Government of Western Australia
Department of Water

Operational policy no. 5.12 – Hydrogeological reporting associated with a groundwater well licence

Previously Statewide policy no. 19 Hydrogeological reporting associated with a groundwater well licence

Looking after all our water needs

Operational policy no. 5.12 – Hydrogeological reporting associated with a groundwater well licence

(Previously Statewide policy no. 19 Hydrogeological reporting associated with a groundwater well licence)

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Summary

In Western Australia, the most widespread useable water resources are found in groundwater systems. The availability of groundwater throughout the state has facilitated the development of our mining and horticultural industries, as well as the growth of our cities and towns.

In most areas of the state, groundwater use must be licensed under the *Rights in Water and Irrigation Act 1914* (the Act) by the Department of Water (with the exceptions of stock and domestic use). Before a groundwater well licence is issued to an applicant, the department undertakes an assessment, including an evaluation of the potential impacts of taking the groundwater. On some occasions, the Department of Water (the department) requires additional information in order to make a better informed decision on the application. These may include cases where the volume of water requested is large, the level of knowledge regarding the state of the groundwater source is limited, the demand for accessing a particular groundwater resource is high, or the potential impacts of taking the water are considered significant. In these cases, the licence applicant may be requested by the department to undertake a hydrogeological assessment at their own cost, to determine the potential impacts of taking the groundwater. The department will determine the level of assessment that is required, as follows:

- *H1* – desktop hydrogeological assessment
- *H2* – basic hydrogeological assessment including drilling and test pumping
- *H3* – detailed hydrogeological assessment including drilling, test pumping and a groundwater model.

Licensees may be required to provide groundwater monitoring reports to satisfy the department that their groundwater abstraction is not causing detrimental impacts on the environment, other users, or the resource itself. There are two types of groundwater monitoring reports that the department may require from licensees:

- *Groundwater monitoring summary* – a brief report on the most recent groundwater monitoring results, to assess the impacts of abstraction over a specified reporting period.
- *Groundwater monitoring review* – a detailed report on all available groundwater monitoring results, to assess the impacts of abstraction over the life of the operation.

This policy provides guidance on when hydrogeological assessments and groundwater monitoring reports (collectively referred to as hydrogeological reports) will be required, and the information that they should contain. It replaces the current guidelines for hydrogeological reports and groundwater monitoring reports associated with a groundwater well licence (Water and Rivers Commission, May 1998).

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1 Policy statement

The Department of Water may require hydrogeological reports to be provided in association with groundwater well licences. There are two types of hydrogeological reports that the department may require:

- *Hydrogeological assessments*. Under clause 4(2), Schedule 1 of the *Rights in Water and Irrigation Act 1914*, the department may require applicants for the grant, amendment, transfer or agreement to temporarily transfer a licence under Section 5C of the Act, to undertake a hydrogeological assessment in support of their application.

  These assessments should address the potential impacts of the proposed groundwater abstraction on the water resource, the environment and on other water users. The department may use these assessments, together with other information that it holds, to determine whether it considers the proposed abstraction to be acceptable. The department will determine the level of assessment that is required.

- *Groundwater monitoring reports*. The department may include conditions in licences requiring the licensee to submit regular groundwater monitoring reports. These reports are required to assess the impacts of the on-going taking and use of groundwater on the environment, other users, and the resource itself.

It is recommended that all reports be prepared by a competent groundwater professional, preferably with relevant qualifications from a recognised educational institution (e.g. in the fields of hydrogeology, geology, engineering or environmental science). The applicant or licensee must cover the costs associated with the preparation of the report.

Chemical analyses of groundwater may be required as part of a hydrogeological assessment, or monitoring of an existing operation. This policy outlines the standard requirements for analyses. If particular chemicals or compounds are required outside of the standard suites provided, the department will inform the applicant, or for existing operations, may include them in the licence conditions.

Other investigations that applicants or licensees may need to perform to satisfy the Department of Water's reporting requirements include drilling, test pumping and groundwater modelling. This policy does not specify how these investigations should be conducted, but refers to relevant guidelines where appropriate.

2 Background

2.1 Issue

The importance of groundwater to development within Western Australia cannot be understated. The groundwater resources found throughout the state have played a key role in the development of agricultural, horticultural and mining industries. Most of the state's drinking water supplies are also sourced from groundwater systems.

As most parts of the state have been proclaimed under the *Rights in Water and Irrigation Act 1914*, the taking of groundwater generally requires statutory authorisation in the form of a licence granted under section 5C of the Act. These licences are granted by the Department of Water, Western Australia's water resource management agency. The section 5C licences prescribe annual water entitlements and conditions with which the licensee must comply. These conditions may relate to the use of the water, monitoring the impact of abstraction, and reporting of monitoring results to the department. Section 5C licences may be amended from time to time, transferred, or the entitlement transferred, in accordance with the Act.

Groundwater licence applications (including section 5C licences, amendments or transfers of section 5C licences, or agreements to temporarily transfer water), are assessed by the department to determine the acceptability of the potential impacts of the proposed groundwater abstraction. Although the department has significant hydrogeological information at its disposal, there are occasions when the department will need additional information to make a decision on whether to grant an application. This information may take the form of a hydrogeological assessment, detailing the likely impacts of taking the groundwater.

The department will determine the level of hydrogeological assessment that is required, based on factors such as the volume requested, the level of use and management of groundwater in the area, the quality of the groundwater resource and proximity of the proposed draw point to other groundwater users or groundwater-dependent ecosystems. The department will consider the hydrogeological assessment report, together with other information relating to the application, before making a final determination on whether or not to grant the groundwater licence application.

In addition, under the conditions imposed on a section 5C licence, existing licensees may be required to submit regular reports to the department on their groundwater usage and the impacts of taking the water. These groundwater monitoring reports are required to provide an outline of the licensee's water operations and an assessment of the impacts of groundwater abstraction on the environment, other water users and the groundwater resource. The department may require a summary report or detailed review, depending on the nature and timing of the operation, and the potential impacts.

This policy has been developed to facilitate the assessment of groundwater licence applications for the grant, amendment or transfer of a licence to take groundwater

under section 5C of the *Rights in Water and Irrigation Act 1914*, as well as the assessment of monitoring results submitted by licensees to comply with conditions imposed on the licence. It outlines the different types of hydrogeological reports required by the department; the acceptable structure of the reports; the issues that need to be addressed; and the data which is required.

2.2 Intent

The intent of this policy is to provide a framework for hydrogeological reports submitted to the Department of Water. This will facilitate the assessment of applications for a groundwater well licence, as well as the assessment of monitoring results. The policy will ensure:

- that data required to manage the state's groundwater resources is provided to the department
- consistency in the structure of hydrogeological reports
- consistency in the issues that need to be addressed in hydrogeological reports
- that the level of information required considers the particulars of the licence application and the groundwater resource to be accessed
- equity in the treatment of applicants for the grant, amendment, transfer or agreement to temporarily transfer a licence to take water under the Act
- equity in the treatment of licensees that need to submit groundwater monitoring reports as per the conditions of their licences.

2.3 Policy links

The policy has links to other policies prepared by the department on water management in this state including:

- Statewide policy No. 6*, Transferable (tradeable) water entitlements for Western Australia* (under review)
- Statewide policy No. 10*, Use of operating strategies in the water licensing process* (under review)
- Operational policy No. 5.11*, Timely submission for required further information.*

2.4 Legislation

Status of the Department of Water

The *Rights in Water and Irrigation Act 1914* establishes a legislative framework for managing and allocating water resources in Western Australia. Under the Act, the right to the use, flow and control of the water in watercourses, wetlands and underground water sources is vested in the Crown.

The Minister for Water has delegated specific water resource management powers and functions set out in the *Rights in Water and Irrigation Act 1914* to the Department of Water to administer. Such powers include the allocation by licensing of water resources and the implementation of associated conditions of use including hydrogeological reporting.

Applications for licences under section 5C of the *Rights in Water and Irrigation Act 1914*

The *Rights in Water and Irrigation Act 1914* requires people to hold a licence to take water from any artesian underground water source throughout the state, and from non-artesian underground water sources located within proclaimed groundwater areas. Licences to take water are issued under section 5C of the Act. Some exemptions apply; for example, taking water for stock and garden uses in most areas of the state.

Under the Act, the grant or refusal of a licence under section 5C is at the discretion of the department. Clause 7(2) provides that in assessing an application for a licence under section 5C, the department is to have regard to all matters that it considers relevant, including whether the proposed taking and use of the water is ecologically sustainable and environmentally acceptable; or whether it may have a detrimental effect on another person. The department may refuse an application on the grounds that the potential impacts of the taking and use of the water are unacceptable.

