Aquifer Risk Assessment Report

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1. INTRODUCTION

Groundwater is an important resource to towns, farmers and industry in NSW and also makes a substantial contribution to maintaining aquatic environments. It feeds many surface ecosystems and often provides the base flow in rivers. The need to manage groundwater carefully is directly related to the value of this resource and the risk of devaluation and its loss through over-exploitation or contamination.

Increasing pressure on groundwater resources have already resulted in over-extraction - mining - of some aquifers which will affect long term supplies. In these systems, current extraction exceeds the sustainable yield.

In other aquifers, current water extraction may be less than the sustainable yield, but significant entitlements to water have been allocated but not used. Activation of these will cause impacts on currently developed users and on the environment.

There are other aquifers where the total of all issued entitlements are less than sustainable yields and where action needs to focus on preventing them from becoming stressed in the future.

Contaminated groundwaters have been identified in both rural and urban areas, and a number of cases have posed threats to human and animal health. As well, rising watertable levels and salinity problems have decreased the utility of land and water resources in some areas. Important wetlands have been degraded or lost altogether as a result of inappropriate groundwater use or contamination.

In mid 1997, the Government announced a series of water reforms which included an assessment of the State's groundwater systems in terms of risk of over-extraction and/or contamination. Aquifers at high risk are to have priority management attention with groundwater management plans started immediately. Those at medium risk are to have plans prepared over a five year period. Those in the low risk category are to be regularly reviewed and steps taken to prevent them becoming stressed.

The aquifer risk assessment approach recognises that not only environmental circumstances but also economic, social and equity factors vary significantly for each aquifer. This means that common rules and actions across all groundwater systems would result in either unnecessary hardship in some or, conversely, inadequate protection in others. On the other hand, the resources and time needed to fully evaluate each aquifer individually and develop appropriate management strategies would be enormous. A key outcome of the aquifer classification analysis is the prioritisation of aquifers for immediate attention.

The aquifer risk assessment approach, therefore establishes a consistent and transparent rationale for the future management of all groundwater systems while allowing for different priorities and policies depending on the circumstances of each system.

Classifying aquifers according to their risk level is the first step in a process to bring groundwater to a sustainable level of management. The ultimate aim of the reforms is:

- to achieve clean and healthy groundwater systems (and rivers) and productive use of water by providing:
  - better balance in sharing water between the environment and water users
  - better clarity of access and use rights for water
  - a water transfer market that will facilitate reallocation of water to its highest valued use.

The steps are to identify the aquifers for highest priority attention (the aquifer risk assessment), establish agreed outcomes for those aquifers, establish a groundwater management committee to prepare a plan to achieve those outcomes, and dealing with management issues such as water transfers, sleeper and dozer licenses, etc. The management plan will provide the rules for aquifer protection and the rules to allow trading to develop.

This report outlines the process that was undertaken for the risk assessment and presents the results of the classification process.

2. MANAGEMENT IMPLICATIONS

2.1 MANAGEMENT INFLUENCES

Under the aquifer risk assessment approach, groundwater systems have been classified according to their assessed level of risk from over extraction and from contamination. This classification will guide both the management priorities and the application of policies. This will ensure that actions are taken according to the needs of the individual aquifers, and that the impact on the rural community is focussed on those areas where it is likely to make a real difference to aquifer health.

The aquifer risk assessment classification will influence the following decisions:

- Licence embargo review.
- Development of groundwater management plans (to be completed by 1998/99 for aquifers at risk from over-extraction and by 2000/01 for those at risk from water quality decline).
- Introduction of any water transfer schemes.
- How sleeper and dozer licences are dealt with.
- The volume available for extraction in any aquifer zone.
- Priority for land use planning controls.

It will **not** determine:

- The actual volumetric allocation and conditions placed on individual licences - this will be undertaken by the Department of Land and Water Conservation based on existing irrigated and licenced areas and the management plan.

The aquifer risk assessment approach will provide water users and the local community with clear information on the issues pertinent to each aquifer and help them in the management of water by making the risks more obvious. They will also be assured that new water licences which could further threaten supply will not be available in aquifers already under stress. However, once the aquifer management plans are in place, water users will be able to trade entitlements in accordance with the rules set by those plans.

Several of the high risk aquifers around the State already have a management plan process underway. The identification of any aquifer in a high risk category for quality and/or quantity factors will trigger immediate management responses and the development of a management plan. Management responses may include measures such as licence embargoes, modified water allocations, or bore rehabilitation or pollution control measures.

For aquifers classified as medium or low risk, an upper limit to development will be determined. Trading will also be allowed subject to reasonable safeguards. Triggers will be put in place which signal when a aquifer is approaching a higher risk level, therefore requiring more intensive management.

2.2 PRIORITY SETTING

Aquifers assessed as being of high risk will be given priority in terms of resources and management. This is so that limited government resources are directed to the area where they can do the most good.

Groundwater management plans will be completed by 1998/99 for aquifers at high risk from over-extraction and by 2000/01 for those at risk from water quality decline. Plans for the median risk groundwater systems will be developed after that time. Low risk systems will be managed through the State-wide licencing policy with regular review to ensure that they are not becoming stressed. All plans will include a set of performance criteria so that management can be reviewed and adjusted as necessary.

2.3 REVIEW AND MONITORING

The NSW Government will establish Groundwater Management Committees to begin developing management plans for each high risk groundwater system. As groundwater management plans are developed, the Committees will review the classification of each aquifer using additional field assessment where appropriate. The Department of Land and Water Conservation will also be undertaking a more detailed assessment of existing groundwater use, particularly irrigation development, and this information will also assist the review.

The Committees will also assist the Government in determining an appropriate aquifer monitoring strategy to enable the classification to be reviewed and performance to be monitored. The type and intensity of field monitoring will be determined according to the needs of the individual aquifer.

It will be essential to re-evaluate the classification of each aquifer approximately every five years. This will indicate the success and appropriateness of the management strategies. If a low risk aquifer was later classified as medium or even high risk, necessary action would be taken. If a high risk aquifer remained stressed, a careful evaluation of the adequacy of management action would be necessary to determine if more stringent actions are justified. This will feed into a review of the groundwater management plan.

3. METHODOLOGY

3.1 OVERVIEW

Although prepared in a whole of Government framework, the methodology for the risk assessment was developed by the Department of Land and Water Conservation (DLWC) in close collaboration with the Environment Protection Authority (EPA). Advice was also sought from the NSW Groundwater Policy Working Group which includes farmer, environmental, local government and government agency representation.

3.2 RISK ASSESSMENT CRITERIA

The key part of the process involves the establishment of criteria to be used to evaluate the risk level of each aquifer. Eight criteria were used to define the total risk to an aquifer system - see Table 1. The criteria were given weightings to reflect the relative importance of each.

3.3 ANALYSIS TECHNIQUES

The central tool used in the analysis is multi-criteria analysis computer software which allows the quantitative assessment of qualitative data. This is critical as much of the information available to complete the classification is based on scientific and technical judgements rather than numerical analysis. This approach is appropriate for a desk-top analysis such as this. As more quantitative data becomes available, the Groundwater Management Committees will be able to re-evaluate the classifications.

