GREAT ARTESIAN BASIN
Well Condition Review

DEWNR Technical note 2015/12

Government of South Australia
Department of Environment,
Water and Natural Resources

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Summary

The Great Artesian Basin Sustainability Initiative Phase 3 Program (GABSI 3) and SA Arid Lands Natural Resources Management Board (SAAL Board) jointly funded a condition review of artesian wells within the South Australia jurisdiction of the Great Artesian Basin. The review occurred in 2013 and 2014 and provides a snapshot of headworks and delivery infrastructure condition, water pressure, temperature and flow based on the observations recorded at the time the well was visited.

A total of 293 wells were visited during the review. A number of wells reviewed were excluded from this report because they were subsequently decommissioned under GABSI 3 or did not intersect GAB sediments. All review data was saved to the state groundwater data archive SA GEODATA. Data on pressure and temperature is available on Groundwater Data via WaterConnect: https://waterconnect.sa.gov.au.

The review data was used to develop criteria to enable each well to be assigned an identified risk and to make recommendations to mitigate the risk. The objective is to inform pastoralists of the priorities around maintenance of headworks and replacement water supplies. Separate workplace health and safety risk criteria based on water temperature (due to its effects on burn injury upon contact) were developed, but not included in the assessment of the wells.

Steps in developing the risk criteria are outlined along with key criteria that most influenced the assigned identified risk. Key criteria were operation of main valves, age of assets, and condition of the headworks and distribution system. Headworks in poor condition were often a precursor to failure of fittings. Drips and leaks in distribution fittings may expose the riser and main valve to accelerated corrosion depending on the severity of the leakage. Distribution systems located offset to the headworks mitigated this risk. Fencing off the headworks and distribution system reduced the risk of damage caused by stock and feral animals.

Bore drains remain at a number of wells. Unregulated flow from these has the capacity to change groundwater pressures and impact the environment to the detriment of the land surrounding the well or drain. Consideration should be given to enforcing compliance of licensed bore drains to ensure licence conditions are being adhere to.

A breakdown of the results showed that 52% of wells reviewed had low risk, 14% had moderate risk, 27% high risk, and 7% extreme risk. The majority of wells rated extreme risk had some form of casing failure, or no headworks to contain the flow.

A breakdown of casing asset age risk showed that 46% of wells had low risk, 22% had moderate risk, 9% high risk, and 23% extreme risk. The majority of wells with extreme casing asset age risk were constructed of mild steel casing, with a significant number linked to casing failures observed during the review.

A summary of results, along with recommendations for managing the risk for each reviewed well, and generic recommendations for managing risk for replacement water supplies for each Station was provided to the SAAL Board.

It was recommended that the SAAL Board promotes self-assessment of well condition by pastoralists using the GAB Well Maintenance Field Guide for Artesian Wells.

Furthermore it is recommended to maintain a program of 5 yearly review of all artesian wells.

1. Report

1.1 Introduction

Artesian water from the Great Artesian Basin (GAB) is used in South Australia for stock and domestic supply on cattle stations, mining, petroleum and gas operations, town water supply, and for tourism. Historical water use practices and failing infrastructure have caused a decline in pressure and flow across the basin.

The Great Artesian Basin Sustainability Initiative (GABSI) program was established in 1999 to deliver water and pressure savings by capping and piping legally flowing artesian wells. The program is jointly funded by the Commonwealth with matching funds provided by the member states and territory (South Australia, Queensland, New South Wales and Northern Territory). South Australia funded a review of all flowing artesian wells within its jurisdictional boundaries to supply an updated snapshot of pressures and flows across the basin after the completion of GABSI 3 (the last review was undertaken in 2006 as a requirement of GABSI 2).

SA Arid Lands Natural Resources Management Board (SAAL Board) oversees the delivery of the Far North Water Allocation Plan which covers the SA-portion of the GAB. The SAAL Board funded a review of well condition based on the standard form used by the pastoralists (Attachment 1), which assesses the condition of the surface casing, headworks and adjacent distribution systems. Both reviews were undertaken concurrently during 2013 and 2014 and provides a snapshot of conditions observed at the time each well was visited.

The initial scope was to provide a summary report and copy of the review sheet for each well visited. The scope was expanded to develop a decision-making tool for pastoralists based on a standard risk assessment approach.

In the context of the well review, the risk is an **identified risk** based on observations recorded at the time of the review, which provides a qualitative means of identifying issues contributing to the risk and strategies to mitigate the risk, and prioritisation of work based on the level of identified risk at each well.