Clause 4(2) of Schedule 1 of the Act provides that an applicant for a licence must provide the department with any further information that the department may require in order to assess the application. The information requested by the department may include a hydrogeological assessment of the proposed taking and use of the water, to assist the department in determining the potential impact of granting a licence under section 5C.

In some cases, it may be necessary for the department to refuse to grant an application, notwithstanding that the applicant has borne significant costs in undertaking a hydrogeological assessment.

The applicant has a right of appeal of a licence refusal but not in the case that an application was deemed incomplete by the department and returned to the applicant because of failure to supply the necessary information the department required to determine whether to grant or refuse the groundwater licence application (refer Operational policy no. 5.11, Department of Water 2009).

Applications to amend section 5C licences under the *Rights in Water and Irrigation Act 1914*

Clause 23(1) of Schedule 1 to the *Rights in Water and Irrigation Act 1914* allows a licensee to apply to the department at any time for the amendment of a licence; for example, a licensee may apply for an increased annual water entitlement. In assessing such an application, the department is entitled to have regard to the same matters as it would when assessing an application for the grant of a new licence –

that is, the matters listed in clause 7(2). The department may also seek further information under clause 4(2).

Applications to transfer section 5C licences under the *Rights in Water and Irrigation Act 1914*

Clause 29 of Schedule 1 to the *Rights in Water and Irrigation Act 1914* allows water entitlements to be permanently transferred to another person who is eligible to hold a licence under section 5C, as a means for reallocating the water in a fully allocated area.

Clause 30 allows for the temporary transfers of water entitlements, by providing that a licensee may enter into an agreement allowing a third party to take water under the licence for a limited period of time.

All permanent and temporary transfers (agreements) require the approval of the department. Before determining these applications, the department may, under Clause 33 of Schedule 1 of the Act, direct that an assessment of the effect of granting the application be made, at the expense of the applicant, by an expert appointed or approved by the department.

Conditions on section 5C licences

In granting a licence under section 5C of the *Rights in Water and Irrigation Act 1914*, the department may impose such terms and conditions as it thinks fit, having regard to all the matters that it considers relevant, including whether the proposed taking and use of the water is in accordance with the matters set out in clause 7(2) of Schedule 1 to the Act.

The department will sometimes impose conditions on a section 5C licence that require the licensee to regularly submit groundwater monitoring information on existing operations, to allow the department to assess whether impacts are acceptable, or if changes to groundwater abstraction and/or licence conditions are required.

Terms and conditions on licences under section 5C may incorporate other documents, which then form part of the licence conditions. The licensee must then comply with the requirements of these documents, if the licensee is to maintain the entitlement to access and use of the water. An example is an operating strategy, which may be required to be prepared for the Department of Water, in accordance with *Statewide policy no. 10* (Water and Rivers Commission, May 2004 (under review)).

Legislation relating to the drilling of bores

If a hydrogeological assessment requires drilling of investigation bores, a licence must first be obtained from the department under Section 26D of the *Rights in Water and Irrigation Act 1914.*

The drilling of a bore and the associated disturbance to the surrounding area must also comply with the state's *Aboriginal Heritage Act 1972* and the Commonwealth

Native Title Act 1993. If the area is subject to a native title claim, the applicant must notify the registered claimant group so they can comment about the proposed activities.

Other legislation

The *Environmental Protection Act 1986* (EP Act) may be applicable to hydrogeological reports. For example, a pollution control licence may be required under the EP Act to dispose of abstracted groundwater into surface water systems.

3 Implementation

3.1 Application

This policy applies statewide to:

- applicants who have applied for a licence to take and use groundwater under Section 5C of the Act
- applicants who have applied for an amendment of a licence to take groundwater under clause 23 of Schedule 1 to the Act
- applicants for a transfer of a section 5C licence or a section 5C licence water entitlement under Clause 29 of Schedule 1 to the Act
- applicants for an agreement to temporarily transfer water under clause 30 of Schedule 1 to the Act
- Holders of groundwater well licences under section 5C of the Act, where the conditions of the licence require the licensee to submit hydrogeological reports to the department.

This policy replaces the Water and Rivers Commission guidelines for hydrogeological reports and groundwater monitoring reports associated with a groundwater well licence (Version 10ab, May 1998).

Regional water resource assessments that are undertaken by licence applicants are not covered by this policy, as the requirements for such assessments will be very specific and will be developed in conjunction with the Water Resource Assessment branch of the Department of Water. An example of such a regional assessment is the South West Yarragadee water resource assessment for a large volume application, undertaken by the Water Corporation.

3.2 Hydrogeological assessments

There are three different levels of hydrogeological assessment:

- H1 – desktop hydrogeological assessment
- H2 – basic hydrogeological assessment including installation and testing of investigation bores
- H3 – detailed hydrogeological assessment including installation and testing of investigation bores, and a groundwater model.

The structure of these reports and the issues that need to be addressed are included in Appendix A.

Regional water resource assessments that are undertaken by licence applicants are not covered by this policy, as the requirements for such assessments will be very specific and will be developed in conjunction with the Water Resource Assessment branch of the Department of Water. An example of such a regional assessment is the

South West Yarragadee water resource assessment for a large volume application, undertaken by the Water Corporation.

Submitting a licence application

Groundwater licence applications (for grants, amendments, transfers or agreements) are submitted to the Department of Water on standard application forms. These forms are available from the department's regional offices or from the department's website <www.water.wa.gov.au>.

Upon receiving an application that meets the requirements of Clause 4(1) of Schedule 1 of the *Rights in Water and Irrigation Act 1914*, the department will undertake a preliminary assessment to determine if it has sufficient information to make a decision on whether to grant the application.

Preliminary assessment of licence applications — is a hydrogeological assessment required?

The main factors that will be considered in determining whether a hydrogeological assessment is required are:

- volume and pumping regime requested
- level of use in groundwater management area (groundwater area or subarea)
- potential impacts upon other users
- potential impacts upon groundwater-dependent ecosystems
- existing salinity of the groundwater resource.

Based on consideration of these factors, the department may decide that it requires additional information to be supplied by the applicant in the form of a hydrogeological assessment. The department will determine the level of assessment that is required, using Table 1 as a guide.

For each application, points are assigned for each column in the table (i.e. volume, allocation and potential impacts – on users, groundwater-dependent ecosystems and salinity) and totalled to give a score. The score is a guide to the level of assessment required, and should be tempered with knowledge of the hydrogeology and allocation in the area. The department's hydrogeologists may be involved in making the final determination as to whether a hydrogeological assessment is required and the level of assessment required.

The factors considered in determining the level of assessment required, if any, are outlined below.

Volume and pumping regime requested

Abstraction or pumping of groundwater lowers the groundwater level around the bore/well. As the volume abstracted increases, a larger area is affected by pumping. In the decision table, higher points are assigned to larger volumes.

Level of allocation of the groundwater resource

The level of allocation of the resource is calculated as the proportion of the resource that is allocated in a groundwater management unit (e.g. subarea), relative to the sustainable yield of the resource. The department has defined four allocation categories, as shown in Table 2. In the decision Table 1, points increase with increasing levels of allocation.

Other groundwater users

Pumping or abstracting groundwater will draw down the groundwater level around the draw point (bore). The extent of the drawdown will vary depending on the characteristics of the aquifer and the volume and duration of pumping. The potential for existing groundwater users to be impacted upon by proposed draw points should be taken into account when determining the requirements for hydrogeological assessment. The significance of the impact should also be taken into account.

In the decision table, points are assigned corresponding to the likelihood of impacting upon another user, either by affecting the quality or quantity of groundwater available to that user. As the likelihood of impacting upon another user increases, the points increase.

Groundwater-dependent ecosystems

The drawing down of groundwater levels as a result of abstraction has the potential to impact on nearby ecosystems that depend on the groundwater (for example, wetlands, streams, springs etc). The significance of these groundwater-dependent ecosystems (GDEs) and the likelihood of their being impacted upon by proposed drawpoints should be taken into account when determining the requirements for hydrogeological assessment.

In the decision table, points are assigned corresponding to the likelihood of impacting upon a GDE, either by affecting the quality or quantity of groundwater available to that ecosystem. As the likelihood of impacting upon a GDE increases, the points increase.

Existing salinity

The salinity of a groundwater resource is a broad measure of the beneficial use or value of the resource. The community places a high value on groundwater that is fresh and can be used for drinking purposes. Groundwater of higher salinity has limited uses. Very saline groundwater can generally only be used for industrial or mining purposes.