Multi-Criteria Analysis

Multi-criteria analysis is a process to help rank a set of number of options according to a defined set of criteria. It provides a structures, yet flexible, approach to decision-making using techniques that range form simple graphical methods to sophisticated mathematical programming. A significant outcome is that by systematically structuring the decision-making process, it makes the results clear and justifies the actions taken.

3.4 LIMITATIONS

The aquifer risk assessment process was designed to provide a rapid desktop analysis of the current stress levels using the best data available. This was carried out by regional scientists and technical experts. Although this process excluded additional data collection and extensive field verification, it is based on the best available information and provides a sound basis from which interim management decisions may be made and developed further.

More detailed investigation will occur at the groundwater planning stage, using the aquifer risk assessment as a guide. It is also acknowledged that on-going monitoring is required to verify the desktop assessments and to enable inclusion of future issues in the planning process.

4. RESULTS

The analysis provides a high, medium and low risk classification for aquifers across the State. They are presented here in terms of the DLWC's regions. Tables 2 shows the high risk aquifers in both the coast and the inland. Tables 3 to 8 show the classification for DLWC regions.

Appendix A shows the results for each region in a graphical form. The larger the total score for each aquifer (the longer the bar) the greater the risk of the aquifer becoming stressed. The chart also shows the dominant criteria for each aquifer.

Table 1: Risk Assessment Criteria

Criteria	Comments	Weighting (max 10)
1 Relationship between licenced water entitlements and the sustainable yield of the aquifer	This is an indicator of the risk of over-extraction of the groundwater. It is most appropriate for the major alluvial aquifers and confined systems, but not as good for upper catchment alluvial aquifers which are free-draining, nor fractured rock aquifers.	10
2 Local interference caused by pumping	This is an indicator of current stress of an aquifer caused by high levels of extraction.	8
3 Small or large flow systems	This will reflect the ability of the aquifer to cope with stress - large flow systems that occur over many kilometres have greater capability to assimilate stresses.	4
4 Vulnerability of the aquifer to pollution	This is an assessment of the physical characteristics of the aquifer and its susceptibility to land use changes.	4
5 Land use threats	This reflects the actual land use threats in an aquifer's catchment - from urban development, agriculture, and industry.	10
6 Proximity of poor quality water that could be drawn in by over pumping	This reflects the potential for the aquifer to be polluted from adjacent aquifers and connections between aquifers.	6
7 Water level rise and salinity trends	This assesses the risk of an aquifer to rising watertable levels and salinity increases and is most applicable to surface aquifers.	6
8 Dependence of surface ecosystems on groundwater flows	This reflects both the potential for surface ecosystems to be contaminated by deteriorated groundwater quality and the potential for water losses from over-extraction	10

5. CONCLUSIONS

The Aquifer Classification Process has been designed as a rapid desktop assessment of the current and potential future stress of groundwater systems. This report on the findings of the approach has been designed as a guide for resource planning and prioritisation of action for aquifers across NSW.

The report will also be used to provide water users and the local community with issues pertinent to each aquifer system and to help them in the management of groundwater by making the risks more obvious. The NSW Government will now move to establish Groundwater Management Committees to begin developing groundwater management plans. The Committees will develop recommendations for the high priority aquifers first, based on the classification in this report. As groundwater management plans are developed, the Groundwater Management Committees will review the classification of each aquifer using additional field assessment where appropriate.

Table 2: Highest Risk Aquifers on a Statewide Basis

Inland Highest Risk Aquifers	Coastal Highest Risk Aquifers
Upper Namoi Alluvium (GWMA 004)	Hunter River Alluvium (regulated river reaches)
Lower Murray Alluvium (GWMA 016)	Goulburn River Alluvium
Lower Murrumbidgee Alluvium (GWMA 002)	Wollombi Alluvium
Belubula River (GWMA 021)	Kingdom Ponds Alluvium
Upper Lachlan (GWMA 011)	Tomago Sandbeds
Peel Valley Alluvium (GWMA 005)	Macleay Coastal Sands
Upper Murrumbidgee Alluvium (GWMA 013)	Williams & Patterson Rivers Alluvium
Lower Macquarie (GWMA 016)	Viney Creek Alluvium
Molong Limestone	Karuah / Myall Alluvium
Young Granites (GWMA 802)	Alstonville Basalt (GWMA 804)
Murrumbateman Fractured Rocks	Hastings River Alluvium
Dubbo (within GWMA 009)	Richmond River Alluvium
Border Rivers Alluvium (GWMA 022)	Maroota Alluvium and Sandstone
Lower Namoi Alluvium(GWMA 001)	Araluen Alluvium/Fractured Rocks
Lower Gwydir Alluvium (GWMA 003)	Richmond Coastal Sands
Billabong Creek Alluvium (GWMA 014)	Mangrove Mountain / Kulnura Sandstone
Cudgegong Valley (GWMA 010)	Botany Sandbeds (GWMA 018)
GAB Intake Beds (GWMA 601)	Note: GWMA refers to an aquifer that has been formally designated as a groundwater management area and its number.
GAB Main (GWMA 601)	

Table 3: Sydney South Coast Region

High Risk Aquifers	Sydney Basin Sandstone (GWMA 603)
Botany Sandbeds (GWMA 018)	Hawkesbury-Nepean Alluvium
Maroota Alluvium and Sandstone	Bega Valley Alluvium
Araluen Alluvium/Fractured Rocks	Miscellaneous South Coast Alluvium
Medium Risk Aquifers	**Low Risk Aquifers**
Southern Coastal Sands	Southern Tablelands Granites
Blue Mountains Sandstone	South Coast Fractured Rock Aquifers
Southern Highlands Fractured Rock (approx. Wingecarribee Shire LGA boundary)	

Table 4: Hunter Region

High Risk Aquifers	Medium Risk Aquifers
Hunter River Alluvium (regulated river reaches)	Hunter Coastal Sands
Wollombi Alluvium	Hunter Miscallaneous Tributaries Alluvium
Goulburn River Alluvium	North West Hunter Basalts
Kingdom Ponds Alluvium	Manning River Alluvium
Tomago Sandbeds	**Low Risk Aquifers**
Viney Creek Alluvium	Wollombi Sandstone
Karuah / Myall Alluvium	North-East Hunter Fractured Rocks
Williams & Patterson Rivers Alluvium	Hunter Coal-Associated Fractured Rocks
Mangrove Mountain / Kulnura Fractured Rocks	

Table 5: North Coast Region

High Risk Aquifers	Medium Risk Aquifers
Alstonville Basalt (GWMA 804)	Tweed Coastal Sands
Macleay Coastal Sands	Brunswick Alluvium
Richmond River Alluvium	Dorrigo Basalt
Richmond Coastal Sands	North Coast Metasediments
Hastings River Alluvium	North Coast Miscellaneous Alluvium
North Coast Fractured Rocks	Clarence Coastal Sands
Macleay Alluvium	**Low Risk Aquifers**
Bellinger Coastal Sands	North Coast Sedimentary Rocks