Four categories of risk were developed using the review data and tested for their usefulness in assigning overall risk of each well. This required several iterations to develop assessment criteria that could be applied consistently.

Data on casing type and age for each well was extracted from the state groundwater data archive SA GEODATA and used to assign a risk based on nominal asset life cycle for the various types of production casing used in the GAB.

Risk assessment was considered the best method to value add the information provided by the review, inform on future funding, assist in the establishment of an insurance scheme for artesian wells, and to inform pastoralists of the risk and priorities around replacement water supplies.

The risk assessment methodology, results and main recommendations are outlined below.

Summary reports, review results and recommendations for each Station were provided to the SAAL Board.

1.2 Risk assessment criteria

Risk assessment combines the likelihood of an event occurring with the consequence of the event if it occurred, to provide an overall risk rating.

The **event** is failure of the casing, headworks and distribution system leading to uncontrolled flow at the headworks, or drips, leaks, or unregulated flow from the distribution system.

Consequence is what the event might lead to. Examples include loss of productive capacity, financial loss or loss of water pressure and flow.

Likelihood is the probability that an event may occur. The five standard categories of likelihood are outlined in bold text in Table 1.1 below. Suggested frequencies for well failure events are provided for each likelihood category.

Likelihood cannot predict when failure occurs. Therefore management actions aimed at minimising the likelihood of a system failing must also consider the consequences of the failure. This determines how much time, effort and resources will be required to manage the risk.

Table 1.1 Likelihood criteria

Likelihood	A	B	C	D	E
	Almost Certain - occurs at least annually	**Likely** - occurs at least every 2 to 5 years	**Possible** - occurs within 5 to 10 years	**Unlikely** - occurs within 10 to 25 years	**Rare** - not likely to occur within 25 years

Consequence of failure is assessed under four standard categories. Each category is defined within the context of the well review.

- **Workplace health and safety (WHS):** injury resulting from exposure to groundwater of varying temperature
- **Financial:** estimated cost of remediating failure of well casing, headworks, or distribution system; stock losses; interruption to plant operation
- **Operational:** length of loss of supply of water to stock, or to plant
- **Environmental:** extent and permanency of change to landscapes; declining water levels.

The estimated outcome for each category is defined for five levels of consequence. Health and financial categories are based on standard outcomes. Operational and environmental categories are described in terms of pastoral and regional outcomes (Table 1.2).

Table 1.2 Estimated consequence outcomes for pastoral operations

Consequence level		Estimated consequence outcomes			
		WHS	Financial	Operational	Environmental
1	Catastrophic	Death	Massive financial loss	ongoing disruption to water supply	irreversible impact
2	Major	Hospitalisation	Large financial loss	up to 1 month loss of water supply	modified environment extending beyond point source
3	Moderate	Medical Treatment	High financial loss	1 week loss of water supply	medium term impact at point source
4	Minor	First Aid Treatment	Medium financial loss	1 day loss of water supply	visible impact at point source
5	Negligible	No injuries	Minimal financial loss	< 12 hours loss of water supply	no impact

Table 1.2a shows standard operational outcomes that may be more applicable for industry in the GAB.

Table 1.2a Estimated consequence outcomes for industry

Consequence level		Estimated consequence outcomes			
		WHS	Financial	Operational	Environmental
1	Catastrophic	Death	Massive financial loss	Greater than 1 week of lost production	irreversible impact
2	Major	Hospitalisation	Large financial loss	3 to 7 days of lost production	modified environment extending beyond point source
3	Moderate	Medical Treatment	High financial loss	12 hours of lost production	medium term impact at point source
4	Minor	First Aid Treatment	Medium financial loss	6 hours of lost production	visible impact at point source
5	Negligible	No injuries	Minimal financial loss	1 hour or less of lost production	no impact

Causal factors to each outcome outlined in Tables 1.2 and 1.2a are defined using the review data.

