Chapter 3

Use of produced water

Introduction

3.1 As discussed in the previous chapter, the volume of water to be produced by the coal seam gas industry is very large indeed. It will vary from region to region both in total volume and in proportion to the volume of gas produced. A paper prepared for the National Water Commission has estimated, for example, that CSG produced from the Surat Basin will entail the extraction of some 192 megalitres of water per petajoule of energy while for the Bowen Basin the ratio will be 50 ML/pj.[1]

3.2 The estimated total volumes will be 2 360 g/l from the Bowen Basin, 5290 g/l from the Surat and, depending on the development scenario adopted, up to 46.9 g/l from New South Wales.[2] The rate of production of this water will fluctuate over time. Individual wells typically produce high volumes of water in the early months or years of production and then taper off. Gas fields will be managed to maintain the required level of production thus new wells will be brought on as required and the overall production of water will fluctuate accordingly.

3.3 The National Water Commission estimates that the total volume of water that will be extracted by the CSG industry to be 7 500 gigalitres.[3] The probable volumes of water have been indicated by the companies. For example AP LNG expects that it "... will typically produce water at the annual rate of 25,000 ML per year, with a peak of 57,000ML per year".[4] Santos estimates that in NSW its Gunnedah project will produce "... water at an average extraction rate of approximately 3.5 GL per annum, and a maximum rate of 5GL per annum".[5]

3.4 While the water is of variable quality, little of it is expected to be of a quality that could be used in agriculture, and none will be suitable for human consumption. The chemical make–up of the water varies but all of it will have significant levels of dissolved salt plus a range of other chemicals – heavy metals such as arsenic, mercury and lead, naturally occurring BTEX chemicals and uranium. The water may also contain residues of chemicals used in the drilling and hydraulic fracturing processes.[6]

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1 RPS Australia East Pty Ltd, *Onshore co-produced water: extent and management*, Waterlines Report Series No. 54 September 2011, table 2, p. 11. By comparison CSG produced in the Sydney Basin yields a ratio of 1.2 ml/pj.

2 RPS Australia East Pty Ltd, *Onshore co-produced water*, table 7, p. 16.

3 Recent estimates for produced water are much lower. See chapter 1.

4 AP LNG, *Submission 366*, p 24. (25 to 57 gl/pa)

5 Santos, *Submission 353*, p. 17.

6 The concentration of total dissolved solids (tds) in CSG water ranges from 200 to 10 000+ milligrams per litre. In comparison, sea water has tds values of 36 -38 000 mg/l.

3.5 Obviously many of these chemicals are potentially dangerous to human health, livestock and soils. Thus the management of these very large volumes of water – storage, treatment and disposal - presents complex challenges.

3.6 It is expected that virtually all produced water will be treated prior to disposal. Santos, for example, intends to treat 100 per cent. The company estimates that reusing extracted water productively will result in its net water use in the Gunnedah project, for example, being reduced by approximately 80% to 0.7 to 1.4 GL/pa.[7]

3.7 AP LNG, for example, has two reverse osmosis plants in operation and proposes to build others throughout its development area. It reports that it is achieving recovery rates in excess of 90 percent from these plants and hopes to achieve 97.5 per cent recovery of useable water from these plants.

3.8 There are three main treatment options. To produce high quality water, suitable for human consumption, reverse osmosis or filtration is required. Depending on the quality and the intended use, water may also be treated by amendment - blending lower and higher quality waters to produce water of an acceptable standard for a given purpose.

3.9 The National Toxics Network did warn that reverse osmosis:

> ... has significant limitations and cannot remove all contaminants, particularly organic compounds with low molecular weight. Reverse osmosis involves forcing water through a semi-permeable membrane, which filters out a select number of water contaminants, depending on the size of the contaminants. In general, if the contaminants are larger in size than water molecules, those contaminants will be filtered out. If the contaminants are smaller in size, they will remain in the water.[8]

3.10 It is essential that, where treated water is to be used for human consumption or food production, it conforms to the Australian Drinking Water Guidelines published by the NHMRC.

3.11 A downside of this is that treatment will result in the production of large quantities of salt and brine. Arrow Energy estimates a range of 5 - 8 tonnes of salt per megalitre of water produced by the industry.[9] On the AP LNG figures quoted above, that company's annual production of salt could be in the range of 125 000 – 285 000 tonnes per annum.

