by activities such as:

- urban and rural development,
- excessive use of fertilisers and pesticides,
- leaking sewage pipes and septic tanks,
- wastewater and sludge disposal,
- poor location of tip sites,
- mining and
- seepage from contaminated lands.

The community needs to be aware of the impacts that these sorts of activities can have on groundwater quality. In some groundwater systems many activities would have almost no impact. In others, where the geology of the aquifer makes it more vulnerable, and the quality of the groundwater is high, the impact may be significant.

Some groundwaters are naturally high in salts and/or trace metals, making them unsuitable for specific uses. Care needs to be taken when using this water to prevent adverse impacts, such as salinity problems in soils or surface water.

Once groundwater becomes polluted, it is difficult to clean up completely. Purification processes which take days or weeks in rivers may take decades to occur in groundwater. Also, the cost of cleaning up groundwater systems is very high - if at all possible. This means that it is better to prevent or reduce the risk of groundwater contamination than to deal with its consequences. The need to properly manage a groundwater system, therefore, is directly related to the value of the groundwater or its dependent ecosystems and the risk of being degraded or destroyed through overuse or contamination.

The NSW Government and the community recognise the need for a coordinated approach to the improved management of groundwater. This can be achieved through implementation of the State Groundwater Policy Framework Document and its component policies, which include this Groundwater Quality Protection Policy. These policies are consistent with NSW Government directions for natural resource management.

Groundwater protection should be seen as an ongoing process, which responds to improvements in our knowledge, to changes in land use, and to the value society places on the resource. It is essential for all groundwater quality protection actions - whether at a State, regional, or local level to adopt an “adaptive management” approach. This means that there will need to be a regular review of policies and plans, to make sure that their priorities, effectiveness, directions and focus are updated, and their strategies continue to meet protection and restoration objectives for groundwater.

To achieve its goal, a partnership approach between the community, industry and government has been adopted for the management of groundwater resources. The community will continue to be involved in the decision-making process.

A handwritten signature in black ink, appearing to read 'Richard Amery', with a stylized flourish at the end.

Richard Amery MP

Minister for Land and Water Conservation

1. POLICY SUMMARY

The goal for the management of groundwater resources in New South Wales is to manage the State's groundwater resources so that they can sustain environmental, social and economic uses for the people of NSW.

It is the policy of the NSW Government to encourage the ecologically sustainable management of the State's groundwater resources, so as to:

- ◆ slow and halt, or reverse any degradation of groundwater resources;
- ◆ ensure sustainability of groundwater dependent ecosystems;
- ◆ maintain the full range of beneficial uses of these resources;
- ◆ maximise economic benefit to the Region, State and Nation.

This Groundwater Quality Protection Policy is specifically designed to protect our valuable groundwater resources against pollution. Adoption of this Policy, means that the sustainability of groundwater resources and their ecosystem support functions will be given explicit consideration in resource management decision making.

NSW groundwater management policies and practices will be consistent with the aims of other national and State policies. These include:

- ◆ the National Strategy for Ecologically Sustainable Development (ESD),
- ◆ the Inter-Governmental Agreement on the Environment (IGAE),
- ◆ the National Water Quality Management Strategy (NWQMS),
- ◆ the Council of Australian Governments (COAG) water reform agenda;
- ◆ NSW Water Reforms; and
- ◆ NSW government policy directions for natural resource management.

This policy has been developed in association with a groundwater policy working group, comprised of community representatives and relevant agency staff. This group has identified management needs, opportunities and management principles.

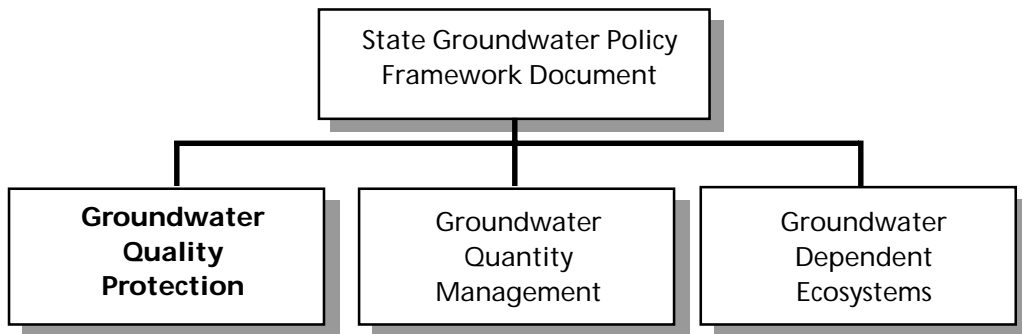
The Policy objectives will be achieved by applying the management principles listed below. These are discussed in detail in section 5.2.

1. *All groundwater systems should be managed such that their most sensitive identified beneficial use (or environmental value) is maintained.*
2. *Town water supplies should be afforded special protection against contamination.*
3. *Groundwater pollution should be prevented so that future remediation is not required.*
4. *For new developments, the scale and scope of work required to demonstrate adequate groundwater protection shall be commensurate with the risk the development poses to a groundwater system and the value of the groundwater resource.*
5. *A groundwater pumper shall bear the responsibility for environmental damage or degradation caused by using groundwaters that are incompatible with soil, vegetation or receiving waters.*
6. *Groundwater dependent ecosystems will be afforded protection.*

7. *Groundwater quality protection should be integrated with the management of groundwater quantity.*
8. *The cumulative impacts of developments on groundwater quality should be recognised by all those who manage, use, or impact on the resource.*
9. *Where possible and practical, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored.*

1.1 The NSW State Groundwater Policy

The Quality Protection Policy is one of three component policies which, in association with the Framework Document, make up the State Groundwater Policy. The groundwater policy links are shown below.



The Framework document sets out the overall direction of groundwater management in NSW and provides broad objectives and principles to guide management. The component policies build on this approach and provide more detail and guidance on how to manage and protect groundwater quality, groundwater quantity and groundwater dependent ecosystems respectively. They are intended to be an aid to catchment managers, planners and resource managers by providing a basis for decision making to achieve sustainable natural resource management.



Inappropriate storage of used pesticide drums

1.2 How Groundwater Quality Protection Will be Implemented

Part of the process of implementing the 1997 NSW Water Reforms has been the assessment, classification and prioritisation of groundwater systems according to their level of risk (low, medium or high) from over extraction and contamination. The classification of the States' aquifers was completed in April 1998 and has been used to determine the priority for the development of groundwater management plans.

For systems classified as being at high risk from contamination, development of groundwater management plans must be commenced by 2000/01. Plans are to be started immediately for systems at high risk of over-extraction. The plans are to be developed by local committees with an independent Chair and both community and agency representatives.

