Australian Water Recycling
Centre of Excellence

Project Report

National Validation Framework for Water Recycling: Cost Benefit Analysis

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Australian Water Recycling Centre of Excellence

Centre for International Economics, February 2013

National Validation Framework for Water Recycling: Cost Benefit Analysis

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About the Australian Water Recycling Centre of Excellence

The mission of the Australian Water Recycling Centre of Excellence is to enhance management and use of water recycling through industry partnerships, build capacity and capability within the recycled water industry, and promote water recycling as a socially, environmentally and economically sustainable option for future water security.

The Australian Government has provided $20 million to the Centre through its National Urban Water and Desalination Plan to support applied research and development projects which meet water recycling challenges for Australia's irrigation, urban development, food processing, heavy industry and water utility sectors. This funding has levered an additional $40 million investment from more than 80 private and public organisations, in Australia and overseas.

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COMMERCIAL IN CONFIDENCE

FINAL REPORT

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Cost Benefit Analysis

Prepared for
The Australian Water Recycling Centre of Excellence

February 2013

THE CENTRE FOR INTERNATIONAL ECONOMICS
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Glossary

AGWR	Australian Guidelines for Water Recycling
AWRG	Australian Drinking Water Guidelines
CBA	Cost Benefit Analysis
DAFF	Commonwealth Department of Agriculture Fisheries and Forestry
ETV	Environmental Technology Verification
FSANZ	Food Safety Australia New Zealand
FTE	Full Time Equivalent
IPART	Independent Pricing and Regulatory Tribunal
LRV	Long Reduction Value
MBR	Membrane Bio-Reactor technology
NatVal	National Validation
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NPV	Net Present Value
OFWAT	Office of Water Services UK
PV	Present Value
QSEIF	Queensland Sustainable Energy Innovation Fund
SUR	Stormwater and Urban Recycling Fund
SUWC	Stormwater and Urban Water Conservation Fund
UV	Ultra Violet
WICA	Water Industry Competition Act

Summary

Over the past decade there has been a significant growth in the number of recycled water schemes. A key driver of the growth was the severe drought that impacted on water supplies in most jurisdictions throughout Australia. Government policy (both state and federal) also had a bearing on the growth in recycling schemes through grants to projects that were commercially unviable without the subsidy.

Under the Australian Water Recycling Guidelines 2006 it is recommended that recycled water schemes be validated *prior* to the scheme commencing operation. Validation, in this context, is defined as

> The substantiation by scientific evidence (investigative or experimental studies) of existing or new processes and the operational criteria to ensure capability to effectively control hazards.

In a practical sense, validation involves demonstrating the treatment capability of the systems by testing the performance of process trains as a whole and/or the individual unit processes, and/or the technologies that can form components of a treatment train. In this context, validation may involve independent testing of the performance of a technology or reviewing/accepting existing validation reports associated with a technology. For other technologies that are significantly influenced by the site specific characteristics (for example, those involving biological processes) the validation is required to take place on-site. For other technologies, a more generic approach to validation can be undertaken.

This report considers the benefits and costs of a national framework for validating treatment technologies used in recycled water schemes.[1] The scope of this report considers validation of recycled water, as distinct from other types of water, and microbial hazard control, as distinct from validation of, for instance, hazardous chemical control. The report focuses on those technologies that do *not* require on-site validation.

Current and proposed national approach to validation

Currently the regulators in each jurisdiction are responsible for the operational approval of specific recycled water schemes, including approval of the validation studies already undertaken (subject to some independent assessment) and of any on-site validation required.

To the extent that validation does take place, each recycled water scheme typically has to demonstrate validation. Validation is demonstrated with reference to one or a combination of specific process trains considered as a whole. That is, the validation of a treatment barrier needs to take account of the quality of feedwater received (which is

1 This report does not consider the 'optimal' level of water recycling.

reliant on the treatment barriers in earlier stages in the process). In this sense validation of individual treatment barriers reflects the scheme as a whole. Following validation, regulators also require the performance of the scheme to be *verified* involving ongoing monitoring.

The growth in the number of new recycling schemes has placed pressure on the resources of the regulators in each jurisdiction. In some instances informal 'recognition' schemes have arisen whereby a jurisdiction may accept technologies that have already been validated in other jurisdictions in Australia or from overseas regulators in North America and Europe. In these instances, additional work would still be required to assess the validation reports provided, but new validation studies may not be required.