In the decision table, points increase with increasing value (i.e. lower salinity) of the groundwater.

Table 1 Decision table for hydrogeological assessments

Volume requested (kL/year)	Level of allocation [+]	Potential for unacceptable impacts		Existing salinity* (Milligrams per litre)
		Other users	GDEs	
<10 000 (0 points)	0 to <30% (C1) (0 points)	Impacts unlikely (0 points)	Impacts unlikely (0 points)	Fresh <500 mg/L (4 points)
10 001–50 000 (2 points)	30 to <70% (C2) (1 point)	Impacts possible (2 points)	Impacts possible (2 points)	Marginal TDS 501–1500 mg/L (3 points)
50 001–250 000 (4 points)	70 to <100% (C3) (3 points)	Impacts likely (5 points)	Impacts likely (5 points)	Brackish TDS 1501–5000 mg/L (2 points)
250 001–500 000 (6 points)	100% and over (C4) (5 points)			Saline TDS 5001–50 000 mg/L (1 point)
500 001–1 000 000 (8 points)				Hypersaline >50 000 mg/L (0 points)
1 000 000–2 500 000 (15 points)				
> 2 500 000 (20 points)				
Points assigned = a	***Points assigned = b***	***Points assigned = c***	***Points assigned = d***	***Points assigned = e***

***** Salinity categories were obtained from the National Land and Water Audit.

[+] do not apply points if drawing from a fractured rock aquifer.

Using Table 1

Points are assigned for each column in the table (ie volume, allocation, potential impacts – users, GDE's and salinity), and add to arrive at a score.

Score (= a+b+c+d+e)

0 - 7 points Generally no assessment required, unless other knowledge of risks indicates that H1 level assessment (desktop hydrogeological assessment is warranted)

8 – 12 points H1 level of assessment (desktop hydrogeological assessment). However, low volume applications with low risk of impacts may not warrant an assessment. These cases can be discussed with the department's hydrogeologists.

12 – 18 points H2 level of assessment (basic hydrogeological assessment, including installation and testing of investigation bores).

> 19 points H3 level of assessment (detailed hydrogeological assessment including installation and testing of investigation bores and a groundwater model)

Policies included in management plans developed for specific areas may override this decision making process in the areas covered by that plan.

Table 2 Level of allocation of the groundwater resource

Utilisation as percentage of sustainable yield	0 to <30%	30 to <70%	70 to <100%	100% and over
Level of allocation	C1	C2	C3	C4

Informing the applicant of the hydrogeological assessment required

Upon receiving a groundwater licence application, the department will undertake a preliminary review to determine whether a hydrogeological assessment by the applicant is required. The department will aim to undertake its preliminary review of the application and inform the applicant in writing of the further information requirements within 60 days for most applications. If the applicant is required to submit a hydrogeological assessment, the letter from the department will outline the level of assessment required to complete the application. The letter will include appropriate timeframes for submitting the required information, consistent with the department's policy on timely submission of information (Operational policy no. 5.11).

Granting a licence to undertake exploratory drilling for water

If the department requests that the applicant undertake a drilling investigation as per the H2 or H3 levels of hydrogeological assessment, the department will grant the applicant a licence to drill an exploratory bore under section 26D of the *Rights in Water and Irrigation Act 1914*. This licence allows the required bore(s) to be constructed by a licensed driller, and test pumped, in order to complete the hydrogeological assessment.

A 26D licence is granted for a short term, generally for six to 12 months, allowing the licensee sufficient time to employ the necessary contractors to carry out the work. The licence will be granted with several conditions, including the requirement for the applicant to submit the bore completion information to the department by the licence expiry date.

Investigation bores should be capped at the applicant's expense when they are no longer required, to the standards outlined in the *Minimum construction requirements for water bores in Australia* (Land and Water Biodiversity Committee 2003).

Granting a licence to take water

Granting of a licence for the construction of an exploratory bore does not guarantee that a licence to take water will be granted. In some cases, the applicant may have to abandon the project due to unsuitable water supply or quality. Investigation bores may need to be capped at the applicant's expense if the licence is not granted. Capping should be completed to the standards outlined in the *Minimum construction requirements for water bores in Australia* (Land and Water Biodiversity Committee 2003).

Following review of the hydrogeological assessment, the applicant may be required to prepare an operating strategy before obtaining a groundwater licence.

If the department does decide to grant a licence to take water, it will be issued under section 5C of the *Rights in Water and Irrigation Act 1914*.

Chemical analysis of groundwater for hydrogeological assessments

Chemical analysis of groundwater is generally required as part of an H2 or H3 level hydrogeological assessment. The standard suites generally required by the department are outlined in Appendix C. If particular chemicals or compounds are required outside of the standard suites provided, the department will inform the licensee, or may include them in the licence conditions. Groundwater sampling should be undertaken in accordance with the Australian Standard, AS/NZS 5667.11:1998. Wherever possible, a laboratory registered by the National Association of Testing Authorities (NATA) should undertake the analyses, using NATA-accredited analysis methods.

3.3 Groundwater monitoring reports

Existing groundwater licensees may be required to provide groundwater monitoring reports to satisfy the Department of Water that groundwater abstraction is not causing detrimental impacts on the environment, the groundwater resource or other users. They also allow the department to check that the volume abstracted is within the licensed allocation. The reports provide valuable information that assists the department in managing the state's groundwater resources.

Groundwater monitoring reports are generally required through conditions on 5C licences, which may incorporate other documents (such as operating strategies) that then form part of the licence conditions. The frequency of reporting is specified in the licence conditions or operating strategy and will be determined by the department. Two levels of reporting have been defined as outlined below.

- *Groundwater monitoring summary – usually an annual report that includes groundwater monitoring data for the reporting period only with brief analysis of impacts of abstraction, the environment and other users.*
- *Groundwater monitoring review – usually a triennial report with a complete history of groundwater monitoring data with a detailed analysis of impacts including trends.*

The structure of these reports and the issues that need to be addressed are included in Appendix B.

Chemical analysis of groundwater for groundwater monitoring reports

The reporting of groundwater chemistry monitoring forms part of the groundwater monitoring reports. Monitoring of groundwater chemistry is often a condition of licences to take water under section 5C of the *Rights in Water and Irrigation Act 1914*. The standard suites generally required by the department are outlined in Appendix C. If particular chemicals or compounds are required outside of the standard suites provided, the department will inform the licensee, or may include them in the licence conditions. Groundwater sampling should be undertaken in accordance with the Australian Standard, AS/NZS 5667.11:1998. Wherever possible, a NATA-registered laboratory should undertake the analyses, using NATA-accredited analysis methods.

Response to licensees

The department will write to licensees once groundwater monitoring reports have been reviewed, to acknowledge receipt of the report and provide feedback on compliance and the need for any changes to the groundwater well licence or licence conditions.

3.4 Provision of information by applicants/licensees

The applicant/licensee should provide the information listed below to the relevant regional office of the Department of Water.

- A copy of the hydrogeological report (i.e. hydrogeological assessment or groundwater monitoring report) in digital format (either on CD or DVD).
- One bound hardcopy of the hydrogeological report. An additional unbound copy should be provided if, in exceptional circumstances, no digital copy is submitted.
- Raw data in digital format on the worksheets available on the department's website under *Doing business with us > Water licensing > Licensing publications and forms – Requirements for the submission of resource information reports and data in electronic format* (parts A and B).
- Note that for chemical analyses the preferred option is to provide both the electronic spreadsheets and hardcopy reports supplied by laboratories; but in the absence of these, data should be entered into the worksheets obtained from the department's website. For monitoring reports, the initial electronic worksheet submitted should include all historical data. Subsequent worksheets should only include new data. Although historical data may not be presented in the electronic worksheets, it will need to be analysed in groundwater monitoring reviews.

Required information not provided in time

Hydrogeological assessment

If the applicant does not provide the required report and associated information to the department within the indicated timeframe, the department will send a 'final notice' letter to the applicant notifying them that they have failed to meet the timeframe for providing the required information. The department will require the applicant to provide the required information or demonstrate the genuine extenuating circumstances which have resulted in the failure to supply the necessary information within 10 working days of receiving the letter.

If the applicant does not reply, the incomplete application will be returned to the applicant (refer Operational policy no. 5.11, Department of Water 2009). In relation to section 5C licence applications (including amendment of section 5C licences), the volume of water reserved for the application will be returned to the pool of available water and be available for allocation to other section 5C licence applicants.