Some groundwater systems are not currently at risk from either contamination or over extraction. These systems, as a prevention measure, will be monitored and reviewed every five years and if warranted, a higher lever of management will be invoked.

The combination of management tools that will be used to achieve groundwater protection includes:

- groundwater management plans
- supporting guidelines for industry
- education
- land use planning instruments
- beneficial use classification
- groundwater vulnerability mapping
- wellhead protection plans
- licence conditions
- monitoring and research.

1.3 Reporting and Review

This policy has been developed through a community/Government groundwater policy working group and has been endorsed by the State Government. The working group will continue to meet periodically to ensure implementation is progressing and to review performance. The policy will be formally reviewed on a five yearly basis. Groundwater management plans prepared by the groundwater management committees will also be endorsed by Government to ensure consistency with government policy and the commitment of necessary resources. Each plan will be reviewed on a five yearly basis by its groundwater management committee.

2. SCOPE OF THE POLICY

The focus of this Policy is to protect from pollution water below the ground surface in a geological structures or formations known as ‘aquifers’, and the ecosystems from which these waters are recharged or into which they discharge.

The Quality Protection Policy provides a framework for the sustainable management of groundwater quality through:

- adopting a beneficial use classification system that will be the basis for setting water quality objectives for all groundwater systems in NSW;
- development of groundwater management plans which include strategies for protecting the quality of water in the State’s groundwater systems which are at risk from contamination;
- providing a comprehensive set of policy principles for groundwater quality protection;
- establishing a mechanism for coordinating the activities of government and the community in relation to protection of groundwater quality;
- providing guidance for groundwater quality protection to resource managers;
- establishing reporting and review requirements for groundwater quality protection measures;
- providing a context for education programs to promote awareness and best practice for groundwater quality protection; and
- restoring the quality of the State’s groundwater.

The Government requires that careful consideration be given to all factors affecting the stability, vulnerability, and productivity of groundwater systems.

The Policy will guide the decision-making of landholders and State and local government authorities in their management and use of groundwater. It will influence the type and selection of management activities and resource development opportunities that will be supported by the State’s resource managers, land use planners and regulators.



*Pumping into
an irrigation
channel*

2.1 The Water Cycle

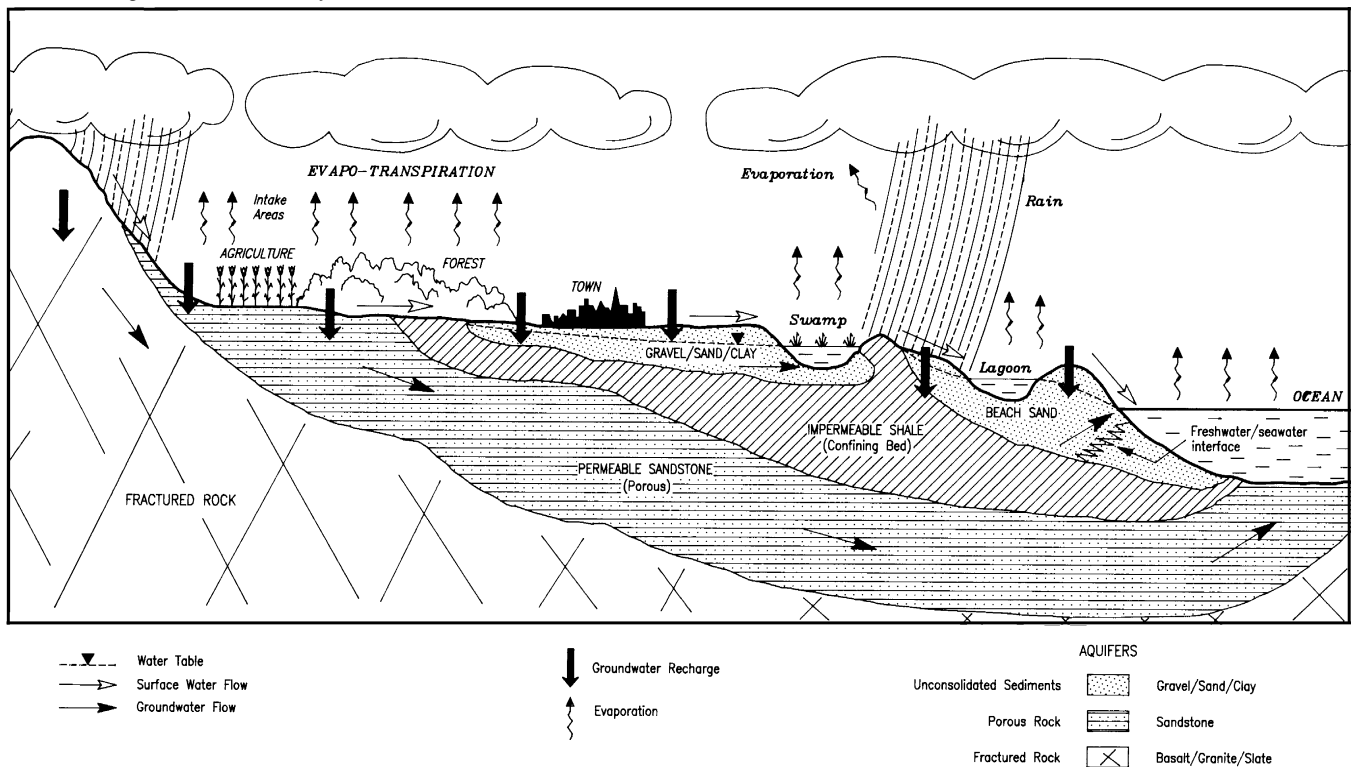
Groundwater, in a broad sense, is all water which occurs below the land surface in aquifers. Aquifers occur in geological formations which are sufficiently permeable to allow water to move within them, and allow it to discharge or be extracted. Groundwater is usually categorised as occurring in:

- **Unconsolidated sediments** - non cemented sands and gravels commonly found in alluvial valleys, coastal plains and sand dune systems. Groundwater is contained within the pore space in these sediments.
- **Sedimentary rocks** - consolidated or semi-consolidated formations such as sandstone, limestone, shales. Groundwater occurs both within the pore space in the rock matrix and also within fractures and joints.
- **Fractured rocks** - volcanic and metamorphic rocks such as granite, basalt, shales and gneiss. Groundwater in these rocks occurs mainly within fractures and joints.

Natural groundwater quality generally reflects both the mineral content of the host rock through which the water is travelling, and the length of time that the water is in contact with the rock. The rate at which water travels through a groundwater system may vary from tens of metres a day for a highly permeable beach sand, to as little as a metre a year in a dense clay.