3.12 AP LNG advised the committee in their submission that, over the 40 to 45 year life of its projects in Queensland, it expected to produce approximately 3.5 million tonnes of salt. Queensland Gas (QGC) expects to produce 4.6 million tonnes

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7 Santos, *Submission 353*, p. 17.

8 National Toxics Network, *Submission 227*, p. 15.

9 http://www.arrowenergy.com.au/icms_docs/73090_Water_and_salt_management_brochure.pdf

of salt from its operations in south western Queensland over the next 30 years. The management of salt and brine is dealt with later in this chapter.

3.13 Storage of extracted water prior to treatment is a major issue. In the early stages of the industry in Queensland, companies stored water, and evaporation was an accepted means of disposal. Queensland has since banned evaporation but large volumes of water remain in storage. A long-term storage pond can be an evaporation pond in all but name. Thus it is extremely important that the industry has the capacity to treat water at the rate at which it is produced.

3.14 Queensland's *Coal Seam Gas Water Management Policy* (June 2010) recognises that aggregation of produced water is necessary prior to reinjection or treatment and seeks to address the issue of *de facto* evaporation ponds by requiring that:

- aggregation dams are deep with a small footprint, and
- that "... during any period of thirty days, following the first 90 days after commissioning ... the total volume of water leaving the dam, other than by evaporation, must be not less than 85 per cent of the volume of water that has entered the dam".[10]

3.15 The stability of storage ponds is an important issue. Given the chemical make-up of the stored water, any seepage will be extremely damaging to the environment. The committee has seen, in the Pilliga area of NSW, the damage done by seepage, and in worst cases, failure of small water storages.[11] There are also concerns about water storages being overtopped by extreme rain events or floods.

3.16 On the other hand the committee also visited Santos's exploration site near Gunnedah where very large storage tanks were being used to manage produced water. It is clear that there is a range of approaches to managing this water.

3.17 It has been put to the committee that the only safe storage ponds are those completely lined with high density polyethylene or a similar material. Ideally storage should be only a short term requirement – companies should have the capacity to treat extracted water as it is produced. However, even where produced water is cycled through holding ponds relatively quickly, sealing of ponds in regular or constant use is still needed – arguably more so where deep storage ponds exert increased seepage pressure. The Queensland policy mentioned above has strict requirements for the construction of storage dams.

3.18 The rehabilitation of storage ponds after the industry moves on is an important issue. The committee would assume that it will be a requirement in any exploration or

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10 Queensland Government, *Coal Seam Gas Water Management Policy* (June 2010), p. 4.

11 Mr A Pickard, *Submission 207*.

production approval that every storage pond would be emptied, any residues removed and the site rehabilitated before a company abandons a gas field.

Use of extracted water

Reinjection

3.19 As noted in chapter 1, reinjection into groundwater systems has been adopted by the Queensland Government as its favoured method of dealing with CSG water. The Queensland Government has recently announced that:

> Coal Seam Gas companies must make reinjection their first priority in their water management practices to give the greatest protection to the environment and landholders ... .[12]

3.20 It is an attractive option because reinjection will help to maintain the water balance in a given area. There are various approaches to this. A method favoured by many localities is to put water into aquifers that have been depleted by agricultural or domestic use over many years.

3.21 Santos, at Roma in Queensland, has committed to recharging with treated water the heavily depleted Gubberamunda aquifer from which the town water supply is drawn. Santos is confident that it can put 10 ML/day into the aquifer, about three times the average withdrawal. The company estimates that this reinjection would also far exceed the maximum vertical seepage from the aquifer that might be attributed to the CSG industry.[13]

3.22 The committee notes the comments of the National Toxics Network at paragraph 3.9 above about the limitations of reverse osmosis. Any water reinjected into an aquifer used for human consumption or agriculture must meet Australian Drinking Water Standards.

3.23 Reinjection is not a universal panacea. AP LNG has described some of the factors that need to be considered:

> Aquifer injection ... involves pumping water into rock formations underground and is not as easy as ... pumping water down a well. There are a number of factors that need to be taken into consideration such as aquifer permeability, aquifer pressure levels, existing water quality and chemical makeup, mineralogy of receiving aquifers, removal of oxygen from the water prior to injection and the capacity of each injection well.[14]

3.24 QGC made the same point:

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12 Queensland Government, The Hon Vicki Darling, Ministerial Media Statement, 9 August 2011.