The applicant will also be advised that, if the application is resubmitted with the required information at a later date, it will be treated as a new application. The fact that the incomplete application has been returned to the applicant is not a matter that is relevant to the department's discretion to grant or refuse any future applications.

Groundwater monitoring reports

Where a licensee is required to submit groundwater monitoring reports to the department as a condition of a groundwater well licence, the submission date will generally be specified (for example, by 30 June each year).

Where a licensee fails to submit a groundwater monitoring report by the date required under the licence, the department may issue a direction to the licensee under clause 18 of Schedule 1 to the *Rights in Water and Irrigation Act 1914*, requiring the licensee to comply with the condition within a specified time period. A licensee who then fails to comply with such a direction may be subject to enforcement action. Alternatively, the department may prosecute the licence holder for a breach of section 5C of the Act. The department also has the option of suspending or cancelling the licence under clause 25 of Schedule 1 to the Act.

Time extensions and extenuating circumstances

There may be circumstances when the applicant has been unable to meet the timeframes provided by the department due to factors outside the applicant's control. Availability of contractors or consultants within the required timeframes, complexities associated with obtaining the required information or health reasons may be relevant factors.

The applicant can write to the department requesting additional time to complete the work, either before the submission date, or in reply to the department's letter requesting further information. In such circumstances, the department will consider

the applicant's request for a revised submission date and inform the applicant of the department's decision.

Hydrogeological report submitted is not to an acceptable standard

Hydrogeological assessment

There may be occasions where the department considers that the information submitted by an applicant is not sufficient to allow the department to make an informed decision in relation to the application.

After reviewing the information provided by the applicant, the department may negotiate with the applicant and write to them, outlining deficiencies in the information provided and requesting that they be addressed within a reasonable time (normally 50% of the original time).

If the applicant does not reply within the negotiated timeframe, the incomplete application will be returned to the applicant with an explanatory letter sent by normal mail services (refer Operational policy no. 5.11, Department of Water 2009). The applicant will be advised that if the application is resubmitted, it will be treated as a new application, and the same further information is likely (at a minimum) to be required for any future applications of the same kind.

Groundwater monitoring reports

There may be cases where a licence holder who is required to submit hydrogeological reports as a condition of the licence, submits a report that the department considers does not meet the requirements of the licence condition.

After reviewing the information provided by the applicant, the department may negotiate with the applicant and write to them, outlining deficiencies in the information provided and requesting that they be addressed within a reasonable time. This may include such issues as the provision of factually incorrect information in the report and/or a variance in data interpretation between the applicant and the department.

Should the applicant not be able to address the deficiencies identified within the timeframe, again the department would consider that the licensee has breached its licence conditions. In these circumstances, the department may issue a formal direction under clause 18 of Schedule 1 to the *Rights in Water and Irrigation Act 1914* requiring the licensee to comply with the condition. A licensee who then failed to comply with such a direction may be subject to enforcement action by the department. Alternatively, the department may prosecute the licence holder for a breach of section 5C of the Act. The department also has the option of suspending or cancelling the licence under clause 25 of Schedule 1 to the Act.

Confidentiality

The department will not release personal, commercial or business information, as referred to in the *Freedom of Information Act 1992*, contained in hydrogeological reports without first consulting the licensee.

Raw data contained in the reports (e.g. bore data; water-table monitoring results) may be released to another party through the provision of information from the department's database or website.

4 Review

This policy will be reviewed in 2012. The policy may be reviewed sooner if significant changes (such as the introduction of new water management legislation or new water management initiatives) warrant a review of this policy.

Appendix A – Requirements for hydrogeological assessments

Appendix A1 H1 level of assessment (desktop hydrogeological assessment)

This level of assessment will generally be required where there is sufficient information available in the immediate area of the proposed abstraction to allow an assessment of impacts without the need for drilling investigations. This may include applications for transfers of water entitlements or amendments to existing licences. It may also apply to applications for small volumes of water in areas with a low level of use, where impacts on the environment or other users are unlikely.

Data should be provided in digital format wherever possible (refer to Provision of information by applicants/ licensees' in section 3.4). The structure of the report and the information to be included is outlined below:

1 Introduction

In this section, the location and intended activity should be described.

- Describe the location of the proposed activity, including groundwater management areas (e.g. groundwater area; subarea). For transfers/agreements, include locations of current and proposed abstraction.
- Include location plan(s) (preferably A4 size, at a commonly used scale such as 1:100 000 or 1:250 000) showing the following information:
  - map sheet name
  - latitude and longitude or MGA coordinates in GDA94 datum coordinates (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred)
  - basic topographic features
  - locations of current and proposed production and monitoring bores
  - locations and names of other users' bores (private, public and Ministerial criteria bores – source Department of Water, see Appendix D – Information sources for hydrogeological reports)
  - cadastral/land tenure information (include vendor's and purchaser's properties for transfers/agreements)
  - areas of current and/or proposed activities (i.e. crops; mining; urbanisation)
  - location of all potential groundwater-dependent ecosystems (e.g. wetlands; terrestrial vegetation; caves), particularly identifying those with Ministerial Conditions – source Department of Water, see Appendix D – Information sources for hydrogeological reports.
  - other relevant information.
- Describe the current and intended land and water use, including quantity and purpose of groundwater abstraction, crop areas, details of any planned urbanisation (area; lot sizes) etc. Include vendor's and purchaser's properties for transfers/agreements.

2 Climate/rainfall

This section should provide a brief discussion of the climate in the area of the proposed activity, and include relevant data such as:

- rainfall figures (preferably monthly, with annual rainfall totals reported for the calendar year)
- stream flow figures where groundwater systems are recharged by local rainfall infiltration or stream flow
- comparisons of long-term stream flow and rainfall data where appropriate
- other climatic factors such as evaporation where relevant.

3 Hydrogeology

This section should describe relevant details of the groundwater system that is to be accessed. This should include:

- an overview of the groundwater system that the aquifer is part of, including recharge and discharge areas, interconnection between aquifers, and connection with groundwater-dependent ecosystems
- identification and description of the aquifer that is to be developed
- estimates and discussion of groundwater storage and recharge potential
- analysis of local groundwater trends (hydrographs may be obtained from the Department of Water – see Appendix D – Information sources for hydrogeological reports)
- proposed bore construction.

4 Existing groundwater use

An assessment should be made of the existing groundwater use in the vicinity of the proposed abstraction site (and the current abstraction site for transfers/agreements). Potential issues such as concentration of groundwater abstraction should be considered.

Other licensed, and where possible, unlicensed groundwater users (such as garden bores or stock bores) should be identified and estimates should be provided of existing use on maps and/or tables. Information on the location of licensed water use can be obtained from the Department of Water (see Appendix D – Information for hydrogeological reports). Other users, including groundwater-dependent ecosystems, which may be impacted upon by the proposed groundwater abstraction, should be identified.

5 Assessment of potential impacts

This section should identify any potential impacts on the aquifer, environment or other groundwater users, that may be caused by the proposed groundwater abstraction.

An evaluation of the extent of the cone of depression (impact of the proposed groundwater abstraction) should be provided; using aquifer parameters obtained either from previous test pumping in the immediate area or from other factual information (which must be referenced).

Based on this evaluation, and other relevant information, an assessment of the potential impacts of the proposed groundwater abstraction on groundwater-dependent ecosystems, other users (private and public) and the groundwater resource should be provided. The assessment should consider potential issues such as bore yield, groundwater level changes, leakage from other aquifers, salt water intrusion, acidification and water quality changes (e.g. nutrients; salinity).

For transfers/agreements, consider whether the proposed abstraction will result in positive, negative or neutral impacts.

6 Management approach/conclusions

Describe whether the impacts of taking the water are assessed to be acceptable, manageable or unacceptable. If the impacts are identified as manageable, the applicant should describe how the taking of the water will be managed to reduce the potential impacts.

Appendix A2 H2 level of assessment (basic hydrogeological assessment)

In some cases, applications for a licence to take underground water under section 5C of the *Rights in Water and Irrigation Act 1914* will require a basic hydrogeological assessment. This level of assessment is likely to apply to applications for significant volumes of water in areas where impacts on other groundwater users and the environment are possible, or where the size and nature of the groundwater resources are not well known.

A basic hydrogeological assessment requires the applicant to undertake some investigations to determine the potential impacts of the proposed abstraction on the aquifer, environment and surrounding users. There will be costs associated with these investigations, and these costs could vary significantly depending on the amount of drilling and tests conducted (e.g. test pumping, geophysical logging or chemical analyses). Use of existing bores may reduce these costs.