Because groundwater is out of sight, its occurrence and movement are generally poorly understood. Groundwater constitutes part of a dynamic water cycle, and is interrelated with surface water. Surface water infiltrates geologic formations to become groundwater. Groundwater reappears at the surface through springs and seeps, and emerges in rivers, lakes, wetlands and the ocean (Figure 1 - The Water Cycle).

Figure 1: The Water Cycle



2.2 Groundwater Quality in NSW

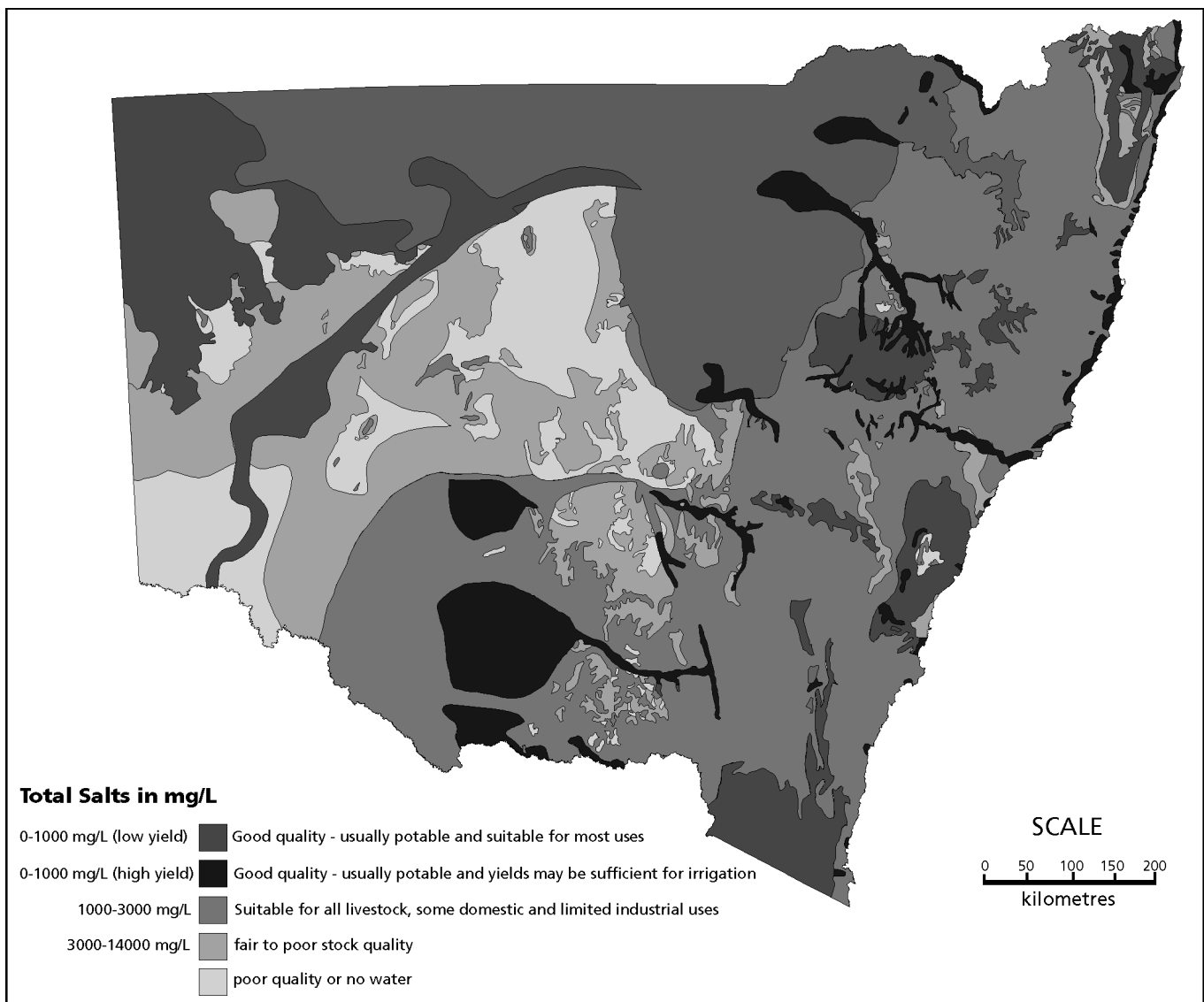
In NSW, the quality of groundwater varies dramatically from region to region. One measure of quality is the level of natural salt content present in groundwater. Salinity levels can range from that of rainwater to more than 10 times that of sea water.

The lowest salinity groundwater can generally be found in the large unconsolidated alluvial systems associated with the major westward draining rivers. Many coastal sand dune systems also contain low salinity water, as do the consolidated sediments of the Great Artesian Basin which occur at depth in the north west of the State. Map 1 shows groundwater availability and salinity across NSW.

Groundwater quality is known to be deteriorating in many parts of the State through contamination from human activities such as urban and rural development, use of fertilisers and pesticides, leaking sewage pipes, septic tanks, tip sites, mining and seepage from contaminated lands.

Groundwater provides a water supply to over 130 communities in NSW. For some of these communities, it is their only source of water. The water is used for drinking, industry and commerce, stock watering, and irrigation.

Map 1 - Map of groundwater resources in New South Wales



The cost of finding alternative supplies in these cases may be prohibitive.

Also, surface water systems into which groundwater flows, such as wetlands, may have environmental values and require the incoming waters to be of a very high quality. The protection of groundwater resources in such areas is an important aspect of total water management.

2.3 Threats to Groundwater Quality

Unlike rivers, which flow in defined channels, groundwater is present everywhere beneath our feet. Many of our activities, therefore, pose potential threats to the quality of our groundwater resources. Many low lying sites were progressively filled in with industrial and urban waste in the first half of this century in the industrial centres of Sydney, Newcastle and Wollongong, causing contamination of the groundwater. Contaminated groundwater systems can pose a threat to other connected ecosystems. Wetlands, for example, are often degraded by groundwater that has become polluted through the burial of waste in the immediate catchment.

Generally, contamination can be described as coming from either 'point' sources or 'diffuse' sources. Point source contamination may range from land fill sites (for example domestic tip sites and industrial land fill sites), to animal-based waste from abattoirs, cattle feed lots and piggeries. Diffuse source contamination includes the spreading of fertilisers onto agricultural land, urban runoff and the fallout from industrial smoke stacks.

Along with threats from surface activities, there is a very real danger that pumping large volumes of groundwater will result in a deterioration in water quality where poor quality water is drawn into an aquifer containing high quality water.