Table 1.3 Causal criteria used for the risk assessment

Consequence level		Consequence criteria			
		WHS	Financial	Operational	Environmental
1	Catastrophic	>50°C extensive exposure (time & area)	>$100,000	Down hole casing failure	Extensive flow to environment or of loss of water pressure from uncontrolled[1] or unregulated[2] flow
2	Major	>50°C minimal exposure (time & area)	<$50,000	Surface well head failure at or below the main valve	Localised flow to environment or of loss of water pressure from uncontrolled or unregulated flow
3	Moderate	<50°C; <5 minutes	<$20,000	Main valve failure or seized	Continuous spray around headworks or distribution systems from failed fitting(s) or split poly pipe
4	Minor	<50°C; <1 minute	<$5,000	Distribution system failure <7 day disruption to supply	Patchy wetting or salt scalds around headworks or distribution system from dripping fittings
5	Negligible	25°C - 37°C	<$1,000	repair in normal water run -water supply temporarily disrupted	Patchy wetting around headworks or distribution systems from seeping fittings

1: uncontrolled flow has no means of stopping flowing wells.
2 unregulated flow is flow via open ended pipes.

1.3 Assessing risk

The risk matrix is a standard look up table based on the likelihood and consequence of an event (Table 1.4). Four levels of risk are identified in by cells highlighted in colour.

Table 1.4 Risk assessment matrix

		Step 2: Estimate consequence for each category				
Step 1: Estimate likelihood		Catastrophic	Major	Moderate	Minor	Negligible
		1	2	3	4	5
A	Almost Certain	Extreme risk	Extreme risk	Extreme risk	High risk	High risk
B	Likely	Extreme risk	Extreme risk	High risk	High risk	Moderate risk
C	Possible	Extreme risk	Extreme risk	High risk	Moderate risk	Low risk
D	Unlikely	Extreme risk	High risk	Moderate risk	Low risk	Low risk
E	Rare	High risk	High risk	Moderate risk	Low risk	Low risk

All wells have an identifiable risk due to antecedent factors. An example is asset type and age, another is water temperature.

When a well experiences a failure event the risk will need to be reassessed based on conditions present at the time of review, including identifiable WHS risk. These observations will determine if the risk profile of the well has changed due to the failure. Therefore the identified risk assigned to a well is a combination of the antecedent factors and observations taken at the time of the review.

Assessing risk for a given well requires undertaking the following steps in sequence.

1. Assess the inherent risk associated with antecedent factors of the well.
2. Determine if the well is experiencing or likely to experience operational failure.
3. Assess the consequence of the operational failure when present.

The assigned risk of the well is the category – WHS, financial, operational or environmental with the highest assessed risk from steps 2 or 3.

Step 1: assessing inherent risk of wells

For the majority of wells water temperature, asset age and infrastructure condition will be the major determining factors.

Antecedent water temperature is nominally measured at the headworks, however individuals need to be conscience of water temperature when undertaking maintenance at any point along the water infrastructure. Assessment of the WHS risk can be made using the **grey highlighted** cells in Table 1.3. An outline of the effect of water temperature on burn injury is provided in section 1.5.

To maintain the focus of this report on well condition, the identified risk assigned to each well excluded the WHS risk associated with water temperature. However pastoralists must be cognisant of WHS risk when assessing risk before undertaking any tasks involving the headworks or distribution system.

From a qualitative perspective asset age can be considered against nominal life cycles. Best industry knowledge was used to develop the lookup table provided below for casing materials used in the GAB. An outline of casing failure pattern is provided in section 1.5.

Known data on production casing type and age was extracted from the state data archive SA GEODATA and used to generate generic risk profiles for all GAB wells by pastoral lease using Table 1.5. Summary results are provided in section 1.7.

Table 1.5 Asset age risk profiles for well casing types used in the GAB

	FRP/ PVC-U[1] casing	Mild Steel casing	Stainless Steel casing	API5LB -high carbon steel casing
Nominal asset life	50 years	20 years	50 years	50 years
Low Risk asset age	0 to 25 years (inclusive)	0 to 10 years (inclusive)	0 to 25 years (inclusive)	0 to 25 years (inclusive)
Moderate risk asset age	26 to 34 years (inclusive)	11 to 13 years (inclusive)	26 to 34 years (inclusive)	26 to 34 years (inclusive)
High risk asset age	35 to 40 years (inclusive)	14 to 16 years (inclusive)	35 to 40 years (inclusive)	35 to 40 years (inclusive)
Extreme risk asset age	above 40 years	above 16 years	above 40 years	above 40 years

#1: FRP –fibreglass reinforced plastic; PVC-U polyvinyl chloride (plastic)

Groundwater at elevated temperatures containing high levels of hydrogen sulphide or salts will significantly reduce the asset life of mild steel casings not specifically designed for these conditions. Understanding water chemistry is recommended as a mitigating strategy.

For headworks and distribution systems which can be visually and mechanically inspected, assessment of the condition can provide a qualitative assessment of inherent risk of failure. Wells with visibly corroded headworks were given a higher risk rating.