Applicants who are required to undertake an H2 level of assessment will need to obtain a licence under section 26D of the Act, which will enable them to construct exploratory bores and undertake test pumping.

Data should be provided in digital format wherever possible (refer to Section 3.4 on the provision of information). The structure of an H2 report and the information required is outlined below.

1 Introduction

In this section, the location and intended activity should be described.

- Describe the location of the proposed activity, including groundwater management areas (e.g. groundwater area; subarea). For transfers /agreements, include locations of current and proposed abstraction.
- Include location plan(s) (preferably A4 size, at a commonly used scale such as 1:100 000 or 1:250 000) showing the following information:
  - map sheet name
  - latitude and longitude or MGA coordinates in GDA94 datum coordinates (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred)
  - basic topographic features
  - locations of current and proposed production and monitoring bores
  - locations and names of other users' bores (private, public and Ministerial criteria bores – source Department of Water, see Appendix D – Information for hydrogeological reports)
  - cadastral/land tenure information (include vendor's and purchaser's properties for transfers/agreements)
  - areas of current and/or proposed activities (i.e. crops; mining; urbanisation)

  - location of all potential groundwater-dependent ecosystems (e.g. wetlands; terrestrial vegetation; caves), particularly identifying those with Ministerial Conditions – source Department of Water, see Appendix D – Information for hydrogeological reports
  - other relevant information.
- Describe the current and intended land and water use, including quantity and purpose of groundwater abstraction, crop areas, details of any planned urbanisation (area; lot sizes) etc. Include vendor's and purchaser's properties for transfers/agreements.

2 Climate/rainfall

This section should provide a brief discussion of the climate in the area of the proposed activity, and include relevant data such as:

- rainfall figures (preferably monthly, with annual rainfall totals reported for the calendar year)
- stream flow figures where groundwater systems are recharged by local rainfall infiltration or stream flow
- comparisons of long-term stream flow and rainfall data where appropriate
- other climatic factors such as evaporation, where relevant.

3 Hydrogeology

This section should describe relevant details of the groundwater system that is to be accessed. This should include:

- an overview of the groundwater system that the aquifer is part of, including recharge and discharge areas, interconnection between aquifers, and connection with groundwater-dependent ecosystems
- identification and description of the aquifer that is to be developed
- estimates and discussion of groundwater storage and recharge potential
- analysis of local groundwater trends (hydrographs may be obtained from the Department of Water – see Appendix D – Information for hydrogeological reports)
- proposed bore construction.

4 Existing groundwater use

An assessment should be made of the existing groundwater use in the vicinity of the proposed abstraction site (and the current abstraction site for transfers/agreements). Potential issues such as concentration of groundwater abstraction should be considered.

Other licensed, and where possible, unlicensed groundwater users (such as garden bores or stock bores) should be identified and estimates should be provided of existing use on maps and/or tables. Information on the location of licensed water use

can be obtained from the Department of Water (see Appendix D – Information for hydrogeological reports).

Other users, including groundwater-dependent ecosystems, which may be impacted upon by the proposed groundwater abstraction, should be identified.

5 Groundwater investigations

Specific requirements of a groundwater investigation may be determined in consultation with departmental hydrogeologists. The following information should be provided.

6 Drilling

Details should be provided of all production/monitoring bores drilled (bore completion reports), including:

- a diagram of each bore showing details of all casings, screens and packers
- purpose of bore, i.e. production/monitoring
- latitude and longitude or MGA coordinates in GDA94 datum coordinates of each bore (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred)
- surveyed level of bore (if available)
- geophysical logs (if applicable)
- palynology (if applicable)
- lithological details
- water level(s), measurement reference point (i.e. measured from ground, collar etc) and date.

7 Test pumping

Test pumping will be required to adequately assess the potential long-term impacts of the proposed abstraction to the aquifer, environment and surrounding users. It will also allow assessment of water availability for the proposed development.

Test pumping should be undertaken in accordance with Australian Standards (AS 2368–1990 Test pumping of water wells). The minimum requirements for test pumping are outlined in the guidelines, *Minimum construction requirements for water bores in Australia* (September 2003).

At least one bore should be test pumped and one observation bore should be monitored; however, the number and placement of bores will vary depending on the proximity of groundwater-dependent ecosystems and other groundwater users. This policy does not prescribe the details of testing or monitoring, as these aspects are covered by the existing standards and guidelines mentioned above.

Data provided should include aquifer parameters and bore yields, as well as a distance-drawdown analysis that extends to the final level of development. Data

should be presented in tabular and graphical form, and raw data should be included as an appendix.

8 Groundwater chemistry

A major component analysis or comprehensive analysis should be undertaken of groundwater from each aquifer investigated for proposed production. *Appendix C* provides details of requirements for analysis and provision of analytical data to the department.

A description of groundwater chemistry should be provided, including a discussion on the potential for water quality impacts likely through migration of different quality water.

9 Assessment of potential impacts

This section should identify any potential impacts to the aquifer, environment or other groundwater users, that may be caused by the proposed groundwater abstraction.

An evaluation of the extent of the cone of depression (impact of the proposed groundwater abstraction) should be provided; using aquifer parameters obtained from test pumping investigations or from other factual information (must be referenced).

Based on this evaluation, and other relevant information, an assessment of the potential impacts of the proposed groundwater abstraction on groundwater-dependent ecosystems, other users (private and public) and the groundwater resource should be provided. The assessment should consider potential issues such as bore yield, groundwater level changes, leakage from other aquifers, salt water intrusion, acidification and water quality changes (e.g. nutrients; salinity).

For transfers/agreements, consider whether the proposed abstraction will result in positive, negative or neutral impacts.

10 Groundwater monitoring

A proposed groundwater monitoring program should be provided where appropriate (e.g. high water use or proximity to sensitive environments), to monitor the impacts of ongoing groundwater abstraction upon commencement of operations. Observation bores used for test pumping may be suitable for ongoing monitoring. The monitoring program should be designed to assess aquifer performance and determine any impact on other users and/or the environment. The monitoring program should also reflect relevant conditions of any pollution control licence under the *Environmental Protection Act 1986*.

11 Management approach/conclusions

Describe whether the impacts of taking the water are assessed to be acceptable, manageable or unacceptable. If the impacts are identified as manageable the applicant should describe how the taking of the water will be managed to reduce the potential impacts.

Appendix A3 H3 level of assessment (detailed hydrogeological assessment)

A detailed hydrogeological assessment will generally be required for applications for large volumes of water under section 5C of the *Rights in Water and Irrigation Act 1914* in areas where impacts on the environment and other groundwater users are likely, or where the size and nature of the groundwater resources are not well known.

This level of assessment requires the applicant to undertake investigations to determine the potential impacts of the proposed abstraction on the aquifer, environment and surrounding users. These investigations are likely to include the drilling of production and monitoring bores, test pumping, geophysical logging and chemical analysis of groundwater. In addition, a groundwater model will be required at this level of assessment.

There will be significant costs associated with an H3 level of assessment, due to the drilling and testing involved and the requirement for a groundwater model. Use of existing bores may reduce these costs.

Applicants who are required to undertake an H3 level of assessment will need to obtain a licence under section 26D of the Act, which will enable them to construct exploratory bores and undertake test pumping.

Data should be provided in digital format wherever possible (refer to Section 3.4 on the provision of information). The information required for an H3 level of assessment is outlined below.

1 Introduction

In this section, the location and intended activity should be described.

- Describe the location of the proposed activity, including groundwater management areas (e.g. groundwater area; subarea). For transfers/agreements, include locations of current and proposed abstraction.
- Include location plan(s) (preferably A4 size, at a commonly used scale such as 1:100 000 or 1:250 000) showing the following information:
  - map sheet name
  - latitude and longitude or MGA coordinates in GDA94 datum coordinates (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred)
  - basic topographic features
  - locations of current and proposed production and monitoring bores
  - locations and names of other users' bores (private, public and Ministerial criteria bores – source Department of Water, see Appendix D - Information for hydrogeological reports)
  - cadastral/land tenure information (include vendor's and purchaser's properties for transfers/agreements)

  - areas of current and/or proposed activities (i.e. crops; mining; urbanisation)
  - location of all potential groundwater-dependent ecosystems (e.g. wetlands; terrestrial vegetation; caves), particularly identifying those with Ministerial Conditions – source Department of Water, see Appendix D – Information for hydrogeological reports
  - other relevant information.
- Describe the current and intended land and water use, including quantity and purpose of groundwater abstraction, crop areas, details of any planned urbanisation (area; lot sizes) etc. Include vendor's and purchaser's properties for transfers/agreements.