If groundwater becomes polluted, it is difficult or impossible to clean up completely. The slow rates of groundwater flow and low microbial activity limit any self-purification. Processes which take place in days or weeks in surface water systems may take decades to occur in groundwater. In addition, the costs of remediating groundwater systems are very high. It is, therefore, better to prevent or reduce the risk of groundwater contamination than to deal with its consequences.

*A mound
spring at
'Peery Station'*



3. POLICY FRAMEWORK

3.1 Context

3.1.1 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) provides the basis for the protection of groundwater quality in NSW. In Australia, the Federal and State Governments have endorsed the National Strategy for Ecologically Sustainable Development (Commonwealth of Australia, 1992). The ESD strategy has three core objectives:

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

Both the national ESD strategy and the Inter-Government Agreement on the Environment (IGAE) have adopted the 'precautionary principle' as one which should provide a basis for policy making and program implementation at all levels of Government. The precautionary principle states that:

'Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.'

The precautionary principle is particularly applicable to groundwater management in NSW. There are often long time scales associated with shifts in the condition of many groundwater systems and our knowledge of groundwater is often poor.

3.1.2 National Water Quality Management Strategy (NWQMS)

The Commonwealth, State and Territory Governments have developed a National Water Quality Management Strategy for Australia. The Strategy aims to deliver a nationally consistent approach to water quality management, including the management of groundwater. The Strategy's objective is:

"to achieve sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development".

The NWQMS has a specific groundwater component and includes Guidelines for Groundwater Protection in Australia (1995).

This Policy has been designed to be consistent with the objectives, policies and processes outlined for groundwater by the National Water Quality Management Strategy.

3.1.3 Integrated approach

This Policy adopts an integrated approach to groundwater management. This means that groundwater issues must be considered in relation to surface water management and land use planning decisions. Decisions should consider interactions between groundwater quality, quantity and dependent ecosystems as well as the possible impacts of using groundwater on soils and vegetation and surface water systems.

3.1.4 Community Involvement

This Policy has been developed with advice from a working group consisting of community and Government members. The community will continue to be involved during the implementation processes, especially through involvement, along with catchment managers and Government, in groundwater management committees which will assist in the development of groundwater management plans. These plans are the major tool for policy implementation. Community representation on the groundwater management committees will reflect a wide spectrum of interests, including state-wide stakeholders. These regional committees are best placed to identify issues and options for groundwater management, and make recommendations to Government about the setting of 'Water Quality Objectives' and possible trade-offs.

3.2 Legislation and Responsibilities

The right to control the use of groundwater in NSW is vested in the Minister responsible for water resources, under the Water Administration Act 1986. The Minister's functions are largely exercised by the NSW Department of Land and Water Conservation (DLWC). The Department, in turn, manages a process to license private individuals and government agencies to extract groundwater.

Development and use of land is the one consistent element in the list of potential threats to groundwater. Land use planning legislation and instruments, therefore, provide some control over the uses to which land is put. Land use planning in NSW is administered by the Department of Urban Affairs and Planning (DUAP), in co-operation with local government authorities under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The EP&A Act requires that the potential effects of proposed developments on groundwater be taken into account when undertaking environmental assessment. The provisions of the Act apply to both local councils approving developments or carrying out their own works, and to other authorities carrying out their own works or issuing approvals, including licences for groundwater extractions.

The protection of groundwater from contamination has primarily been governed by the *Clean Waters Act 1970*, which has been superseded by the *Protection of the Environment Operations Act 1997* which makes it an offence to pollute waters, including groundwater. The Environment Protection Authority (EPA) administers these Acts. Individuals, local and state government agencies can bring legal action under this legislation.

4. QUALITY PROTECTION CONCEPTS

4.1 Beneficial Use and Water Quality Objectives

The National and State guidelines for groundwater protection rely on a framework in which there is the identification of existing or potential beneficial uses for each groundwater resource. The choice of a beneficial use classification depends upon the quality of water present and the potential values of the water in the long term (NWQMS, 1995). The term “beneficial use” may be used interchangeably with the term “environmental value”. Although the former term is used throughout this report the latter terminology is preferred by some as it sends a strong signal that the environment is a water user too.

The following beneficial uses were recommended by the NWQM Strategy Guidelines for Groundwater Protection in Australia (1995) and have been adopted in this Component Policy. They include:

- ecosystem protection;
- recreation and aesthetics;
- raw water for drinking water supply;
- agricultural water; and
- industrial water.

Comprehensive but not necessarily complete water quality criteria are available for each beneficial use (environmental value) category. Each beneficial use has a unique set of water quality criteria. The term “Water Quality Criteria “ refers to a list of the critical concentrations of contaminants in water that must not be exceeded if a given beneficial use is to be sustained. See Appendix A for further sources of information.

All natural resource managers need to know the beneficial use of a groundwater system before setting appropriate water quality objectives, and working out management rules and plans to safeguard those beneficial uses. The Government, in consultation with local and regional communities, will classify all major groundwater systems according to their beneficial use(s), and tabulate information or publish maps showing this classification. Since there is often more than one beneficial use for an aquifer system, water quality objectives should always protect the groundwater quality to a level that meets the most sensitive end users’ requirements.

4.2 Groundwater Vulnerability

Groundwater vulnerability maps are a tool that allow planners, developers, resource managers and regulatory agencies to:

- make better informed judgements on whether a potentially polluting development or activity is appropriate, and
- establish the appropriate development controls to minimise the risk to groundwater should a spill or leakage occur.

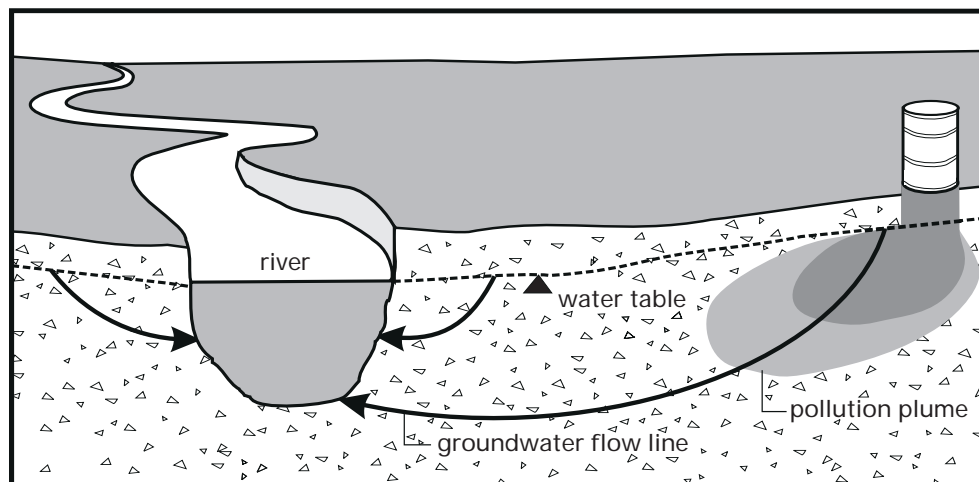
When considering a proposed development or activity, planners and resource managers need to assess the level of risk it poses in terms of polluting groundwater resources. To do this, an assessment must be made both of the threat, and of the vulnerability of the groundwater system to that threat. How susceptible an aquifer is to pollution is a function of natural geological conditions including soil type, depth to groundwater, and the transmitting capacity of the aquifer. The concept of groundwater vulnerability recognises that risks of pollution from an activity are greater in certain hydrogeological, geological and soil situations than in others.