Table 6: Murray Region

High Risk Aquifers	Low Risk Aquifers
Lower Murray Alluvium (GWMA 016)	Murray Fractured Rocks - East
Billabong Creek Alluvium (GWMA 014)	Murray Fractured Rocks - West
Medium Risk Aquifers	
Upper Murray Alluvium (GWMA 015)	

Table 7: Murrumbidgee Region

High Risk Aquifers	Medium Risk Aquifers
Lower Murrumbidgee Alluvium (GWMA 002)	Muttama Creek Alluvium (part of GWMA 013)
Upper Murrumbidgee Alluvium (GWMA 013)	Lake George Alluvium
Murrumbateman Fractured Rocks	**Low Risk Aquifers**
	Murrumbidgee Fractured Rocks

Table 8: Central West Region (including parts of Far West Region)

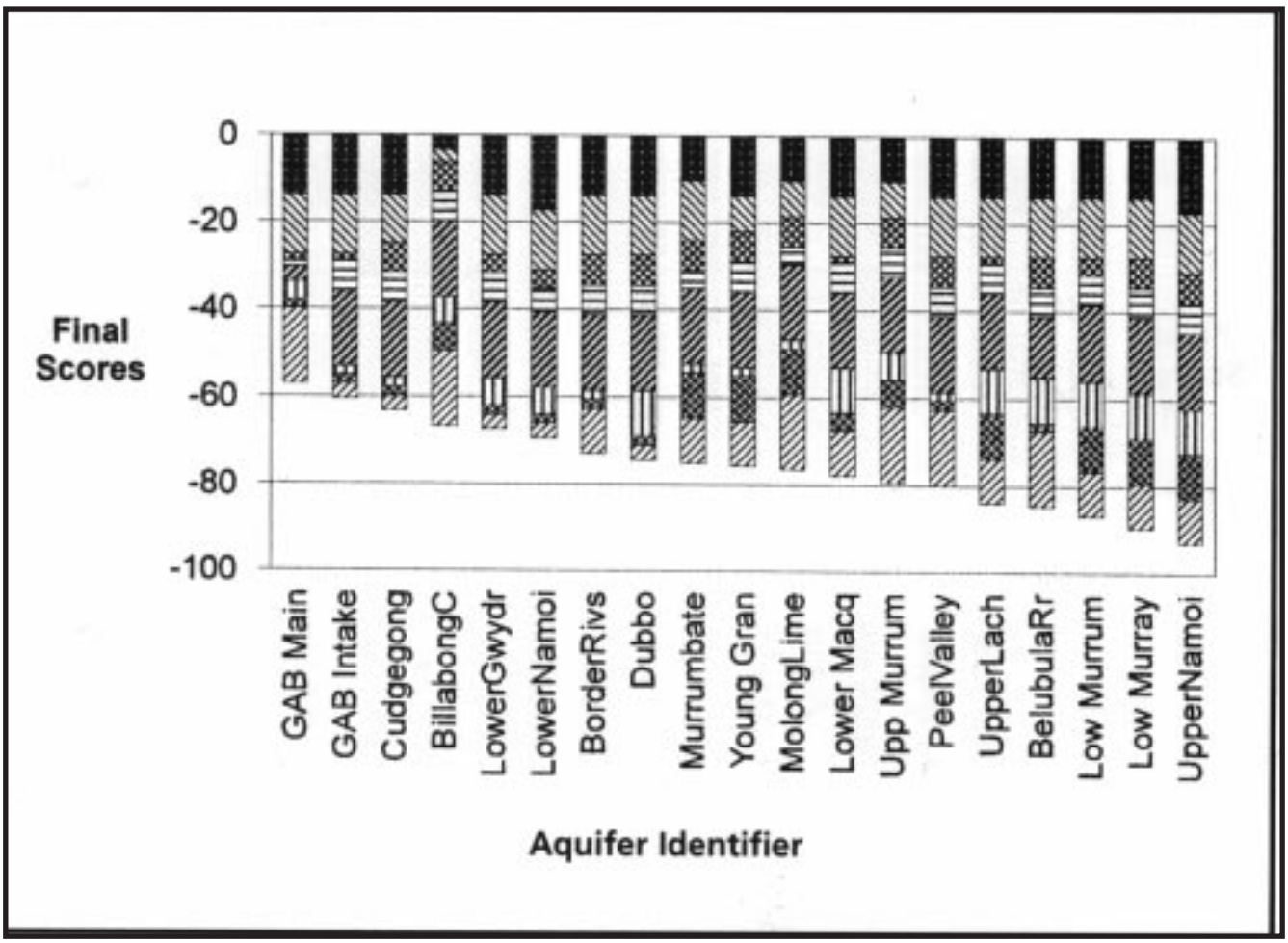
High Risk Aquifers	Low Risk Aquifers
Upper Lachlan (GWMA 011)	Murray River d/s of Murrumbidgee junction
Belubula River (GWMA 021)	Castlereagh Alluvium
Lower Macquarie (GWMA 016)	Lachlan Fold Belt Metasediments
Cudgegong Valley (GWMA 010)	Upper Tributaries Alluvium
Molong Limestone	Macquarie Marshes
Young Granites (GWMA 802)	Darling River - South of Menindee
Dubbo (within GWMA 009)	Castlereagh Basalts
Medium Risk Aquifers	GAB - Shallow (part of GWMA 601)
Bell River (GWMA 020)	Darling River - North of Menindee
Orange Basalts (GWMA 801)	Macquarie-Lachlan Granites
GAB - Main (within GWMA 601)	Crookwell Basalts
Darling River Anabranch	Broken Hill
Upper Macquarie (GWMA 009)	Far West
Lower lachlan (GWMA 012)	
Talbragar- Coolaburragundy (GWMA 019)	

Table 9: Barwon Region (including parts of Far West Region)

High Risk Aquifers	Medium Risk Aquifers
Upper Namoi Alluvium (GWMA 004)	Namoi Fractured Rocks
Peel Valley Alluvium (GWMA 005)	Maules Creek Alluvium (GWMA 006)
Border Rivers Alluvium (GWMA 022)	Namoi Miscellaneous Tributaries Alluvium(GWMA 007)
Lower Gwydir Alluvium (GWMA 003)	
Lower Namoi Alluvium(GWMA 001)	**Low Risk Aquifers**
GAB Intake Beds (GWMA 601)	Inverall Basalt (GWMA 803)
GAB Main (GWMA 601)	Miscellaneous Fractured Rocks