2 Climate/rainfall

This section should provide a brief discussion of the climate in the area of the proposed activity, and include relevant data such as:

- rainfall figures (preferably monthly, with annual rainfall totals reported for the calendar year)
- stream flow figures where groundwater systems are recharged by local rainfall infiltration or stream flow
- comparisons of long-term stream flow and rainfall data where appropriate
- other climatic factors such as evaporation where relevant.

3 Hydrogeology

This section should describe relevant details of the groundwater system that is to be accessed. This should include:

- an overview of the groundwater system that the aquifer is part of, including recharge and discharge areas, interconnection between aquifers, and connection with groundwater-dependent ecosystems
- identification and description of the aquifer that is to be developed
- estimates and discussion of groundwater storage and recharge potential
- analysis of local groundwater trends (hydrographs may be obtained from the Department of Water – see Appendix D – Information sources for hydrogeological reports)
- proposed bore construction.

4 Existing groundwater use

An assessment should be made of the existing groundwater use in the vicinity of the proposed abstraction site (and the current abstraction site for transfers/agreements). Potential issues such as concentration of groundwater abstraction should be considered.

Other licensed, and where possible, unlicensed groundwater users (such as garden bores or stock bores) should be identified and estimates should be provided of existing use on maps and/or tables. Information on the location of licensed water use can be obtained from the Department of Water (see Appendix D – Information sources for hydrogeological reports).

Other users, including groundwater-dependent ecosystems, which may be impacted upon by the proposed groundwater abstraction, should be identified.

5 Groundwater investigations

Specific requirements of a groundwater investigation may be determined in consultation with departmental hydrogeologists. The following information should be provided.

6 Drilling

Details should be provided of all production/monitoring bores drilled (bore completion reports), including:

- a diagram of each bore showing details of all casings, screens and packers
- purpose of bore, i.e. production/monitoring
- latitude and longitude or MGA coordinates in GDA94 datum coordinates of each bore (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred)
- surveyed level of bore (if available)
- geophysical logs (if applicable)
- palynology (if applicable)
- lithological details
- water level(s), measurement reference point (i.e. measured from ground, collar, etc) and date.

7 Test pumping

Test pumping will be required to adequately assess the potential long-term impacts of the proposed abstraction to the aquifer, environment and surrounding users. It will also allow assessment of water availability for the proposed development.

Test pumping should be undertaken in accordance with Australian Standards (AS 2368–1990 Test pumping of water wells). The minimum requirements for test pumping are outlined in the guidelines, *Minimum construction requirements for water bores in Australia* (September 2003).

At least one bore should be test pumped and one observation bore should be monitored; however, the number and placement of bores will vary depending on the proximity of groundwater-dependent ecosystems and other groundwater users. This policy does not prescribe the details of testing or monitoring, as these aspects are covered by the existing standards and guidelines mentioned above.

Data provided should include aquifer parameters and bore yields, as well as a distance-drawdown analysis that extends to the final level of development. Data should be presented in tabular and graphical form, and raw data should be included as an appendix.

8 Groundwater chemistry

A major component analysis or comprehensive analysis should be undertaken of groundwater from each aquifer investigated for proposed production. Appendix C provides details of requirements for analysis and provision of analytical data to the department.

A description of groundwater chemistry should be provided, including a discussion on the potential for water quality impacts likely through migration of different quality water.

9 Groundwater modelling

An appropriate analytical or numerical groundwater model must be used to predict the likely impacts of the proposed groundwater abstraction. The type and level of modelling may be determined in consultation with Department of Water hydrogeologists. Numerical groundwater models should be developed using the *Murray Darling Basin modelling guidelines* (Murray Darling Basin Commission 2000) as a guide.

A description of the groundwater model that is used should be provided, including:

- conceptual model
- aquifer parameters used
- modelling results, including any calibration and sensitivity analysis
- impact assessment, including:
  - identification of groundwater-dependent ecosystems and quantification of potential impacts on these systems
  - identification of other groundwater users accessing the same or connected groundwater systems, and quantification of potential impacts on these users; and sensitivity analysis.

A digital copy of the groundwater model should be submitted to the Department of Water, together with the hydrogeological report.

10 Assessment of potential impacts

This section should identify any potential impacts on the aquifer, environment or other groundwater users, that may be caused by the proposed groundwater abstraction.

Based on the results of groundwater investigations and modelling, an assessment should be provided on the potential impacts of the proposed abstraction on:

- bore yields

- groundwater levels
- groundwater quality (e.g. saline interface)
- other users
- the environment
- the aquifer.

For transfers/agreements, consider whether the proposed abstraction will result in positive, negative or neutral impacts.

11 Groundwater monitoring

A proposed groundwater monitoring program should be provided where appropriate (e.g. high water use or proximity to sensitive environments) to monitor the impacts of ongoing groundwater abstraction upon commencement of operations. Observation bores used for test pumping may be suitable for ongoing monitoring. The monitoring program should be designed to assess aquifer performance and determine any impact on other users and/or the environment. The monitoring program should also reflect relevant conditions of any pollution control licence under the *Environmental Protection Act 1986*.

12 Management approach/conclusions

Describe whether the impacts of taking the water are assessed to be acceptable, manageable or unacceptable. If the impacts are identified as manageable, the applicant should describe how the taking of the water will be managed to reduce the potential impacts.

Appendix B – Requirements for groundwater monitoring reports

Appendix B1 Groundwater monitoring report types

Timely and adequate monitoring reports are essential to enable the Department of Water to better manage the state's groundwater resources. There are two types of groundwater monitoring reports.

1 Groundwater monitoring summary

This should include groundwater monitoring data over the current reporting period only, and a brief analysis of aquifer response to groundwater abstraction over that period. These reports will usually be required annually, but this may vary depending on the nature of the operation. The report structure and content is outlined in section Appendix B2 below.

2 Groundwater monitoring review

These reports should include a complete history of groundwater monitoring data over the life of the bore/borefield (if available digitally). A detailed analysis of all the data should be undertaken to depict trends in water quality and quantity and determine the impacts of the abstraction on the water resource, the environment and other users. A review is often required triennially, but may be required annually where close management of the abstraction is required (for example, where complex dewatering and re-injection operations are undertaken, or in areas where the environment or other users may be impacted upon). The report structure and content is outlined in section Appendix B2 below.

Appendix B2 Groundwater monitoring report outline

The structure of groundwater monitoring reports and the information to be included is outlined in this section. One report outline is provided for both groundwater monitoring report types, as the information required is essentially the same – only the timeframe and the level of analysis differs. Data should be provided in digital format wherever possible. Please refer to "Provision of information by applicants / licensees, section 3.4).

1 Introduction

Give a brief outline of the licensed operation, including details of the licensee and the consultant preparing the report.

- Describe the location of the operation, including groundwater management areas (e.g. groundwater area; subarea).
- Include location plan(s) (preferably A4 size, at a commonly used scale such as 1:100 000 or 1:250 0000) showing the following information:
  - map sheet name
  - latitude and longitude or MGA coordinates in GDA94 datum coordinates (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred)
  - basic topographic features
  - locations of abstraction points (identifying production/monitoring bores)
  - locations and names of other users' bores (private, public and Ministerial criteria bores – source Department of Water, see Appendix D – Information sources for hydrogeological reports)
  - cadastral/land tenure information
  - areas of activities (i.e. crops; mining; urbanisation)
  - locations of all potential groundwater-dependent ecosystems (particularly identifying those with Ministerial Conditions – source Department of Water, see Appendix D – Information sources for hydrogeological reports)
  - other relevant information.

Describe groundwater use on the site and include:

- a list/table of all groundwater well licences relating to the site
- a copy of all groundwater well licences related to the report in an appendix.

2 Climate/rainfall

This section should provide a brief discussion of the climate in the area of the operation, and include relevant data such as:

- rainfall figures (preferably monthly, with annual rainfall totals reported for the calendar year)
- stream flow figures where groundwater systems are recharged by local rainfall infiltration or stream flow
- comparisons of long-term stream flow and rainfall data where appropriate
- other climatic factors such as evaporation, where relevant.

3 Hydrogeology

This section should describe the hydrogeological setting of the operation. It should include:

- identification and description of the aquifer that is being used
- an overview of the groundwater system that the aquifer is part of, including recharge and discharge areas, interconnection between aquifers, and connection with groundwater-dependent ecosystems.

4 Borefield description

Provide a description of the borefield used to access groundwater for the operation.