Under the proposed National Validation (NatVal) framework a more formal scheme would be established. It would still take on the intent of current informal recognition arrangements but would seek to introduce greater rigour into the arrangements. Individual jurisdictions would maintain regulatory responsibility and decide which schemes require the components of the treatment train to be validated.

The key elements of NatVal include:

- developing a formal set of principles and protocols to be applied to all acceptable validation studies;
- undertaking new validation studies of technologies according to the developed principles and protocols or reviewing/approving validation studies conducted by manufacturers or other parties against those principles and protocols; and
- developing a database of unit processes and technologies that have successfully been validated and would be accessible to the regulators in all jurisdictions in Australia.

Some level of permanent staffing would be required to perform these tasks on an ongoing basis. Independent experts may also be drawn upon on an 'as needs' basis to provide input into the development of the guidelines as well as assisting in the validation of the technologies.

Number of technologies requiring validation

The number of technologies requiring validation under existing arrangements will depend on a range of factors including:

- the number of *new* recycled water schemes into the future;[2]
- the number of technology choices available. Where there are fewer choices there will be less unique technologies requiring validation. Where there is rapid technological change, this would broaden the potential range of new technologies that could be adopted in the future and would require validation;
- the willingness of scheme proponents to try alternative technologies versus choosing technologies that have previously been adopted. Even if there is a wide range of

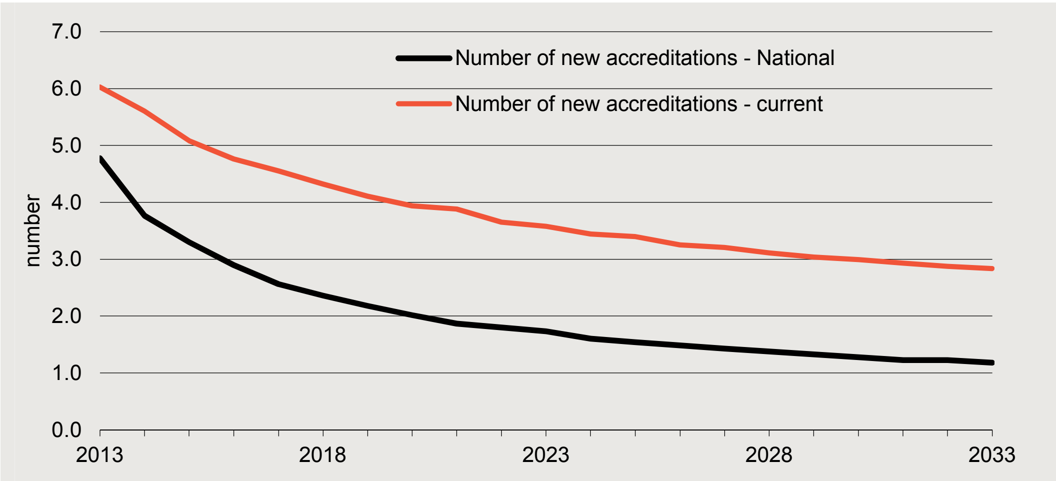
2 Additional validation may also be influenced by the number of *existing* schemes where technologies may be required to be replaced and validated prior to installation. As noted later, we test this assumption as part of the sensitivity analysis.

available technologies, scheme proponents may still choose previously adopted technologies where the operation and maintenance requirements are well understood.

The projection of the number of technologies requiring validation is presented in chart 1. The number of units required to be validated is expected to be around 6 per year initially, declining to around 2.8 per year by 2033. This is based on an assumption of 18 new recycling schemes per year which maintains the same growth in the number of new schemes as occurred over the past 8 years (except for Queensland). The growth pattern has differed in each jurisdiction, with the majority of future growth expected to occur in New South Wales (NSW) and the remainder in Victoria. Queensland has previously experienced significant growth in the number of recycling schemes. However, the 'regulatory simplification' amendments currently being considered in Queensland would effectively limit or slow the need for validation for the majority of Queensland's schemes. We assume that only 25 per cent of future schemes in Queensland will require validation. Based on recent history and stakeholder consultation, we assume no additional technologies requiring validation in the Northern Territory, WA, Tasmania and the ACT over the next 20 years.