AQUIFER RISK ASSESSMENT

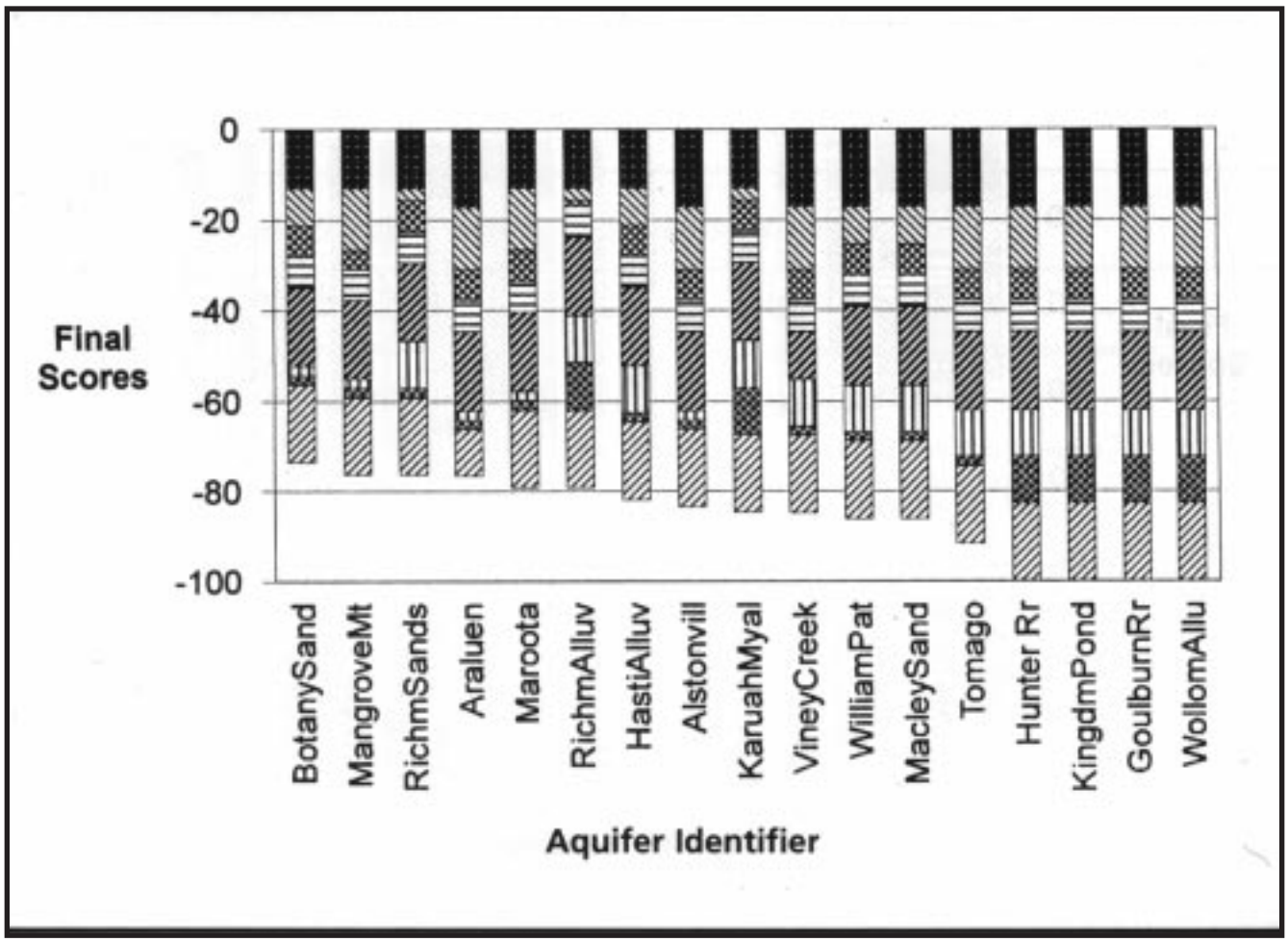
HIGHEST RISK AQUIFERS ON A STATEWIDE BASIS INLAND REGIONS



- Licensed entitlements compared to sustainable yield
- Local interference effects
- System flows
- Vulnerability to pollution
- Land use threats
- Poor quality water adjacent to aquifer
- High water levels and salinity
- Groundwater dependent ecosystems

AQUIFER RISK ASSESSMENT

HIGHEST RISK AQUIFERS ON A STATEWIDE BASIS COASTAL REGIONS



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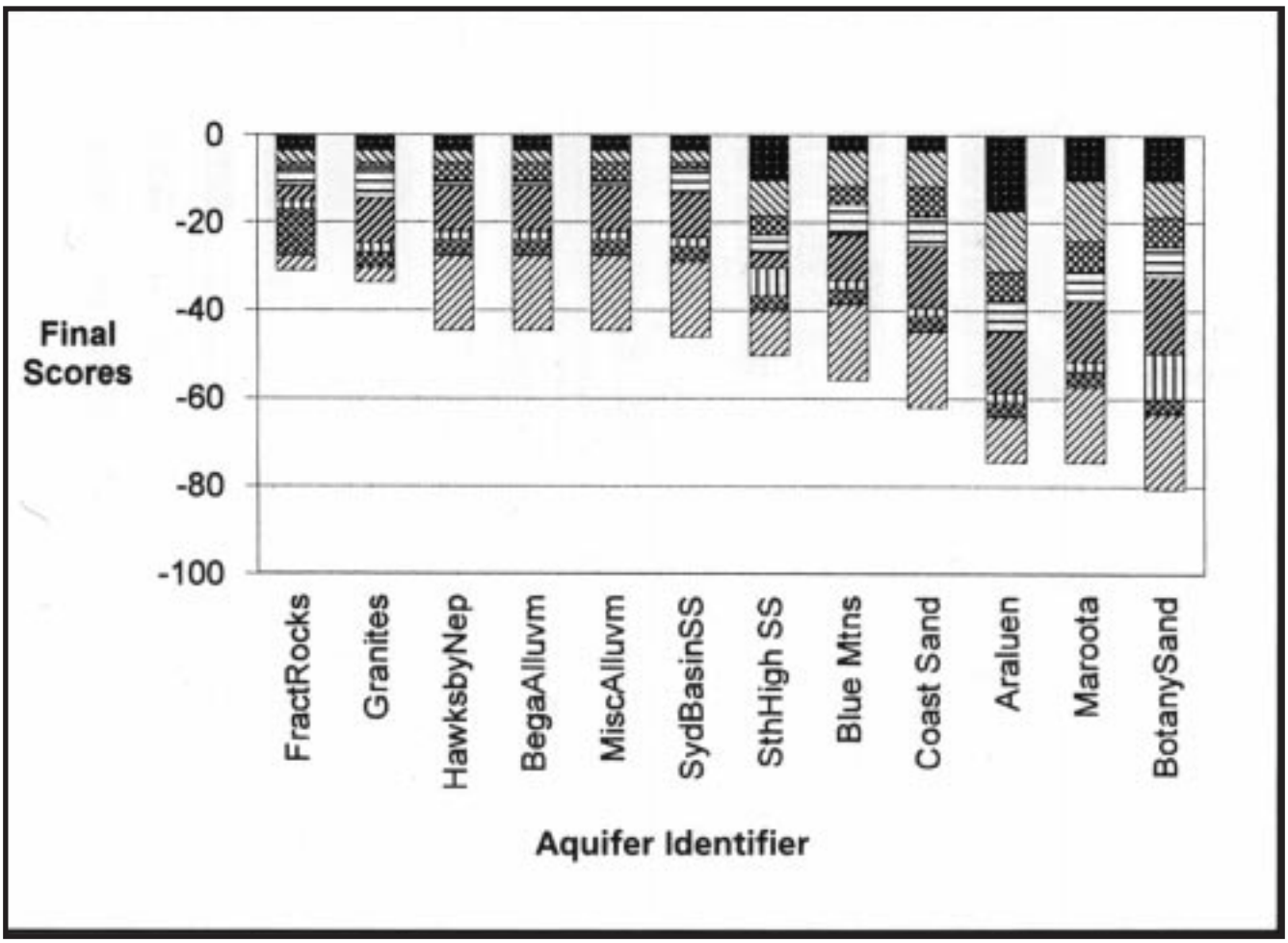
AQUIFER RISK ASSESSMENT