Include a summary table listing all bores, identifying new and existing bores, and summarising details such as purpose (production/monitoring), location (MGA coordinates), surveyed level of bore (specifying reference point), completion details (date constructed, depth and screened interval), and details of water meters fitted to each bore (serial number and meter manufacturer's name). The table should also indicate whether any additional information is available, such as lithology, palynology, geophysics, test pumping data, water levels or chemistry.

Include bore completion reports for all new production/monitoring bores, comprising:

- A diagram of each bore, showing details of all casings, screens and packers.
- Purpose of bore, i.e. production/monitoring.
- Latitude and longitude or MGA coordinates in GDA94 datum coordinates of each bore (latitude and longitude in decimal degrees with a minimum of six significant decimal places and in GDA94 are preferred).
- Surveyed level of bore (if available).
- Geophysical logs (if applicable).
- Palynology (if applicable).
- Lithological details.

- Water level(s), measurement reference point (i.e. measured from ground, collar, etc) and date.
- Test pumping data (if applicable) presented in tabular and graphical form, together with analysis including yields and derived aquifer parameters. Raw data should be included as an appendix. Test pumping should be undertaken in accordance with Australian Standards (AS 2368–1990 Test pumping of water wells). The minimum requirements for test pumping are outlined in the guidelines, *Minimum construction requirements for water bores in Australia* (September 2003).

5 Groundwater abstraction

This section should include a breakdown of volumes abstracted from each production bore and the total from the borefield, as required in licence conditions/operating strategy.

If groundwater is abstracted from more than one source (for example, from the borefield as well as from a pit or excavation), abstraction totals from each separate source should be listed.

If groundwater abstraction is metered for licensing purposes, it is the proponent's responsibility to install and maintain accurate cumulative water meters on bores. Meters must be installed in accordance with the department's policy on metering the taking of water (2009); the department's guidelines for water meter installation (2007); and legislative provisions under the Rights in Water and Irrigation (Approved Meters) Order 2009. Under this Order, a meter is approved for use if it:

a) complies with Australian Technical Specification 4747-2008, Meters for non-urban water supply, published by Standards Australia;

or

b) has been tested at a National Association of Testing Authorities (NATA) accredited laboratory and verified on a NATA report, or certificate to be within 2.5% accuracy;

and

c) is installed in accordance with the manufacturer specifications.

Details of each water meter fitted (e.g. date of installation, serial number and meter manufacturer name) are to be provided to the department for each relevant bore.

It is also the proponent's responsibility to periodically read meters and submit readings to the department for each water year, or as specified on departmental licences.

Where a water meter is not a condition of a licence, an estimate can be provided by calculating the volume of groundwater abstraction from electric (power or hour) meter readings.

If a site water balance is specified in the operating strategy or groundwater licence, it should be included in this section.

A brief discussion of the method and location of the disposal of waste or surplus waters should be included where applicable, identifying any potential impacts upon groundwater systems or connected surface water systems. Where this is covered in reporting for an environmental protection licence requirement, reference should be made and a copy attached.

6 Monitoring results

Monitoring data is to be presented in tables and graphical format (raw data in appendix, summary data in text). The preferred presentation for graphs is to show production, water levels, rainfall and electrical conductivity on one page with consistent time scales to allow comparison. Vertical scales should be sufficient to clearly show trends.

Discussion of the data presented should indicate any peculiarities or information necessary to understand and interpret the data (for example, problems encountered with the operation of bores or monitoring equipment during the reporting period).

7 Water levels/quantity

Provide a discussion of the results of water level monitoring that is required as part of the groundwater well licence conditions or the operating strategy. Groundwater levels should be compared to groundwater abstraction and rainfall.

The discussion should include the aquifer's response to abstraction, including any observed trends (e.g. changes in groundwater levels) over the reporting period.

If monitoring results indicate that there are any significant changes to groundwater quantity, then this should be explained, together with the remedial action to be taken.

8 Water quality

Provide a discussion of results of the chemical analyses that are required as part of the groundwater well licence conditions including the operating strategy, if applicable.

Results should be compared to the appropriate guideline for water quality and presented in tables, highlighting any results that exceed the guideline value.

The discussion should include the aquifer's response to abstraction including any observed changes in groundwater quality over the reporting period.

If monitoring results indicate that there are any significant changes to groundwater quality, then this should be explained, together with the remedial action to be taken.

9 Other

Provide other monitoring data that may be relevant to this report (e.g. monitoring of stygofauna or springs).

10 Compliance

Examine compliance with licence conditions and the adequacy of the monitoring to reveal any problems or likely problems, regardless of the agreed or required

monitoring program. It is the responsibility of the professional preparing the report to draw attention to anomalies and potential problems.

11 Recommended changes to monitoring program

If the monitoring results indicate that the monitoring program should be changed, recommendations for these changes should be made in this report, and the rationale for the change included. The monitoring program will then be reviewed by the Department of Water.

12 Assessment of impacts

The data presented should be evaluated with regard to:

- the capacity of the aquifer to sustain the demands upon it
- the past and likely future effects of use on other groundwater users, groundwater-dependent ecosystems and depletion or degradation of the aquifer
- significant changes to groundwater quantity or quality highlighted by monitoring results.

To aid this evaluation, existing groundwater models should be updated periodically using groundwater monitoring results.

13 Recommendations

This section should consolidate any recommended changes to groundwater abstraction, monitoring, or reporting that are made throughout the report.

14 Appendices

Supporting information such as raw monitoring data, bore completion reports or relevant groundwater well licences should be included as appendices at the end of the report.

Appendix C – Requirements for groundwater chemistry

Appendix C1 Introduction

Chemical analyses of groundwater may be required as part of a hydrogeological assessment, or monitoring of an existing operation. This appendix outlines the standard requirements for analyses. The Department of Water will inform applicants/licensees of the analysis suite required. If particular chemicals or compounds are required outside of the standard suites provided, the department will inform the applicant/licensee, or may include them in the licence conditions.

Groundwater sampling should be undertaken in accordance with the Australian Standard (AS/NZS 5667, 1998) and wherever possible, a NATA-registered laboratory should undertake the analyses, using NATA-accredited analysis methods. If a NATA-registered laboratory is not available, evidence to support data quality should be presented in the report.

As discussed in section 3.4 ‘provision of information by applicants / licensees, it is preferable for chemical data to be provided in the format supplied by laboratories (electronic plus hardcopy). If data is not available in this format, analytical results should be entered into the worksheets available from the department’s website, under *Doing business with us>Water licensing>Licensing publications and forms – Requirements for the submission of resource information reports and data in electronic format* (parts A and B).

For each set of analyses, the department requires the following information (preferably on a chain of custody form):

- laboratory name and address
- site and sample identification (i.e. site name; sample number)
- sampling details (date, time, depth/reference point – top of casing/ground level, etc, collection method, collection instrument);
- sample treatment details (filtered/unfiltered, preservation (e.g. HNO3 etc))
- analytical method code for each analyte
- units for each analyte
- how result is expressed for each analyte (e.g. as N or as CaCO3)
- the form of each analyte, if applicable (i.e. total or filtered)
- limit of reporting for each analyte.

For field results, include site and sample details as above, on a suitable form. Also document the instrument used to measure each parameter, specify the parameter being measured and the units reported for each result. The department may require monitoring of groundwater chemistry as outlined in the following sections.

Appendix C2 Drinking water analyses

The Department of Water cannot guarantee the quality of water drawn from surface water bodies or groundwater, especially where there is significant human activity or agriculture in the surrounding catchment. The department's water quality protection note on private drinking water supplies provides further information on this issue, as does the Department of Health's pamphlet *Using bore water safely* (June 2004).

Caution is required when making a decision to use these sources as a drinking water supply. Wherever possible, scheme water is recommended for such use. If surface or groundwater is to be used for drinking, the user is responsible for the testing and treating of this water to ensure that it is suitable for this purpose. It is important to maintain groundwater quality (potability) within the minimum criteria given in the *Australian drinking water guidelines* (2004).

It is beyond the scope of these guidelines to specify requirements for drinking water analysis. Licensees should refer to the Department of Health for further advice on this issue.

Appendix C3 Major components analysis

Major components analysis is usually undertaken to characterise groundwater quality, or detect significant changes in groundwater quality.