13 Santos, *Submission 353*, pp 18–19.

14 AP LNG, *Submission 366*, p. 35.

> While it is technically feasible in some circumstances to re-inject water produced as a result of coal seam gas extraction, this is unlikely to be possible in most cases.
>
> Re-injection in the same location as the water is drawn from is even less likely to be possible.[15]

3.25 Reinjection has been proposed as a possible solution to the disposal of the brine residue produced by reverse osmosis. However that would be subject to many of the constraints mentioned in the previous paragraphs. The receiving aquifer would have to be at a depth and of a stability to ensure that there was no risk of contamination of other aquifers and the water in the aquifer would need to be of a similar quality to the brine. Pumping into deep aquifers is both expensive and technically demanding.

Virtual reinjection

3.26 Virtual reinjection refers to the supply of appropriately treated extracted water to existing agricultural or domestic users as a substitute for the water they would otherwise extract from aquifers. Given the technical limitations on reinjection described above, virtual reinjection should be an important intermediate option to achieving a similar outcome. However water used in this way must be properly measured and regulated – it must be a substitute for an existing water entitlement, not a supplement to such an entitlement.

Direct use in agriculture and industry

3.27 Virtual reinjection is one method of using extracted water. In addition, there have been numerous proposals to supply water to other users in agriculture or industry. Superficially this is an attractive option but it carries with it a range of problems.

3.28 CSG water will be available for a relatively short period of time in any given region, little more than a generation. It is important that the water not be used to develop otherwise unsustainable industries that will later make demands on already allocated sources of water to maintain their activities.

3.29 In its submission to the committee, AP LNG identified a number of issues:

- How the water will be delivered,
- How much water supply can be guaranteed,
- How much demand can be guaranteed,
- How seasonal demand can be managed, and
- How the variability and decline of CSG water production over time can be managed.[16]

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15 QGC, *Submission 259*, p. 10.

3.30 These considerations do not necessarily preclude expanding existing activities or developing new uses, but they do show that it is not a straight-forward option. Any such developments must have regard to the relatively short term availability of this additional water.

3.31 In Queensland, Santos is providing water to a private landowner to irrigate forage crops:

> Farm productivity could be expected to increase 25 fold during CSG water production, and a legacy productivity improvement of 5 fold could be expected to remain once the water production has ceased.
>
> ... That is, the landholder will experience an increase in agricultural productivity while CSG operations are underway, and CSG will leave a legacy of an increase even after water supply has ended.[17]

3.32 This is clearly a productive use of extracted water but it must be understood that landholders who benefit from such arrangements have no call on other sources of water once the CSG industry moves on. If there is a 'legacy' improvement in productivity that is an advantage, but the landholder must be prepared for the decline in income resulting in the withdrawal of CSG water.

3.33 There is a related issue with regard to the regulation and pricing of water supplied by the CSG industry to commercial users. This water is extracted outside the existing water entitlements and regulatory systems applying to all other ground water used in agriculture. These matters are dealt with later in this chapter.

3.34 Gas companies are also using produced water on their own properties. Where major infrastructure is installed, for example storage ponds or compressor stations companies have bought properties and now manage the remaining land as agricultural enterprises. Both Santos and AP LNG provided details of such projects.

3.35 Santos is using produced water to irrigate forage crops and support forestry projects on two properties associated with its Fairview field. AP LNG is developing a range of crops associated with its Spring Gully and Talinga water treatment facilities. Crops include pongamia, a feedstock for bio-diesel production and for fodder, and a range of other fodder crops.[18]

Disposal into surface water

3.36 Untreated water cannot be released into surface water courses. However the committee has received claims that untreated water has been released; for example, in small quantities from low points in gas pipelines. While volumes of such releases

16 AP LNG, *Submission 366*, p. 36.

17 Santos, *Submission 353*, p. 19.

18 Santos, *Submission 353*, p. 19 and *Submission 366*, p. 35.

may be small, where such water is released into intermittent creeks there is a risk of build up of toxic pollutants which will, ultimately, be mobilised by seasonal flows.

3.37 Release of treated water is not straightforward. Matching the quality of released water to that of the surface water is not easy; ironically water can be too clean. The release of water must also match the natural, seasonal flow pattern in a watercourse.