SYDNEY/SOUTH COAST REGIONS



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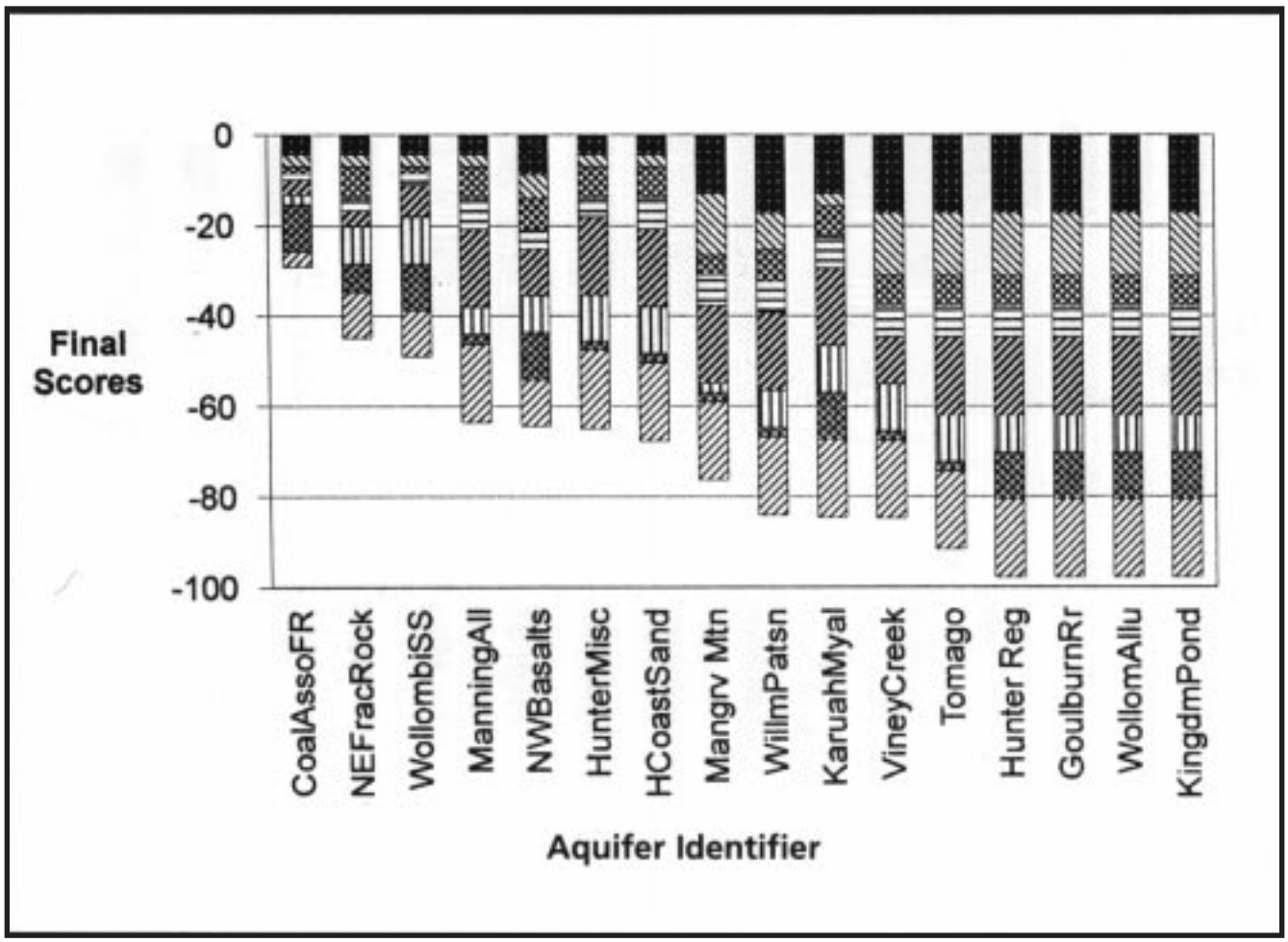
AQUIFER RISK ASSESSMENT

HUNTER REGION



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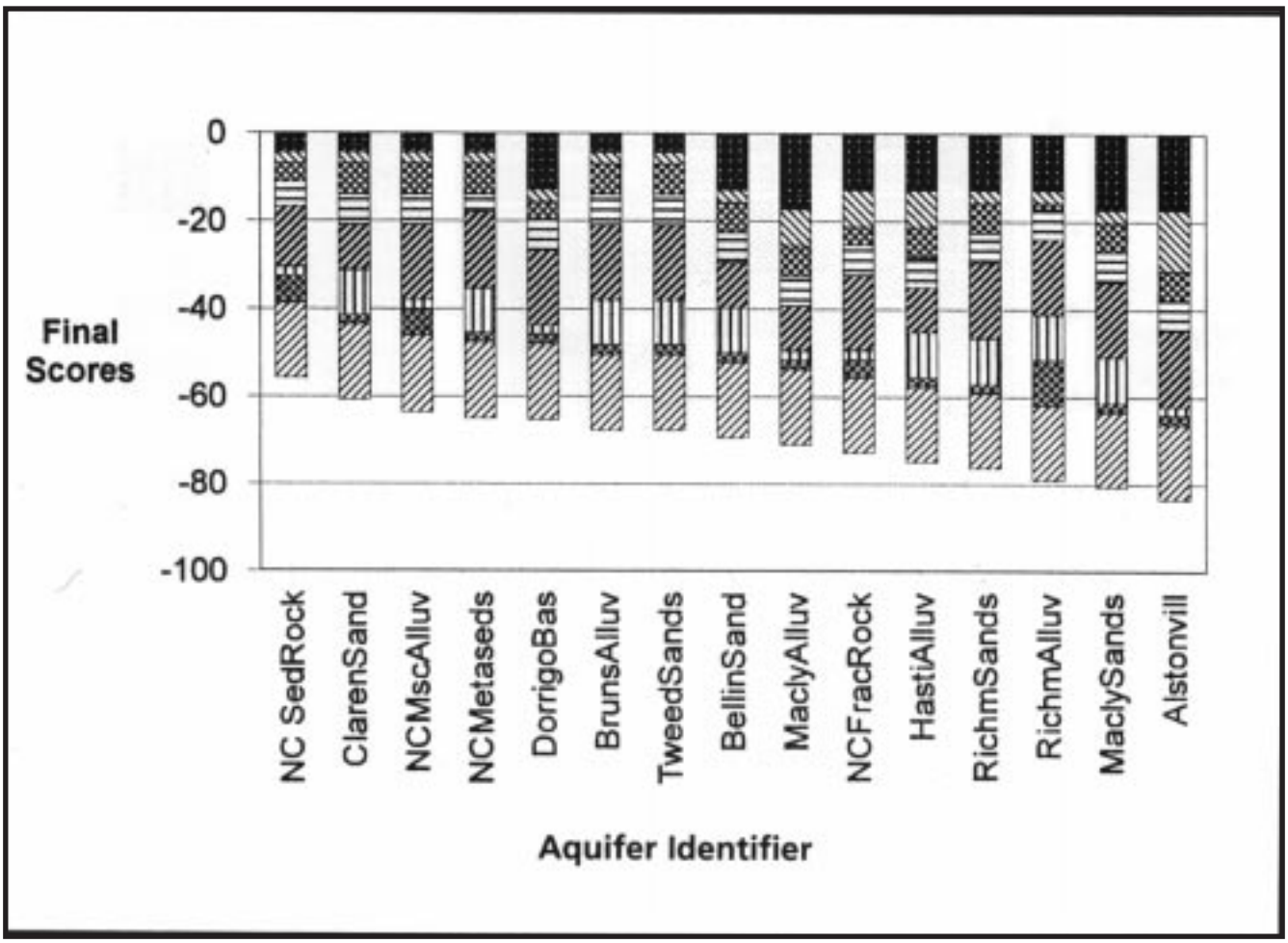
NORTH COAST REGION