Absence of structures such as fences that could minimise damage to headworks and other fittings add to the inherent risk. Fencing off headworks was recommended when absent as a mitigating strategy.

Step 2: identifying wells with current operational failure

These wells have some form of operational failure identified from the review data using the descriptions provided in the **blue highlighted** cells in Table 1.3.

Wells with operational failure require assessment of the consequence using step 3.

Step 3: assessing consequential risk of wells with operational failure

Types of operational failure are listed in Table 1.3 and include leaky fittings, casing to headworks joints, or casing failure. There is no likelihood of failure as the failure is already occurring. Therefore the identified risk assigned to the well is based on an assessment of the **consequence** of the failure using Table 1.6.

Table 1.6 Risk assessment of wells with operational failure

Consequence Level		Consequence criteria			
		Health	Financial	Operational	Environmental
1	Catastrophic	>50°C extensive exposure (time & area)	>$100,000	Casing failure	Extensive flow to environment or of loss of water pressure from uncontrolled or unregulated flow
2	Major	>50°C minimal exposure (time & area)	<$50,0e00	Surface well head failure at or below the main valve	Localised flow to environment or of loss of water pressure from uncontrolled or unregulated flow
3	Moderate	<50°C; <5 minutes	<$20,000	Main valve failure or seized	Continuous spray around headworks or distribution systems from failed fitting(s) or split poly pipe
4	Minor	<50°C; <1 minute	<$5,000	Distribution system failure <7 day disruption to supply	Patchy wetting or salt scalds around headworks or distribution system from dripping fittings
5	Negligible	25°C - 37°C	<$1,000	repair in normal water run -water supply temporarily disrupted	Patchy wetting around headworks or distribution systems from seeping fittings

Legend:	Extreme Risk	High risk	Moderate risk	Low risk

Example:
A well was rehabilitated with FRP casing in 1984. The well has a seized main valve and a failed distribution valve which sprays water. Replacing the failed distribution valve requires turning off the water flow via the main valve, but this is not possible with a seized main valve. The antecedent water temperature is 60°C.

From Table 1.5 the FRP casing is assigned an identified moderate inherent risk.

From Table 1.6 the seized main valve and spray resulting from the failed distribution valve have identified moderate operational and environmental consequence, respectively.

Overall risk is determined by the category with the higher risk rating, in this case moderate risk.

Mitigating strategies can be a number of options, which need to be concurrently considered to understand risks associated with undertaking proposed work. Options for the above example may include:

Option 1: do nothing. This is a compliance risk under the *Natural Resources Management Act (SA) 2004*, therefore is not an option.

Option 2: repair or replace the main valve. The methodology requires consideration of WHS risk and cost. For example it may not be possible to determine if the main valve can be repaired without removal and close inspection hence it may be easier to replace it.

Option 3: repair or replace the distribution valve only. This option also requires consideration of WHS risk and cost, given that without an operating main valve the flow cannot be shut down.

The asset age of the FRP casing will require consideration in future rehabilitation or replacement options for the well as part of the 5 year financial/business operations planning cycle of the Station.

Assigning management responsibility

Successful management of risk requires assigning responsibility to ensure identified actions occur in a timely manner. Recommended actions for each well reviewed were assigned management responsibility based on overall risk.

Wells marked green: manage by routine maintenance

These wells have low risk. Management is the responsibility of individuals who routinely inspect the wells to undertake any recommended maintenance or maintenance identified during their routine inspection.

Wells marked yellow: assign responsible person to action

These wells have moderate risk. An individual is assigned responsibility to undertake recommended or required actions, and to follow up on issues identified via routine inspection.

Wells marked amber: (**high** risk)**; Well marked red:** (**extreme** risk) **to be actioned by senior management**

Both are assigned to senior management to be responsible to implement required actions, as wells in these categories are already or have the potential to significantly impact individuals, business operations and finances, and/ or the environment. An extract from a summary table is provided below.

Table 1.7 Example well summary table

Well	Water	Main valve		Headworks		Distribution		Risk rating	Comments
	Temp.	Turns	G/F/P	Condition	Fenced	Offset from headworks	Type		
Well A	≥50°C	×	F	F	×	×		**moderate**	*Assign management action.* Seized main valves need freeing up or replacing. Fence off to protect from stock.
Well B	≥50°C	No valve		G	×	×	tanks & troughs	**high**	*Pastoralist: Senior management action.* Install main valve. Fence off to protect from stock.