4.3 The Conduit Effect

Aquifers not only store water, they transmit it down a hydraulic gradient. An individual particle of water will move slowly along its flow path from the point of recharge to the point of discharge. The aquifer is in effect a conduit for carrying water. If the aquifer becomes polluted at some point then the polluted water will be transported to the discharge site (see Figure 2). This is called the 'conduit effect'. It becomes especially important if the groundwater discharges to a sensitive surface water body that requires a higher level of protection than the groundwater itself.

Often a groundwater system has a low value because of its naturally poor water quality, but it may be given a high level of protection because it discharges to a surface water body nearby. For example, leakage of small amounts of petroleum products from a petrol station located over a moderately saline and unused groundwater system may have little impact on the system directly. It may, however, be a major problem if the groundwater discharges into a surface water body nearby that is used for stock watering, or if it supports a sensitive wetland.

Figure 2: Polluted Groundwater Impacting on a Surface Water Stream



4.4 Compatibility of Groundwater

When groundwater is extracted and used for irrigation, proper consideration must be given to the compatibility of the water with respect to the soil and crops on which it is to be applied. If not, it could cause a breakdown in soil structure, salinisation of the root zone, leaching of salts to underlying groundwater and, ultimately, the movement of salts into creeks and rivers. Groundwaters that have a high sodium adsorption ratio, for instance, should not be used on sodic soils. Saline drainage flows need to be managed to prevent contamination of surface waters.

Similar problems occur in the bore drains used to distribute water from flowing bores in the Great Artesian Basin. Here the continual use of low gradient drains that pass through sodic soils with limited leaching capacity has caused a build up of soil salinity in the immediate vicinity of the drains. This has often caused native vegetation to die off and be replaced with non-native salt-tolerant species.

5. OBJECTIVES AND PRINCIPLES

5.1 Policy Objectives for Groundwater Protection

For groundwater quality protection, it is the policy of the NSW Government to encourage the ecologically sustainable management of the State's groundwater resources so as to:

1. slow and halt, or reverse any degradation in groundwater resources;
2. direct potentially polluting activities to the most appropriate local geological setting so as to minimise the risk to groundwater;
3. establish a methodology for reviewing new developments (industrial/mining/urban and rural) with respect to their potential impact on water resources that will provide protection to the resource commensurate with both the threat that the development poses and the value of the resource; and
4. establish triggers for the use of more advanced groundwater protection tools such as groundwater vulnerability maps, or groundwater protection zones.

Groundwater quality protection is an evolving process, which must respond to improvements in our technical understanding of groundwater resource dynamics, changes in land use, and to the value society places on the resource. It is imperative, therefore, that all groundwater protection strategies, whether at a State, regional, or local level, adopt an adaptive management approach. This will require regular review of policies and plans, of their priorities, effectiveness, direction and focus, and the evolution of adapted or different strategies to continue to meet protection objectives.

5.2 Policy Principles

This Policy adopts the principles outlined in the NSW State Groundwater Policy Framework Document. In relation to Groundwater Quality Protection, the following principles specifically apply:

Principle One

All groundwater systems should be managed so that the most sensitive identified beneficial use (or environmental value) is maintained.

Once the beneficial use of a groundwater system has been identified, the obligation to protect it lies both with the industry or people involved in the activity which has the potential to contaminate the groundwater, and with the government authorities that regulate the activities. Potential dischargers need to either establish that their activity does not contaminate the groundwater system, or show that their proposal will not affect the beneficial use selected. This is consistent with the 'polluter pays' principle, which requires the costs of pollution prevention, or cleaning up pollution, to be met by the polluter.

It must be clearly understood by all members of society that no-one has the right to contaminate groundwater in such a way as to create a significant risk to public health, critical ecosystems or other valued users of water (NWQMS, 1995).

As a general rule, degradation of groundwater quality so that the system degrades to a lower beneficial use category, will not be permitted. Any degradation must not result in a

substantial change over the natural background quality. If groundwater quality is gradually deteriorating then groundwater management plans will need to set trigger levels to initiate preventative action so that beneficial uses are preserved.

Where a groundwater system is already polluted, this classification system will also help determine clean up levels for rehabilitation purposes. For highly degraded groundwater, such as occurs under some industrial areas, a progressive approach towards clean up may be the most appropriate way to achieve the highest beneficial use. In some situations, it may not be possible or practical to remove all the contaminants from the groundwater system, so water quality objectives appropriate to the use of the site in the foreseeable future will be determined by Government using advice from committees on their needs.

Principle Two

Town water supplies should be afforded special protection against contamination.

The protection of town water supply wells (wellfields, bores or borefields) is a high priority in many countries, including Australia. This reflects the importance of natural sources of drinking quality water and the high cost of providing alternatives if they are polluted. These wells can become contaminated in a number of ways, including:

- land use practices incompatible with well recharge areas;
- leaking of contaminants into the well or around the outside of the casing, if not properly sealed or poorly operated or maintained;
- groundwater contamination by leakage of poor quality or contaminated groundwater from one aquifer to another via improperly constructed or corroded bores; and
- inter-aquifer contamination by movement of poorer quality groundwater into fresh water aquifers through excessive pumping.

Where town water supplies wholly or partly come from groundwater, strategies may be required to ensure that land use activities doesn't adversely affect its quality. One way of achieving special protection for town water supply wells is through the development of wellhead protection plans (See Appendix C for more detail).

Principle Three

Groundwater pollution should be prevented so that future remediation is not required.

This principle recognises that there are no quick or cheap solutions for groundwater clean up once contaminated. In many cases it is unlikely that contaminated groundwater systems can be returned to pre-contamination conditions. This knowledge strengthens the resolve for the prevention or minimisation of further contamination of groundwater systems. Contaminated groundwater can take tens or even hundreds of years to move from the pollution source to

the discharge site. Remediation of polluted groundwater can cost millions of dollars to achieve water quality objectives. In the past, the effectiveness of remediation has been poor.

Principle Four

For new developments, the scale and scope of work required to demonstrate adequate groundwater protection shall be commensurate with the risk the development poses to a groundwater system and the value of the resource.