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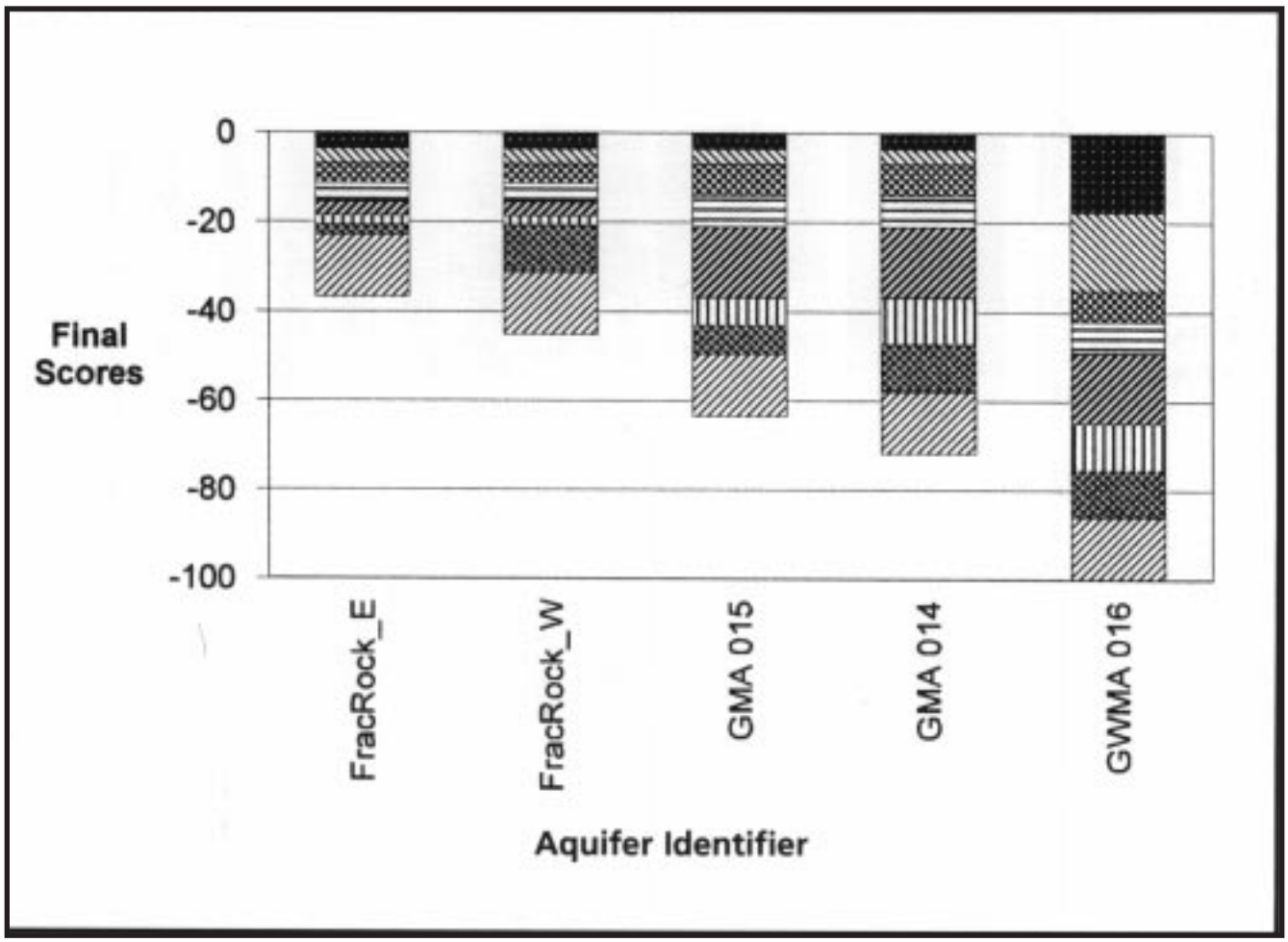
MURRAY REGION