3.38 Companies do release treated water into surface flows under strict conditions. For example:

> Under an agreement with SunWater, a Queensland Government-owned corporation for the Central and Southern Project development areas, QGC will provide treated water into the Chinchilla Weir in the upper Condamine River for beneficial use in a scheme managed by SunWater.[19]

3.39 Similarly, AP LNG releases:

> ... some of the water from the Talinga water treatment facility into the Condamine River. This is done under stringent environment conditions set as part of the Environmental Approval for the Talinga development. The released water meets, as a minimum, Australian Drinking Water standards.[20]

3.40 Queensland's *Coal Seam Gas Water Management Policy* identifies disposal of CSG waters to surface water as a "non-preferred option".[21] Despite this purported commitment to the protection of surface water, the Queensland Government granted a significant number of permits for emergency release of large amounts of contaminated waters into Queenslands rivers and streams during the months following the Queensland floods of early 2011. Given the risk of severe weather events in the coming decades, there is a clear need for a step change in the management of water both in normal and severe weather situations.

Use by industry

3.41 Produced water is used by the CSG industry on site principally for dust suppression and may be supplied to coal companies for dust suppression or washing coal. It is important that where water is used in these ways that it is treated prior to use. The committee has heard claims of residues of water used for dust suppression causing environmental damage and health problems.

3.42 It must be an absolute requirement that no untreated water can be used in any circumstance where there is any run-off.

19 QGC, *Submission 259*, p. 10.

20 AP LNG, *Submission 366*, p.37

21 Queensland Government, *Coal Seam Gas Water Management Policy*, (June 2010), p.2

Regulation and pricing of extracted water

3.43 At present, water extracted by the coal seam gas industry is regulated under the Petroleum and Gas Act not the Water Act. This reflects the fact that the water is not, for the most part, being withdrawn from the aquifers and alluvial sources that supply agriculture and domestic users and is viewed as a by-product of the gas industry. To the industry it is an expensive encumbrance.

> Unlike other water producers and users, coal seam gas producers have no economic incentive to produce water. Water is a by-product of gas production and adds significant capital and operating costs to a gas producer.[22]

3.44 Coal seam gas water cannot, in the end, be separated from other water. As has been said earlier in this report, groundwater and surface water systems are linked. Actions in one area will have impacts in others. The timescales may be slow and difficult to predict but the linkage is real.

3.45 Santos has stated that "Modelling indicates that, at the period of maximum groundwater impact, the vertical drainage from CSG activities, from Gubberamunda, will be minimal at 0.04 megalitres per day".[23] It has also been stated that "...groundwater extraction to reduce the water pressure in the coal seams may induce some vertical leakage into the coal seams and produce impacts on the surrounding sandstone aquifers".[24]

3.46 There is a perception that CSG companies do not pay for the water they extract. This may have arisen because they are operating outside the regulatory system applying to all other water users and do not pay a fee based on the volume of water taken. However, in an answer to a question put by the committee, the CEO of AP LNG stated that:

> We pay a fair bit. We pay between $1.5 million and $2 million a year to the government directly for administration of it, which I would say is not a trivial amount.[25]

3.47 In response to another question Mr Maxon indicated that the company "...do[es] not intend to sell it or try to make it a revenue source".[26]

3.48 It has been suggested that the companies should pay a fee based on the volume of water extracted, which would be reimbursed on the basis of the beneficial

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22 QGC, S*ubmission 259*, p. 9.

23 Santos, *Submission 353*, p.19

24 USQ, *Preliminary Assessment of Cumulative Drawdown Impacts in the Surat Basin Associated with the Coal Seam Gas Industry*, (March 2011), p.1 It has been suggested that vertical movement of water into the Walloon Coal Measures after depressurization could be significant.

25 Mr P Maxon, CEO AP LNG, *Committee Hansard*, 9 September 2011, p.12.

26 Mr P Maxon, CEO AP LNG, *Committee Hansard*, 9 September 2011, p.12.

use of the water, thus giving them an incentive to find uses for the water. Extracted water, its storage, treatment and disposal is already a very significant cost to the companies; it is unlikely that an additional fee would add any extra incentive.