New developments that require development consent should be assessed for the risk they pose to a groundwater system. The assessment should be based on three variables:

- the threat factor;
- the vulnerability of the groundwater system; and
- the beneficial use or environmental values of the groundwater system (e.g. groundwater dependent ecosystems).

The threat factor should consider the nature of the hazard(s) i.e. toxicity, the scale of the development, and the geographical and temporal impacts that may result. Ideally, the vulnerability assessment should be directly related to potential hazards being considered. If this is not possible because of the complex nature of soil/contaminant chemical reactions, then a more general and conservative vulnerability assessment that assumes that the pollutants are non-reactive (and thus more mobile) should be conducted.

Industry groups will be encouraged to site particular activities and land uses in a way that minimises the risk to groundwater. Activities posing a significant threat to highly vulnerable systems that have high beneficial use should seek alternative sites or other options.

The process of deciding the most cost effective level of protection is based on a risk assessment. Appendix D lists a number of groundwater protection levels and the type of the assessment required for each level.

*Artesian bore
and drain*



Principle Five

A groundwater pumper shall bear the responsibility for environmental damage or degradation caused by using groundwaters that are incompatible with soil, vegetation or receiving waters.

Many groundwaters are naturally high in mineral content and some can be acidic while others are alkaline in nature. Persons using groundwaters should consider the risk groundwater poses to the surface environment. These risks include damage to vegetation as well as permanent soil structural damage caused by groundwater sodicity and salinity and possible salinisation of shallow groundwater systems through percolation.

Principle Six

Groundwater dependent ecosystems will be afforded protection.

This principle recognises that protective strategies may be warranted for areas of environmental value. Ecosystem protection may be sought for a number of reasons, including:

- maintenance of intrinsic environmental value, particularly where groundwater dependent ecosystems support threatened species, populations and communities, or critical habitat as defined in the Threatened Species Conservation Act 1995;
- conservation of special or representative areas: the State's wetlands may, in particular, require special protection against excessive groundwater pumping, particularly where these are given protection under other policies, planning instruments, or international agreements. Likewise they need to be protected against inappropriate land use.

Buffer zones that restrict certain activities should be developed in groundwater management areas that include sensitive wetlands, stream banks and remnant vegetation.

Principle Seven

Groundwater quality protection should be integrated with the management of groundwater quantity.

Groundwater quality protection decisions should not occur in isolation from groundwater sharing decisions. All groundwater management plans and other catchment plans should integrate both and make clear the linkages.

Experience has shown that over-pumping groundwater, especially near the coast, has led to a deterioration in groundwater quality, as saline water is drawn into the fresh water zone. This is also a potential problem in the alluvial groundwater systems of the western flowing rivers, where fresh water occurs in groundwater systems adjacent to groundwater systems containing brackish or saline water.

Principle Eight

The cumulative impacts of developments on groundwater quality should be recognised by all those who manage, use, or impact on the resource.

Many different land uses occur within a catchment, including urban development, industry and agriculture. Individually, these land uses may only contribute small pollution loads into the groundwater system. However, collectively the impact on the quality of groundwater from these land uses may be unacceptable. This principle highlights the need for the individual development impacts to be considered in the context of the total pollution load from all land uses.

Principle Nine

Where possible and practical, environmentally degraded areas should be rehabilitated and their ecosystem support functions restored.

Where groundwater systems are found to be contaminated, every effort needs to be made to locate the polluter and ensure clean up of the groundwater system (although it is often difficult to trace the source of pollution). The 'polluter pays' principle shall apply as shall the provisions of the *Protection of the Environmental Operations Act*. When the groundwater system is also a conduit (see 5.2) to sensitive ecosystems, including wetlands, springs, lakes or hanging valleys, steps should be taken to clean up the source of pollution and restore the degraded wetland areas so that the ecosystems are returned.

A wetland under threat



6. HOW GROUNDWATER QUALITY PROTECTION WILL BE IMPLEMENTED

This policy will be implemented through a number of mechanisms. Some of these mechanisms are well advanced because they have been part of groundwater management in NSW for the last decade. Other mechanisms are newer and will need to be further developed and implemented.

6.1 Beneficial Use (Environmental Value) Classification

The Government will classify all the major groundwater systems in consultation with local and regional communities and tabulate information or publish maps which show this classification. This process should make clear what the agreed levels of protection are for each groundwater system. The information can then be used by all sectors of the community involved in groundwater protection. Work has already begun at a national level on the methodology to use in the classification process. This is required to ensure that groundwater systems that cross State and Territory boundaries are afforded the same level of protection.

People requiring this information should contact Regional offices of DLWC (see Appendix B).

6.2 Groundwater Management Plans

Where a groundwater system is at high risk from over extraction or contamination, priority will be given to developing a groundwater management plan. Development of groundwater management plans for aquifers at risk from contamination are required to be commenced by 2000/01. Regional groundwater management committees with community and government representatives will assist in the development of these plans.

Groundwater management plans (GMPs) will set out the operating rules for sharing and protecting groundwater at a regional or local level. They will contain statements on existing water level behaviour and water quality, and will use water quality objectives established by government as a guide for developing management strategies and actions.

GMPs will identify the most sensitive beneficial use of the groundwater system and will require monitoring to ensure that the beneficial use of the aquifer is not compromised. They will also address when appropriate the allowable impacts of groundwater use on the surface environment so as to minimise environmental damage.

GMPs have already been developed for several major groundwater systems in NSW, in consultation with the local community. Most are in high yielding groundwater areas, but some are in low yielding areas where groundwater is highly valued.

The plans will be reviewed and updated every five years after analysing water usage, water quality and water level data. These plans are to be an integral part of catchment planning and management.

6.3 Guidelines for Industry

The development of best practice guidelines for industry and local government will be a key to the implementation of this policy. Guidelines on groundwater protection issues and management options relevant to the particular industry or agency, developed through consultation, will ensure that policy objectives are integrated into the day-to-day management activities and decision making of relevant groups.

Guidelines need to cover issues such as:

- the use of groundwater vulnerability maps to highlight sensitive groundwater systems;
- determining the beneficial use of groundwater systems;
- licensing bores;
- procedures for abandoning bores; and
- water quality standards for irrigation with groundwater.

Other national guidelines have already been developed by Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) such as those regarding the requirements for the construction of bores.

6.4 Education

Education is an important part of policy implementation. The implementation strategies listed above include a substantial education component. It is also important to provide a variety of people - including catchment planners, educators, groundwater users and environmentalists - with details of the groundwater resources in their area and the potential threats to these resources. The message of valuing and protecting our groundwater systems also needs to reach the whole community.