1.4 Review data influencing risk

Generalised patterns of risk became evident from the review, with overall risk rating linked to the following key criteria.

Asset Age

Asset age is associated with inherent operational and financial risk, and consequential environmental risk in the event of casing failure, or failure at the headworks or distribution system.

The charts for PVC/FRP and mild steel casing types shown in Figure 1.1 provide an estimated failure rate for wells of construction age falling within 10 year incremental age ranges, using best industry knowledge gained from past failure events. They show a rapidly accelerating likelihood of failure with incremental well age.

All wells will gradually move to higher risk levels until rehabilitated or replaced. The following generic recommendations for managing the risk were provided based on an increased likelihood of accelerated failure rates of wells within higher risk levels:

Wells marked green –low risk:	focus on monitoring and maintenance of infrastructure in the 5 year business plan and long term planning for replacement
Wells marked yellow –moderate risk:	include financial planning and mitigation measures in out years of the business plan; recommend to include contingency in budget forecast for managing casing failure events
Wells marked amber –high risk:	include a schedule for future rehabilitation or decommission/replacement in the 5 year business plan; include contingency in budget forecast for managing casing failure events
Wells marked red –extreme risk:	priority wells for rehabilitation or decommission/replacement in 5 year business plan; maintain contingency within budget to manage casing failure events until wells are rehabilitated or decommissioned

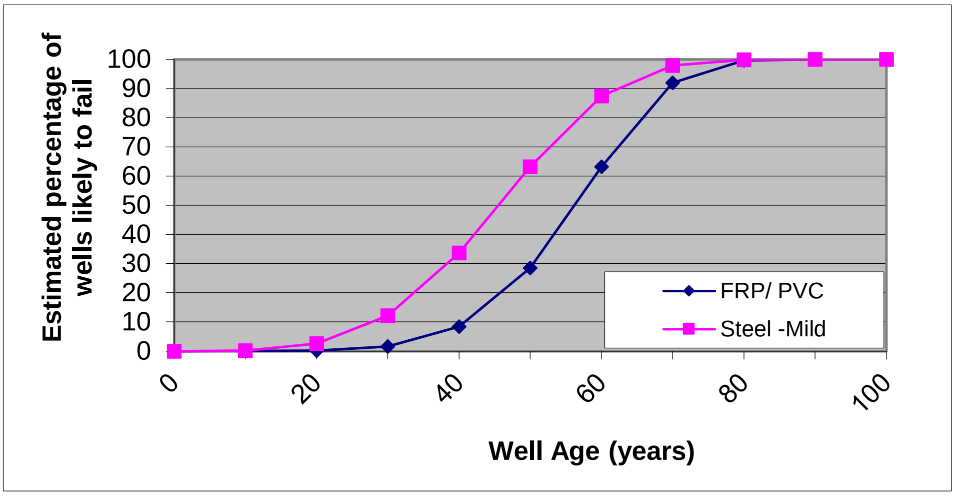

Figure 1.1 Estimated effect of production casing type on failure rate of wells of varying age

Keeping good asset management and maintenance records is essential to provide information on why failure occurs and to inform the business planning process on whether there are any emerging risk issues. Additional information on managing assets is provided in the GAB Well Maintenance Field Guide for Artesian Wells.

Operation of main valves

Operation of main valves has inherent operational and financial risk. The consequence of seized main valves can present major WHS risk when there is no other means for turning of flow.

The *Natural Resources Management Act (SA) 2004* requires installation of headworks capable of preventing uncontrolled flow of water from artesian wells. This is achieved by the use of an operating main or distribution valves. The latter may be located at the headworks or closer to the points of exit from distribution lines.

Operation of main valves is summarised below. Around 20 to 25 per cent were not operating at the time of the review.

Table 1.8 Operation of main valves

Main valve	Water temperature	
	<50°C	≥50°C
operating	52%	74%
seized	20%	26%
no valve	28%	

Headworks with seized main valves are considered to have failed operationally as there may not be any alternative means of turning off flow along the distribution system.

Bore drains

Unregulated flow to bore drains is primarily associated with the environmental consequence. However there is an inherent financial risk due to the requirement to install tanks and troughs.

Unregulated flow to bore drains has the capacity to permanently change groundwater pressure and alter significant areas of landscape. The Far North Prescribed Wells Area (PWA) Water Allocation Plan (WAP) requires phasing out of bore drains.

A number of bore-fed wetlands listed in Table 1.9 are currently exempt. However some of these bore-fed wetlands have too much flow therefore the conditions of the exemptions may require reconsideration by the SAAL Board.