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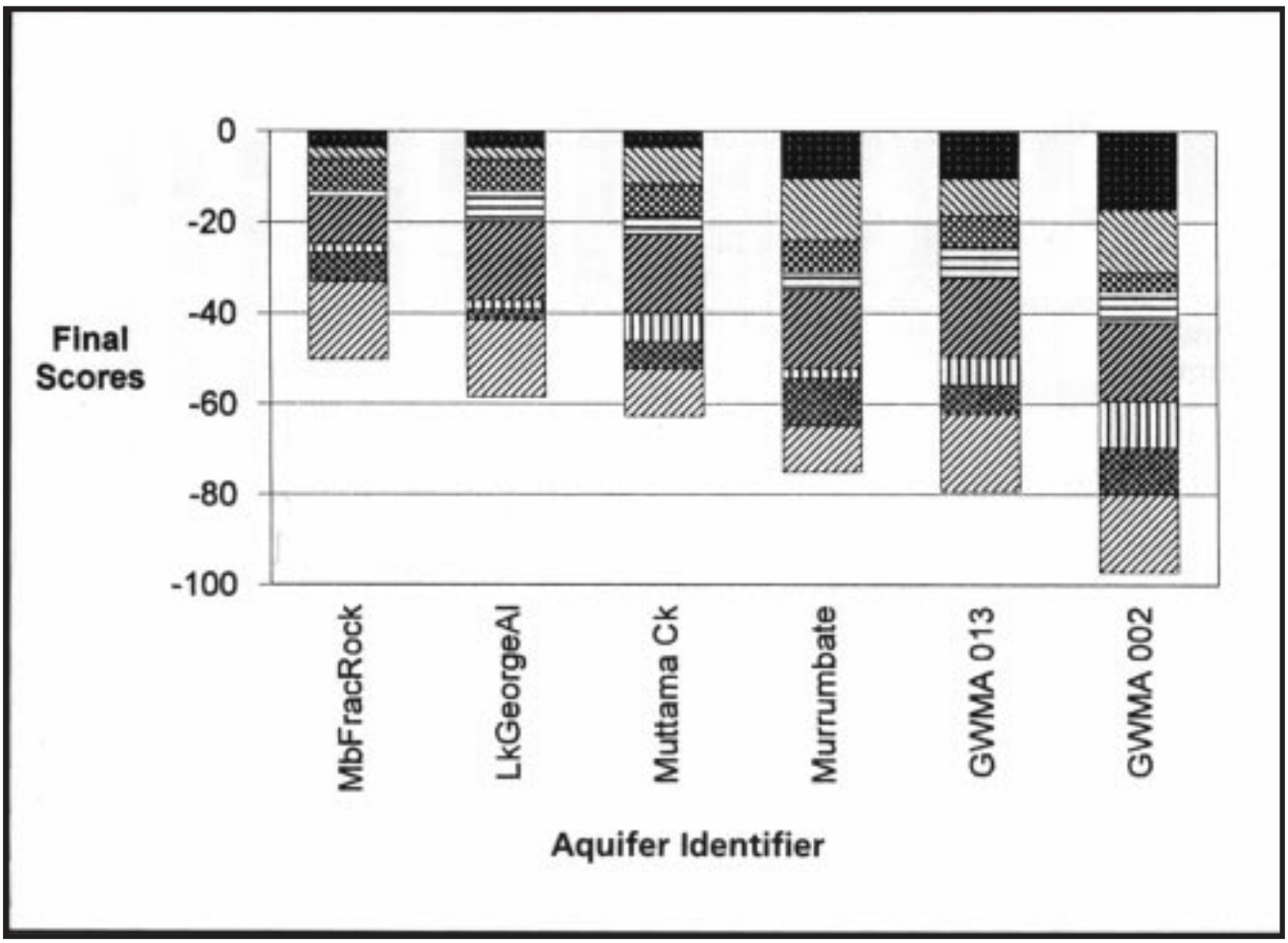
MURRUMBIDGEE REGION



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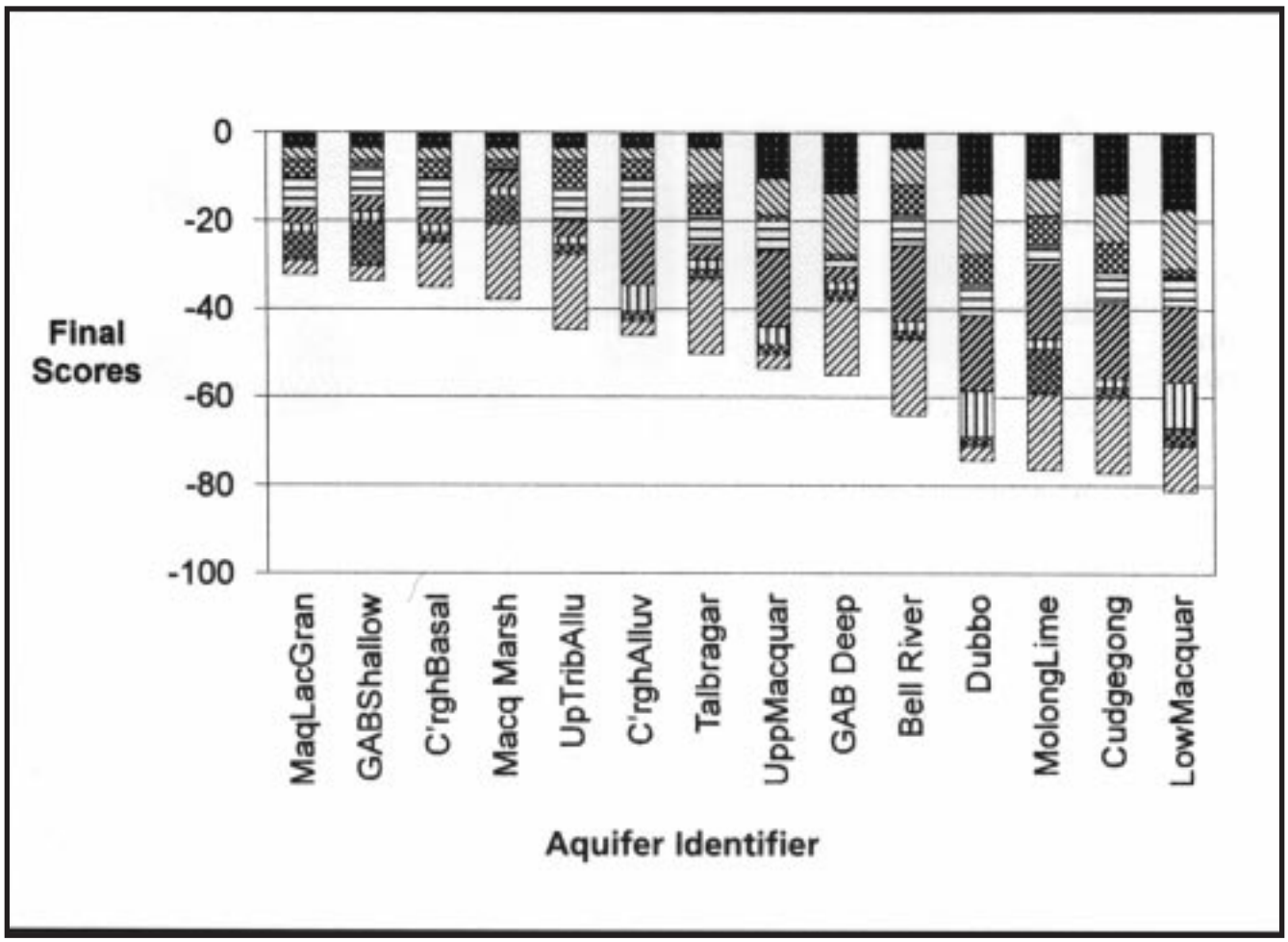
AQUIFER RISK ASSESSMENT

CENTRAL WEST REGION
(Macquarie & Castlereagh Catchments)