A variety of educational tools will be needed for different parts of the community, so they have the information needed to make decisions. An 'education' kit with brochures/position papers on groundwater issues is currently being developed by DLWC.

6.5 Planning Instruments

Policy implementation can be achieved through existing environmental planning processes. GMPs will identify groundwater issues that need to be addressed in development control plans, local environmental plans, regional environmental plans and state environment planning policies. These planning instruments direct the type of land use that is permissible and thus have a major impact on protecting valuable groundwater resources.

6.6 Groundwater Vulnerability Mapping

The Government has already begun a program of groundwater vulnerability mapping of the most valuable of the State's groundwater resources. Some maps have been prepared for local government areas, while others are at regional scale. Planning officers and consultants should refer to these maps when considering new developments or working on existing developments.

Coverage for the remainder of the State will be completed over the next five years.

6.7 Wellhead Protection Plans

A wellhead is the part of a bore that is located above the ground. It is critical that bores that supply drinking water to towns are given a high level of protection. As a component of groundwater management plans, wellhead protection plans can be developed that will define buffer zones for protecting town water supply bores from contamination. The adoption of a wellhead protection plan will also heighten the awareness of water supply operators and the public about groundwater protection. Appendix C identifies zones applicable to wellhead protection.

6.8 Research

There is a need for ongoing research in the area of groundwater protection. In particular, little is known about the value of groundwater-dependent ecosystems and how they react to and recover from pollution stresses. Similarly, little is known about transportation of micro-organisms in groundwater systems, both native and introduced species. Developing more robust scientific tools for management purposes is one of the many areas where applied research could be of benefit in groundwater management.

Government agencies will look for more opportunities to use the knowledge and expertise within universities and the CSIRO. Co-operative research has been identified as the most appropriate way to achieve a better understanding of the processes governing groundwater quality.

6.9 Monitoring

A limited network of monitoring bores exists around the State to monitor groundwater quality. A review by DLWC of sampling procedures and adequacy of the network has commenced and is due for completion in 1999.

Only through a combination of broad scale and point source water quality monitoring will it be possible to manage the State's groundwaters effectively and evaluate the success or otherwise of this policy. The analytical results will be compared with the water quality objectives set for aquifer systems and the trends in groundwater quality will be published in the NSW State of the Environment Report.

Monitoring will occur at several levels including:

- measuring general water quality parameters on a regular basis at key sites in major groundwater systems across the State, so that inter-valley comparisons can be made on the health of groundwater systems.
- measuring the attenuation and degradation of pollutants over time at selected sites of groundwater pollution. This will provide valuable information on natural and enhanced degradation rates;
- recording contaminated groundwater sites and the level of activity to clean up the problem; and
- recording the level of activity in preparing groundwater management plans, vulnerability maps, beneficial use maps, wellhead protection plans and supporting industry guidelines.

7. REPORTING

Reporting on groundwater occurs at several different levels, and at a variety of times. There is currently an attempt to dramatically improve co-ordination of the various environmental reporting and auditing processes.

Where groundwater management plans already exist, there is a process in place to ensure that the status of the groundwater system, and the performance of the plan against its objectives, is regularly reported on. Plans are reviewed and updated every five years, if necessary. In practice only the most highly developed and stressed groundwater systems have had this level of review.

The three-yearly NSW State of the Environment Report gives an overview of the health of groundwater across the State. Groundwater reporting is also currently included in the State of the Rivers and Estuaries reporting, and is proposed for the State of the Catchments reporting process currently under development. This will allow information from one reporting process to be incorporated and presented as an overview in another forum without duplication.

Appropriate groundwater and dependent ecosystem indicators need to be developed and monitored by Government to reflect the state of groundwater in NSW. This work is evolving and these indicators will then become the basis by which the success of this Policy can be judged. This will indicate where adjustments to the Policy need to be made if the desired outcomes are not being achieved.

8. CO-ORDINATION AND REVIEW

Policy development, co-ordination and review will be implemented through a working group comprising relevant agency and community representatives. The working group will meet periodically to review policy performance and ensure implementation is progressing. The policy will be formally reviewed on a five yearly basis.

Groundwater management plans will be reviewed and reporting will be through local groundwater management committees.

APPENDIX A

SUGGESTED FURTHER READING

- 1985 Review of Australia's Water Resources and Water Use, AWRC 1987.
- The NSW State Groundwater Policy Framework Document, DLWC, 1997.
- State of the Environment Report Groundwater Sub-Chapter, DWR, 1995, ref. TS 95.003.
- Australian Water Quality Guidelines for Fresh and Marine Waters, NWQMS, 1992.
- Australian Drinking Water Guidelines, NWQMS, 1996
- Guidelines for groundwater protection in Australia, NWQMS, 1995.
- Minimum Construction Requirements for Water Bores in Australia, ARMCANZ, 1997.

APPENDIX B

GROUNDWATER CONTACTS

Department of Land and Water Conservation

Parramatta: 02 9895 6211

Barwon and Far West: 02 6764 5927

Central and Far West: 02 6881 0460

Hunter: 02 4929 4346

Murray: 02 6041 1650

Murrumbidgee: 02 6953 0745

North Coast: 02 6642 7799

Sydney-South Coast: 02 9895 7875

NSW Environment Protection Authority (EPA)

Chatswood: 02 9795 5000

Australian Geological Survey Organisation (AGSO)

Canberra: 06 249 9111

APPENDIX C

Wellhead Protection Zones

A wellhead protection plan recognises three protection zones.

Zone I (Inner Protection Zone)

Zone II (Outer Protection Zone)

Zone III (Catchment Zone)

Zone I (Inner Protection Zone)

This zone is located immediately adjacent to the bore. It is designed to protect against the effects of human activity which might have an immediate effect upon the bore. The area is defined by a 50 day travel time in the aquifer, and has a minimum 50m radius.

Zone II (Outer Protection Zone)

This zone is defined by the 400 day travel time radiating out from the bore hole. This travel time will allow attenuation and degradation of some pollutants.

Zone III (Catchment Zone)

This zone covers the complete catchment area of water that travels towards the bore and will eventually be pumped out. It is defined as an area needed to support an abstraction from long term annual groundwater recharge.

Methods for determining the size and location of these zones are readily available in the groundwater literature. Once the protection zones are determined then restrictions on land use within each zone can be implemented if deemed appropriate. High risk activities may be excluded within the wellhead protection plan area.

Figure 3 shows an example of wellhead protection zones for a public water supply.