Salt

3.49 The management and disposal of salt and brine is a major concern. As has been described earlier in this report, water produced in conjunction with coal seam gas is generally brackish. There is considerable variation in the salt content from particular gas fields but no one has disputed that the overall volumes of salt produced will be very large. QGC expects to produce more than 4.5 million tonnes of dry salt over the next 30 years while AP LNG estimated that it would produce 3.5 million tonnes over the 45 year life of its projects.[27]

3.50 These are only two of a number of projects. Combining Arrow Energy's estimate for salt production and the National Water Commission's estimate of total water production for the industry provides a range of 37 500 000 to 60 000 000 tonnes over the whole life of the industry. Conservatively, the industry will be handling some 750 000 tonnes of salt per annum. Water purification will also result in a concentrated brine residue.

3.51 At present the Queensland Government's position appears to be that the gas companies are expected to apply their best efforts to finding a beneficial use for salt, for example as an industrial feedstock. However, in the absence of such a use, disposal in an appropriate landfill will be acceptable. For example, QGC stated in its submission that,

> While the QCLNG Project base case suggests that salt will be managed by solar crystallisation with longterm storage of solids in landfill, QGC wants a better salt management solution. In June 2010 the Queensland Government published its Coal Seam Gas Water Management Policy requiring preference be given to "beneficial use" rather than "waste disposal" solutions.[28]

3.52 In evidence to the committee, Mr P Maxon, CEO of AP LNG said,

> We do have the base plan, which is that at a minimum we will concentrate it, segregate it and ultimately dispose of it in controlled landfill. The basis on which we proceed is that if nothing better can come about that is reasonable and doing that does not pose a significant risk.[29]

3.53 The committee has been briefed on a proposal to use brine as a feedstock for the production of table salt, sodium bicarbonate and soda ash. The latter two products

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27 QGC, *Submission 359*, p. 11; Mr P Maxon, CEO, AP LNG, *Committee Hansard*, 9 September 2011, p. 3.

28 QGC, *Submission 259*, p. 11.

29 Mr P Maxon, CEO AP LNG, *Committee Hansard*, 9 September 2011, p. 3.

have a range of uses, including in glass making. QGC has entered into an agreement with Penrice Holdings and GE for the construction and operation of a pilot plant to test this process.

> The GE Penrice BPP is part of a wider initiative by the coal seam gas industry to investigate the technical and commercial viability of producing products such as table salt and soda ash from brine, a by-product of coal seam gas water treatment.[30]

3.54 This is a welcome development but at the same time a cause for concern. The pilot plant will be operational early in 2012. Presumably the process has to be proven and then, having demonstrated that there are markets for the products, scaled up to a commercial level.

3.55 In the absence of any details of the size of the potential markets or the volumes of brine that the plant could utilise, there remains a high degree of uncertainty about the handling of brine and salt by the industry. Until some industrial applications or other disposal options can be found for the salt and brine produced by the industry, storage will be a major issue.

3.56 Reinjection of brine is also frequently mentioned as an option for disposal but, as discussed above, that remains unproven as a practical option.

3.57 Storage of solid salt and brine constitutes a major potential risk to agricultural land and to waterways. The salt could be spread onto adjacent agricultural land either by flood waters, wind or by seepage from even well-constructed storages.

3.58 In a paper provided to the committee, it was pointed out that:

> ... the salt will be highly alkaline made up of sodium carbonate and bicarbonate mixed with sodium chloride salt. The environmental impacts of these mixed salts are substantially more complex than that of ordinary salt.[31]

3.59 The paper went on to identify a number of problems with storage of the salt or the development of a salt harvesting industry and concluded that:

> ... there is also an overwhelming need for the CSG-LNG industry to consider the options for minimisation of the cumulative effects of brine management issues at catchment level (ie, beyond the boundaries of the individual upstream CSG operations) ...[32]

3.60 Queensland's *Water Management Policy* requires brine storage ponds to be constructed to very high standards and have safety monitoring systems built in. The

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30 GE Penrice, Media Release, 24 October 2011.

31 Mr A Arakel, *Brine Management in the CSG Industry- the untold story*, 24 June 2011.

32 Mr A Arakel, *Brine Management in the CSG Industry*

committee notes that AP LNG has developed what the company considers to be a 'fail-safe' design for storage ponds in response to these requirements.

> The selected liner system consists of a dual layer with intermediate drainage. A highly impermeable polymer geomembrane layer forms the uppermost layer. As a contingency in case of a leak developing in the primary liner, a secondary polymer membrane liner is laid underneath. A system for leak detection is used that consists of a pair of probes, one in the stored liquid and one in the surrounding soil, to measure the electric resistivity across the pond liner to detect flaws in the liner which allow the passage of brine.[33]

3.61 It is clear that, at the time of making their submissions to this inquiry, the gas industry envisaged long-term storage and removal of solid salt to approved land fill as the only proven means of handling brine and salt.