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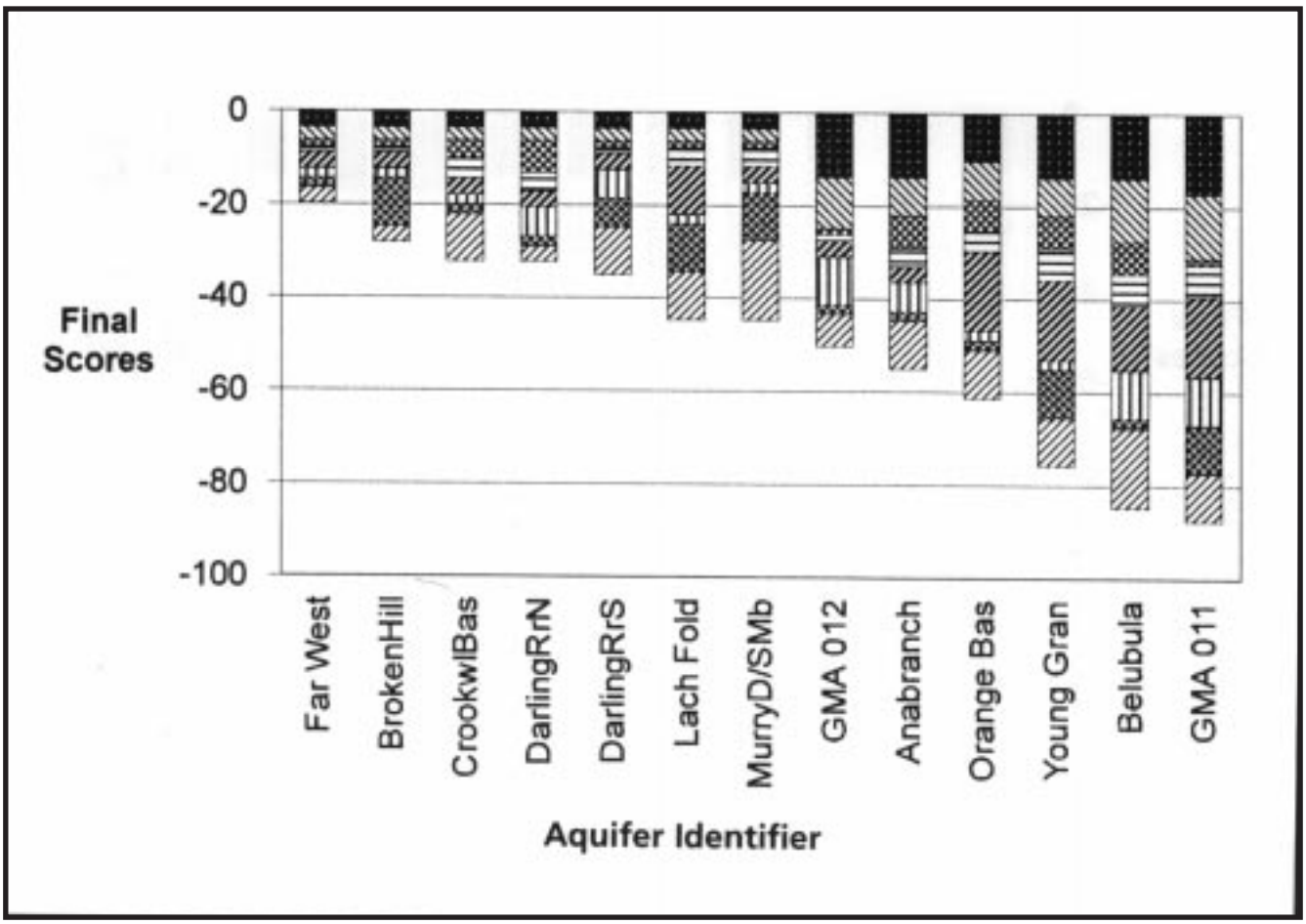

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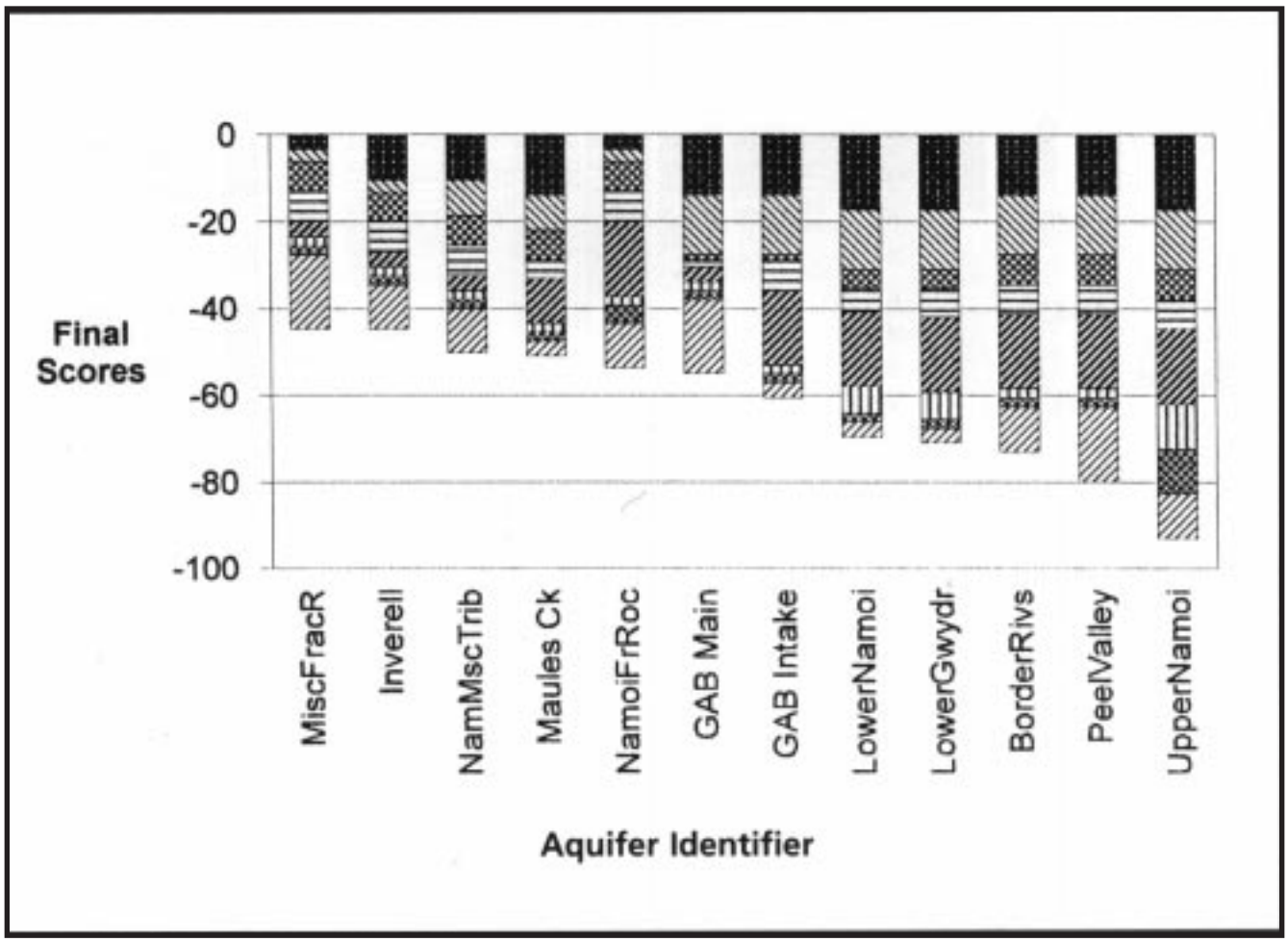
BARWON REGION



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