1 Field analysis

- Temperature (^oC)
- Conductivity (compensated to 25^{o}C, or if uncompensated – report the value measured and the temperature; report complete units (e.g. mS/cm, not mS)
- pH
- Eh
- Dissolved oxygen (mg/L and %DO)
- Bicarbonate (HCO_3)

2 Laboratory analysis

Physico-chemical

- pH
- Conductivity (preferably compensated to 25^{o}C; report value measured; compensation factor and complete units (e.g. mS/cm, not mS)
- Total dissolved solids (calculated @ 180^{o}C)
- Total hardness (as $CaCO_3$)
- Total alkalinity (as $CaCO_3$)

Ions

- Calcium Ca
- Magnesium Mg
- Sodium Na
- Potassium K
- Ammonia NH_4
- Phosphate PO_4
- Carbonate CO_3
- Bicarbonate HCO_3
- Chloride Cl
- Sulphate SO_4
- Nitrate NO_3
- Silica SiO_2

Metals

Filter and acidify samples in field

- Aluminium Al
- Iron Fe
- Manganese Mn

Other analytes where appropriate

(e.g. bromide; nickel; arsenic)

Appendix C4 Comprehensive analysis

A comprehensive analysis most commonly applies to activities with the potential to contaminate the groundwater, such as horticulture, industry and, in some cases, mining. In these cases additional analytes to those specified in the major component analyses may need to be measured (e.g. nitrate; total phosphorus, indicating possible groundwater pollution by fertilisers).

1 Field analysis

- Temperature (^oC)
- pH
- Eh
- Conductivity (compensated to 25^{o}C, or if uncompensated – report the value measured and the temperature; report complete units (e.g. mS/cm, not mS)
- Dissolved oxygen
- Bicarbonate (HCO_3)

2 Laboratory analysis

Physico-chemical

- pH
- Conductivity (preferably compensated to 25^{o}C; report value measured; compensation factor and complete units (e.g. mS/cm, not mS)
- Total dissolved solids (calculated @ 180^{o}C)
- Total hardness (as $CaCO_3$)
- Total alkalinity (as $CaCO_3$)

Ions (mg/L)

- Calcium Ca
- Magnesium Mg
- Sodium Na
- Potassium K
- Ammonia NH_3
- Phosphate PO_4
- Carbonate CO_3
- Bicarbonate HCO_3
- Chloride Cl
- Sulphate SO_4
- Nitrate NO_3

- Nitrite NO_2
- Silica SiO_2

Metals (mg/L)

Filter and acidify samples in field

- Aluminium Al
- Arsenic As
- Cadmium Cd
- Chromium Cr
- Iron Fe^{2+}
- Lead Pb
- Manganese Mn
- Mercury Hg
- Selenium Se
- Zinc Zn

Nutrients

- Total Kjeldahl nitrogen TKN
- Total phosphorus TP

Other analytes where appropriate

(e.g. bromide; nickel; organics)

Appendix D — Information sources for hydrogeological reports

Information required	Information source	Contact
Locations and licensed allocations for bores[1]	*WRL database* Water Licensing branch	Ph: 6364 6864 Group email: <WRL@water.wa.gov.au> (external), WRL (internal) Fax: 6364 6526
Additional bore information – identification of existing bores (private – licensed; public; Ministerial criteria bores); lithology; water levels; water quality, etc[2] Hydrographs for monitoring bores including Ministerial criteria bores.	*WIN database* Water Information branch	Group phone no: 6364 6505 Group email: <waterinfo@water.wa.gov.au> (external), Water Information (internal) Fax: 9426 4821
Location of wetlands – Swan coastal plain; Augusta to Walpole; South Coast WA	*Geographic data atlas* Department of Environment and Conservation	<www.dec.wa.gov.au> (under Applications and data > Geographic Data Atlas > Inland Waters theme) Ph: 6364 6500 for enquiries
Locations of groundwater-dependent ecosystems and monitoring bores on the Gnangara and Jandakot mounds, including Ministerial criteria bores. Hydrographs for monitoring bores on the Gnangara and Jandakot mounds, including Ministerial criteria bores.	*Department of Water website* Water Allocation Planning branch	<www.water.wa.gov.au> (under Waterways health > Groundwater > Gnangara Mound) Ph: 6364 6830 for enquiries
Location of wetlands – other areas of the state	*WetlandBase – The Western Australian wetlands database* DEC, Murdoch and Edith Cowan universities	<www.dec.wa.gov.au/management-and-protection/wetlands/wetland-base.html> Ph: 6364 6500 for enquiries

1 WRL contains the most up to date location data for licensed bores.

2 Not all existing bores are in the WIN database.

Glossary

Abstraction	pumping groundwater from an aquifer
Allocation	is the volume of water taken from a water source (groundwater or surface water) for use by an individual on an annual basis. An allocation may or may not be licensed (e.g. a domestic allocation). See 'water entitlement'.
Allocation limit	in the department's current water licensing system, an allocation limit is the volume of water set aside for annual licensed use based on the current understanding of the resource.
Aquifer	a geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water. Usually described by whether they consist of sedimentary deposits (sand, gravel, sandstone) or fractured rock. Aquifer types include unconfined, confined and artesian.
Artesian bore	is a bore, including all associated works, from which water flows, or has flowed, naturally to the surface.
Bore	A small diameter, normally vertical hole, usually drilled with machinery to obtain access to underground water for monitoring or abstraction purposes. Referred to as 'well' in the *Rights in Water and Irrigation Act, 1914*.
Confined aquifer	is an aquifer saturated with water which is under pressure because the aquifer is situated between relatively impervious layers.
Ecological water requirements	means the water regimes needed to maintain the water-dependent ecosystems at a low level of risk.
Environment	means living things, their physical, biological and social surroundings and interactions between all of these.
Environmental water provisions	means the water volume that is provided to maintain the environment, including the social and cultural requirements, as a result of the water allocation decision-making process. Environmental water provisions take into account the ecological, social, cultural and economic impacts. They may meet in part or in full the ecological water requirements.
Full allocation	refers to an area where all the available water resources have already been allocated.

Groundwater	refers to the water that occurs in pore spaces and fractures in rocks beneath the ground surface.
Groundwater dependent ecosystem (GDE)	an ecosystem that is dependent on groundwater for its existence and health.
Hydrogeology	means the geological science associated with the occurrence, distribution, movement and quality of groundwater
Policy	refers to a guiding principle (protocol) that is not directly supported by any legislation but has been adopted by the department as its guide to undertaking its business.
Sustainable yield	The volume of water abstracted from a source that can be sustained on a long-term basis without exceeding the rate of replenishment.
Unconfined or water table aquifer	is an aquifer which generally receives direct recharge from rainfall. Its upper surface is the water table and the aquifer is not confined or is under pressure.
Water entitlement	the quantity of groundwater permitted to be abstracted on an annual basis by a well licence (i.e. a licensed water entitlement) granted under the *Rights in Irrigation Act 1914,* usually specified in kilolitres/year (kL/year). Also referred to as a 'licensed allocation'.
Water table	The saturated level of the unconfined groundwater. Wetlands in low-lying areas are often seasonal or permanent surface expressions of the water table.
Well	An opening in the ground made or used to obtain access to underground water. This includes soaks, wells, bores and excavations.
Wetland	An area that is permanently, seasonally or intermittently waterlogged or inundated with water that may be fresh, saline, flowing or static. Includes areas of marine water in which the depth at low tide does not exceed six metres.

References

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Water and Rivers Commission 2000, Statewide policy no. 5, *Environmental water provisions policy for Western Australia*, Perth. [under revision]

Water and Rivers Commission, 2003, Statewide policy No. 6, *Transferable (tradeable) water entitlements for Western Australia*, Perth, November 2003. [under review]

Water and Rivers Commission, 2004, Statewide policy no.10. *Use of operating strategies in the water licensing process*, Perth, May 2004. [under review]

Regional enquiries

Please direct any enquiries relating to the implementation of this policy or to management of water resources in the regions to the following regional offices:

Kimberley Region
Lot 225 Bandicoot Drive
Kununurra WA 6743
Telephone (08) 9166 4100
Facsimile (08) 9168 3174

Pilbara Region
Lot 4608 Cherratta Road
Karratha WA 6714
Telephone (08) 9144 2000
Facsimile (08) 9144 2610

South Coast Region
5 Bevan Street
Albany WA 6330
Telephone (08) 9842 5760
Facsimile (08) 9842 1204

South West Region
35-39 McCombe Rd
Halifax WA 6231
Telephone (08) 9726 4111
Facsimile (08) 9726 4100

Swan Avon Region
7 Ellam Street
Victoria Park WA 6100
Telephone (08) 6250 8000
Facsimile (08) 250 8050

Mandurah Region
107 Breakwater Parade
Mandurah WA 6210
Telephone (08) 9550 4222
Facsimile (08) 9581 4560

Mid West–Gascoyne Region
94 Sanford Street
Geraldton WA 6530
Telephone (08) 9965 7400