Committee view

3.62 Management of the surface and groundwater resources of the Murray-Darling Basin relies on having reliable data on all inflows into, and withdrawals from, the system. Thus all water removed by the CSG industry should be metered and the volumes extracted reported to the Murray-Darling Basin Authority.

3.63 The industry already monitors the flow of water through its wells, thus it should be no imposition on them to require that the volumes of water being produced be reported to the relevant state water authority to ensure that there is a clear picture created of all the withdrawals and inflows within a system.

Recommendation 11

3.64 The committee recommends that all CSG water should be included in the calculation of the total withdrawal from the ground and surface water systems. Seepage into depressurised coal seams, reinjection into regulated formations and virtual reinjection or surface disposal must be monitored and recorded if a complete picture of the state of artesian and sub-artesian water is to be maintained.

Recommendation 12

3.65 The committee recommends that where any aquifer used for the supply of stock or domestic water is depleted as a result of coal seam gas activities, the relevant company or companies should be required to pay for that water at the prevailing rate or make good the loss of water by virtual reinjection or reinjection where water to be reinjected is of an environmentally appropriate standard. The onus should rest with the gas companies to prove that, where an aquifer is depleted, it is not the result of coal seam gas extraction.

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33 AP LNG, *Submission 366*, p. 38.

3.66 The committee considers that produced water offers considerable opportunities to improve the management of groundwater in the affected areas of the Murray-Darling Basin. The use of reinjection or virtual reinjection to 'rest' or replenish stressed aquifers that are heavily used by agriculture, industry or domestic use has the potential to be a significant and unexpected benefit of the industry.

3.67 It is important that treated CSG water is not used to undermine the long-term objectives of getting the use of GAB and sub-artesian water under control and returned to sustainable levels. For example the Santos project to reinject water into the Gubberamunda aquifer must be treated as an opportunity to recharge a depleted aquifer. It is not an excuse for continuing to deplete the aquifer at unsustainable rates.

3.68 Similarly virtual reinjection, by substituting for withdrawal of water from an aquifer, is an opportunity to 'rest' that aquifer. The water available to a licence holder as virtual reinjection must be governed by the same conditions as the licence holder's ordinary entitlement.

Recommendation 13

3.69 The committee recommends that as a general principle it should be established that where a gas company supplies treated CSG water for beneficial use to an existing water user in agriculture, industry or for domestic use that supply must be as a substitute for an existing allocation.

3.70 Where treated water is supplied to landholders (including on a company's own land) to develop a new crop or enhance existing production, that supply should be clearly understood to create no entitlement, above a pre-existing water licence, to water from any other source once the supply of CSG water ceases.

3.71 All the companies that the committee has spoken to have emphasised that they have, or will develop, programs to treat and dispose of extracted water in ways that are not damaging to the environment. Reinjection of produced water has been identified by the Queensland Government as its preferred method of water management. With regard to salt and brine, reinjection and use as an industrial feedstock are the preferred management methods. However, as indicated above, the industry is still seeking to determine the feasibility of all of these options.

Recommendation 14

3.72 The committee recommends that comprehensive water management plans, *and the capacity to implement those plans*, particularly with regard to the disposal of salt and brine, be a requirement before any further production approval for coal seam gas be granted.

3.73 The management of salinity in the Murray-Darling Basin is a priority for the Basin Authority. Given the toxicity of brine and salt, long term storage of brine or disposal of solid salt should not be permitted in an agricultural area.

Recommendation 15

3.74 The committee recommends that all salt and brine residues that cannot be disposed of within the short term, either as part of an industrial process or by safe injection into a suitable aquifer, should be required to be removed from agricultural areas and water catchments. No controlled landfills for the disposal of salt should be permitted in the Murray-Darling Basin.

3.75 In view of the fees paid to government for the use of the water, and the extensive regulatory requirements governing its management, the committee takes the view that there is no need for an additional fee based on the volume of water extracted.

3.76 If at any stage consideration is given to allowing companies to sell water to other users, the state governments should review the charges the companies pay and impose a volume based fee on such water.