Table 1.9 Bore-fed wetlands

Station	Bores
Callanna	Callanna Bore 2 Morphetts' Bore
Clayton	Clayton Bore 2
Clifton Hills	Goyders Lagoon Kalladeina Bore
Coward Springs	Coward Springs 2
Cowarie Station	Mirra Mitta Bore
Dulkaninna	Dulkaninna Bore 2
Etadunna	New Kopperamanna
Finniss Springs	Morris Creek Bore
Kalamurina	White Bull Bore
Lindon	Fortville 3
Muloorina	Muloorina Bore
Mungerannie	Jack Lake 2 Lycium 1 Mungerannie Bore
Murnpeowie	Murnpeowie HS Bore
Witjira National Park (Simpson Desert Regional Reserve)	Purni 1
Strezelecki Regional Reserve	Montecollina Bore

The presence of bore drains at non-exempt wells was rated a high risk due to the environmental consequence.

Distribution system failure

Failure of distribution systems has operational risk if water supplies are disrupted and indirect financial risk if drips and leaks accelerate corrosion and failure of the headworks or riser. More significant leaks can impact the localised environment if left unchecked for a period of time.

Failure of the distribution system tended to have the least weighting to overall risk due to most failure types being seepage and drips. Majority of wells had main valves that could turn off flow to facilitate maintenance and replacement of distribution fittings.

Multiple failure points of the distribution system, or failure type resulting in water spraying from fittings, were given an overall moderate risk rating.

Corroded, seeping or leaky fittings were recommended or required to be replaced.

A small number of wells did not have headworks attached or had distribution valves deliberately left on, which is not in the spirit of the *Natural Resources Management Act (SA) 2004*.

1.5 Risk associated with water temperature

Water temperature is the major factor in determining inherent WHS risk. This is because the time required to sustain third degree burns rapidly falls with increasing water temperature, becoming instantaneous above 50°C (Figure 1.1). Given that distribution pipes can raise water temperature by several °C during summer, water temperature at the point of exposure can result in serious injury, even for wells with antecedent temperatures below 50°C (measured at the well head). Wells delivering water at or near boiling point at high pressure generate steam which can easily cause third degree burns from direct contact.

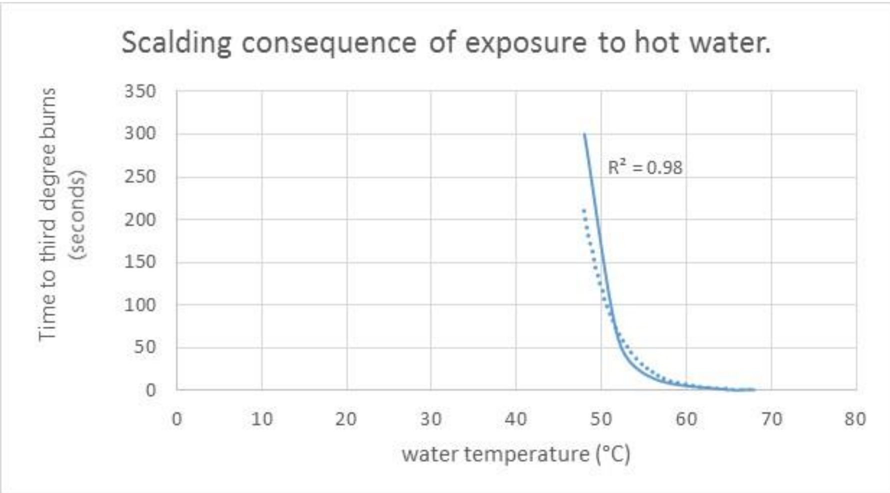

Figure 1.2 Effect of water temperature on time required to develop third degree burns

http://www.antiscald.com/prevention/general_info/table.php

Management and resourcing

Whilst not a specific criterion in Table 1.3 as this cannot be assessed by a field review of the wells, stations clearly showed patterns of compliance, maintenance and resourcing, which influenced overall risk rating of wells.

1.6 Well review results

Using the methodology outlined in Section 1.3, each well reviewed was assigned an overall risk. Figure 1.3 summarises results for all stations. Of the wells reviewed, approximately 7% had extreme risk, 27% high risk, 14% moderate risk, and the remaining 52% low risk.