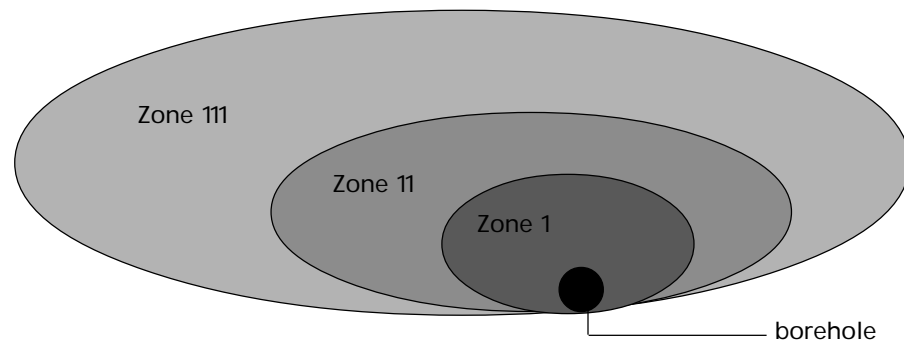


Figure 3: Diagram of Wellhead Protection Zones for a Public Water Supply

Wellhead Protection Plans should be prepared by the owner/operators of all public water supply bores in consultation with DLWC.

The Plan should involve three aspects of work;

- **Well Integrity Assurance:** The integrity of well casing should be regularly checked to ensure that corrosion is not occurring that can lead to failure. The physical condition of the well collar should also be regularly inspected as a damaged collar can cause leakage problems from the surface to the aquifer.

- **Wellhead Protection Zones:** The definition of protection zones around the well should be calculated and the results presented on a suitable scale map. Controls on future development can then be developed and implemented through Local Environmental Plans. Potential contaminating sources need to be documented and action taken as necessary after inspecting the sources and conducting tests.
- **Monitoring System:** Water quality monitoring within the wellfield is required. This is the responsibility of the owner/operator. A set of key indicators need to be established to provide means of identifying and measuring change. See the National Water Quality Management Strategy (1992) for possible indicators.

APPENDIX D - Groundwater Protection Levels

Level of Protection	Assessment Required
<p>Level I Professional Statement In areas which have low groundwater value, where groundwater discharge to other environments is not significant, and where there are no obvious sources of contaminants.</p>	<p>A professional hydrogeological appraisal is required showing the nature of the groundwater resource, the risk the development places on the resource, and a statement of environmental effects based on professional opinion.</p>
<p>Level II Groundwater Contamination Assessment Report In areas where one or more of the variables might indicate a potential risk to groundwater or the environment.</p>	<p>A desk study is required showing the nature of groundwater resource, pollution risk, extent of any barriers to pollution flow, either natural or engineered. Calculations showing level of environmental impact based on existing knowledge of the site.</p>
<p>Level III Site Investigation with Monitoring In areas where Level II investigation indicates a potential risk, or where it is otherwise known to exist.</p>	<p>Limited site investigation is required to collect baseline data. Some soil and water testing required. Definition of groundwater flow system is required. Effectiveness of barriers, either natural or engineered, to be demonstrated. Calculations or modelling results are to be provided in support of conclusions on level of impact. Limited ongoing monitoring required.</p>
<p>Level IV Demonstrated Groundwater Protection Plan - In areas where the risk to groundwater is demonstrated by Levels II and III assessment, or is otherwise known, and where these effects cannot be tolerated, (that is, the beneficial use of the system will be lowered if adequate action is not taken).</p>	<p>Extensive site investigation for baseline soil and water data. Definition of groundwater flow system is required. Engineering designs for any artificial barriers to be provided. An effluent/water management plan is required. Calculations or modelling results are to be provided in support of conclusions on level of impact. Demonstrated management skills have to be shown. A groundwater protection plan is required coupled with a monitoring schedule and an annual report.</p>
<p>Level V Demonstrated Remedial Action Plan In cases where the potential risk is so great, or where the impact of contamination on a high value aquifer is evident, but not sufficient to warrant clean up, a demonstrated remedial action plan will be required. The purpose of this level of protection is to devise a plan to restore a degraded groundwater body to higher quality to satisfy a designated beneficial use should significant contamination occur.</p>	<p>As for Level IV, plus a feasibility plan for clean up which analyses the effectiveness of the planned remediation approach in achieving designated beneficial use criteria. The financial capacity of the responsible party to enact the plan should also be evaluated.</p>
<p>Level VI Prohibition/Clean Up In the event that the risk to groundwater is unacceptable, an activity or land use may be banned by the responsible authority. For proposed new developments, consent may not be given. For existing activities causing unacceptable off site impacts to groundwater or dependent ecosystems, a clean up order may be issued by the NSW EPA, or a voluntary investigation or remediation agreement be entered into.</p>	<p>Extensive discussions with EPA are required.</p>

The above table has been adapted from the National Water Quality Management Strategy (NWQMS 1995)

In reviewing environmental impact assessments the following matters should be considered:

not all groundwater systems are of equal value;

- the level of protection should always be commensurate with the risk that the development poses to an aquifer and the value that the community puts on the aquifer;
- a development should not lower the beneficial use of the aquifer;
- prevention of pollution is far less costly than clean up;
- containment of hazardous wastes cannot be assured;
- an appropriate level of management must be demonstrated;
- appropriate monitoring should be undertaken by the developer to confirm or otherwise the predictions stated in the Environmental Impact Statement; and
- only a minimal impact to the groundwater resource is acceptable and any higher level of impact must be justified to show how the benefits outweigh the costs.

The level of protection for an aquifer should be decided in accordance with Principle 4 on page 20. The appraisal necessary to demonstrate protection is also given in the Table above.

Care should also be taken when assessing environmental impact assessments to ensure that minor impacts from individual developments do not add up to an undesirable cumulative impact.

It is good practice for any authority that is going to approve a new development to set performance criteria in their consent conditions that reflects the limit of acceptable impact. This could be by way of water quality criteria, water level criteria or cumulative limits on interference effects between users (including the environment).

Monitoring and reporting are essential to ensure that the environmental impacts do not exceed agreed limits.

APPENDIX E

List of Acronyms

ANZECC	Australian and New Zealand Environment Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AWRC	Australian Water Resources Council
COAG	Council of Australian Governments
CSIRO	Commonwealth Scientific Industry Research Organisation.
DCP	Development Control Plans
DLWC	Department of Land and Water Conservation
DUAP	Department of Urban Affairs and Planning
DWR	Department of Water Resources
EPA	Environmental Protection Authority
ESD	Ecological Sustainable Development
LEP	Local Environment Plans
NWQMS	National Water Quality Management Strategy
REF	Review of Environmental Factors
SAR	Sodium Adsorption Ratio
SEE	Statement of Environmental Effects
SEPP	State Environment Planning Policies
SCMCC	State Catchment Management Co-ordinating Committee