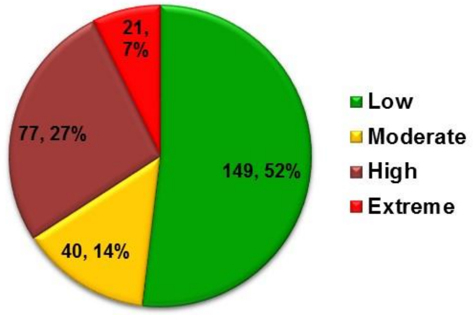

Figure 1.3 Identified risk rating of wells at the time of review

While subjective, the strength of focussing on causal criteria to assign risk assists with identifying what to focus on when identifying actions to manage the risk. This is especially important in the prevention of catastrophic well head failure and uncontrolled flow. A key learning of the GABSI and National Heritage Trust (NHT) programs is that catastrophic well failure usually requires either expensive remedial action, or decommissioning and re-drilling of the failed well to maintain the water source.

Majority of wells rated extreme risk had uncontrolled flow. Most of these wells were potentially repairable, subject to further investigation. However a small number of wells had water pooling around the headworks where the source of the leak was not clearly evident, or was covered by sand or thick vegetation, making assessment difficult. These sites require urgent further investigation to determine if catastrophic failure is likely to occur, and what remedial action is required to prevent failure. Three wells: Johnsons No. 3, Bakewell Bore, and Coolong Springs Bore, are unlikely to be controlled due to complexities of the failure, the condition of the immediate area surrounding the well, and native title or heritage considerations.

Poor maintenance over an extended period is regularly a precursor to many of the catastrophic failures seen across the GAB. Comparison of wells in fair or poor condition with photographs from the 2004 review indicated that:

- in most cases wells with headworks in fair to poor condition in 2013–14 were in good condition in the 2004 review
- maintenance and replacement of fittings was less likely at wells with no or seized main valve and/ or wells with higher pressure and temperature.

WHS concerns related to the high temperature, pressure and flow rates adds to the reluctance of landowners to maintain the headworks. Maintaining the main valve in good working order, in accordance with the GAB Well Maintenance Field Guide for Artesian Wells, should overcome the majority of issues relating to WHS in these cases.

All of the wells upgraded through the various GABSI and NHT programs should have distribution systems able to contain and deliver the water in response to need. However a number of sites with upgraded headworks still deliver part or all of the water to bore drains, ponds or swamps, into which the water is allowed to flow unregulated. This type of unregulated distribution of the water appears counterproductive to the GABSI objectives of promoting best practice to ensure that the pressure and flow of the resource can be maintained. The Far North WAP requires bore drains to be phased out by 2019 (excluding wells listed in Table 1.9).

It is imperative that the wells, wellheads and distribution systems are protected from damage. Approximately half of the wells were partly or fully protected from damage by stock and feral animals, but the remainder were unfenced and remain at risk of damage. In cases where part protection was offered there was a tendency to leave the distribution system fittings unprotected, making it more vulnerable to damage. To maintain risers, headworks and distribution systems in good condition it is imperative that fences are built and maintained around the entirety of the infrastructure. Installation of distribution systems offset from the riser reduces the likelihood of corrosion caused by leaky fittings.

1.7 Casing asset age risk results

A breakdown of casing asset age risk showed that 46% had low risk, 22% had moderate risk, 9% high risk, and 23% extreme risk. Figure 1.4 summarises results for all stations.

The majority of wells with extreme casing asset age risk were constructed of mild steel casing, with a significant number linked to casing failures observed during the review. A number of these wells were failing at the time of the last GAB review in 2006.

The oldest wells constructed using PVC or FRP production casing are reaching an age of high risk where an accelerating rate of catastrophic failure is likely over the next 10 year period. Consideration of asset age and condition *will* become an increasingly important element of financial/ business operations planning for most station managers.

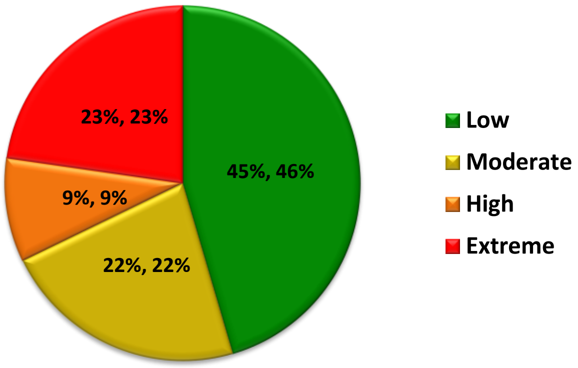

Figure 1.4 Casing asset risk profile summary as at August 2014

1.7 Conclusion and Recommendations

The well condition review results were within expectations but showed opportunities for improvement. The results also presented many good examples of how sites can be set up to minimise likelihood of failure and make maintenance more convenient and easier to undertake.

Casing type and asset age risk will present an increasing challenge to pastoralists to manage well replacement programs.

There is opportunity for and it is strongly recommended that, the SAAL Board engage and work with pastoralists to deliver ongoing improvement to the management of artesian wells in the GAB

A number of recommendations to progress ongoing improvement are provided below for consideration by the SAAL Board:

1. Develop and implement a schedule for site visits to investigate issues and develop repair options for sites requiring urgent/further investigation and report findings back to the SAAL Board.
2. Develop and implement a training program to educate pastoralists in the correct procedures for maintaining well heads and water distribution system infrastructure.
3. To assist the maintenance program it is recommended that the SAAL Board adopts one or more of the following:
    a. Pastoralists voluntarily maintain a maintenance program using the schedule contained in their version of the GAB Well Maintenance Field Guide for Artesian Wells, with maintenance logs extended to include photographic evidence of the visit.

       Pastoralists assign management responsibility based on risk.

b. Make maintenance records available on request to Officers authorised under the *Natural Resources Management Act (SA) 2004*.

c. The SAAL Board requests pastoralists to provide scanned copies of maintenance records and photographs within a stated compliance time period. The frequency of requests to reflect well condition and capacity of Natural Resources South Australian Arid Lands (NRSAAL) staff to assess the records—a similar approach is used by other agencies responsible for compliance. This will allow the SAAL Board to report on the continual improvement of well condition via "Across The Outback", promote the objectives and benefits of the program and maintain goodwill with the land managers.

d. The SAAL Board request pastoralists to inform NRSAAL of sudden change in the conditions of wells, whether improvement or deterioration –a similar approach is used by other agencies responsible for compliance to promote more open communication with land managers and facilitate more rapid response to address issues before they lead to failure.

e. Licence conditions explicitly indicate asset monitoring and maintenance requirements.

4. Develop and implement a program to offset the distribution-infrastructure systems from the headworks to minimise pooling of water around headworks from leaky fittings, and to require both the headworks and distribution system to be fenced off to prevent damage from stock/feral animals.

5. Maintain a program of 5 yearly reviews of all wells; more frequent reviews of wells in high or extreme risk categories is recommended.

6. SAAL Board seeks to clarify and document the ownership of wells drilled on pastoral land by impactors other than the pastoralist and seek agreement with the impactor on the asset management and monitoring process including status reporting and decommissioning timelines.

Management of well replacement lies outside the scope of this report however the SAAL Board, NRSAAL and pastoralists need to aware of the business risk associated with casing asset age.

Attachment 1: Example Well Review Form

Unit Number	Well Name	Latest Well Depth (m)	Antecedent Temperature (°C)	Maximum Shut in Pressure (kPa)	Shut in Test Time (min)
Unique identifier					

COORDINATES	EASTING		NORTHING	

Insert photograph of headworks showing main valve (when present)	Provide brief description of each photograph in this column
Insert 90° view of headworks	
Insert view of headworks and adjacent distribution system (e.g. tanks & troughs)	

WELL MAINTENANCE SHEET

WELL NAME:

INSPECTED BY: Date:

COMPONENTS	LEAKAGE	CONDITION good (G) fair (F) poor (P)	COMMENTS/ ACTIONS
MAIN VALVE Body Gland Spindle	 No No N/A		
CHECK OPERATION OF MAIN VALVE Note: After testing the operation of the main valve the gland may develop a small leak – retighten gland nuts on gland housing			Checked : Yes/No Operating: Yes/No
FLANGES Flange Bolts / Nuts Gaskets	 No No No		
DISTRIBUTION VALVES Glands Body Spindle Threads	 No No N/A No	 G G G G	
PRESSURE TEST VALVE	No	G	
DISTRIBUTION MANFOLD(S)	No	G	
COOLING POND Isolation Valve Float Valve Liner Vegetation Dam Condition Fencing			
PIPELINE Air relief Valve Tanks - Capital Float Valve Isolation Valve Overflow – fencing, erosion around base of tank Troughs – Capital – float valve			
PACKER Pressure Stability of Head works			
DEGASSER Air Release Valve			

Additional comments: Other related information not capture above

Government of South Australia

Department of Environment, Water and Natural Resources