Information was sought on the treatment technologies validated in each jurisdiction. Based on information provided by regulators, there are currently 18 treatment technologies that have been validated in Victoria and 8 in South Australia (excluding DAFF and lagoons). We assume that NSW has the same number of treatment technologies validated as Victoria.[3] We assume that technologies that have already been validated by any jurisdiction will be 'grandfathered' to the national scheme.

1 Projected number of technologies requiring validation per year



Data source: The CIE.

The vast majority of new schemes are expected to be smaller schemes such as decentralised systems and 'green building' schemes. Based on this we expect that natural technologies are less likely to be used. Membrane filtration, UV disinfection, Membrane Bio-Reactor (MBR) technology, reverse osmosis, ozonation and chlorination are likely to

3 This reflects the strong information sharing that exists between the regulators in these jurisdictions.

be the main types of technologies used in these schemes. Chart 1 assumes that new schemes will have three treatment barriers which is common in smaller schemes.

We assume that there will be no additional validation of treatment technologies associated with existing schemes, only new schemes. In the sensitivity analysis below we consider alternative assumptions relating to technology replacement in existing schemes that could require validation.

Under the national scheme there is expected to be fewer new technologies requiring validation than under current arrangements. This reflects the current arrangements where the same technologies would require validation in multiple jurisdictions. This assumes that there is limited recognition of validation between jurisdictions. Technologies are assumed to only be validated once a scheme is proposed. That is, there is no upfront validation, irrespective of whether the technology will be used.

We assume a 1 per cent rate of growth in the number of new technologies in each year. Despite this, over time the number of technologies required to be validated declines reflecting the fact that once a technology is validated it no longer requires validation. That is, there is a pool of possible technologies available for selection and over time, as more technologies get validated, the pool of unvalidated technologies declines.

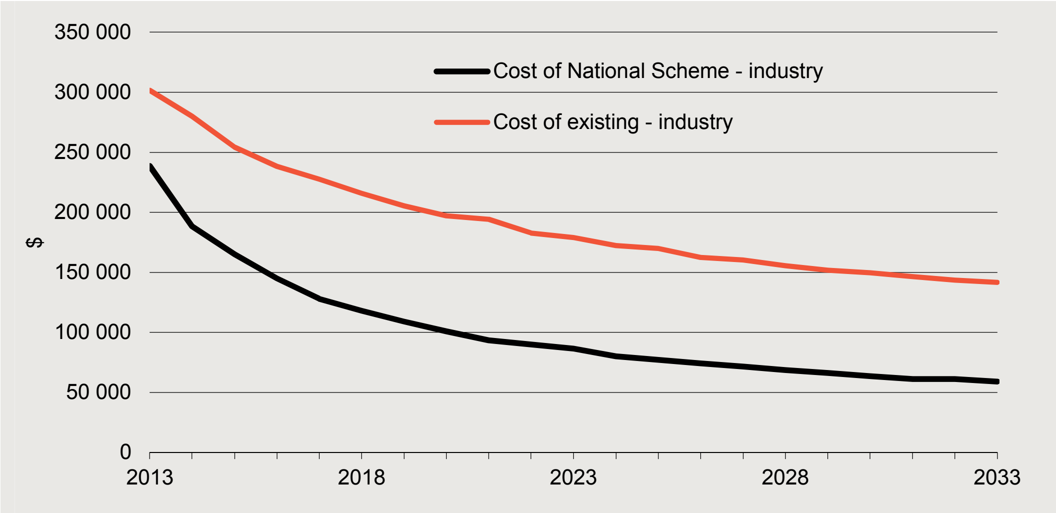
Expected net benefits

Net benefits from removing duplication

The national approach is expected to deliver cost savings by reducing the duplication of effort amongst individual jurisdictions. The pooling of expertise into a central body is also expected to deliver a more rigorous and accurate assessment of the performance of the technologies in the treatment train.

Chart 2 presents the expected cost to manufacturers and utilities of undertaking validation studies of technologies. The cost differences reflect the differences in the number of units requiring validation.

2 Cost to industry of validating technologies, current approach and NatVal



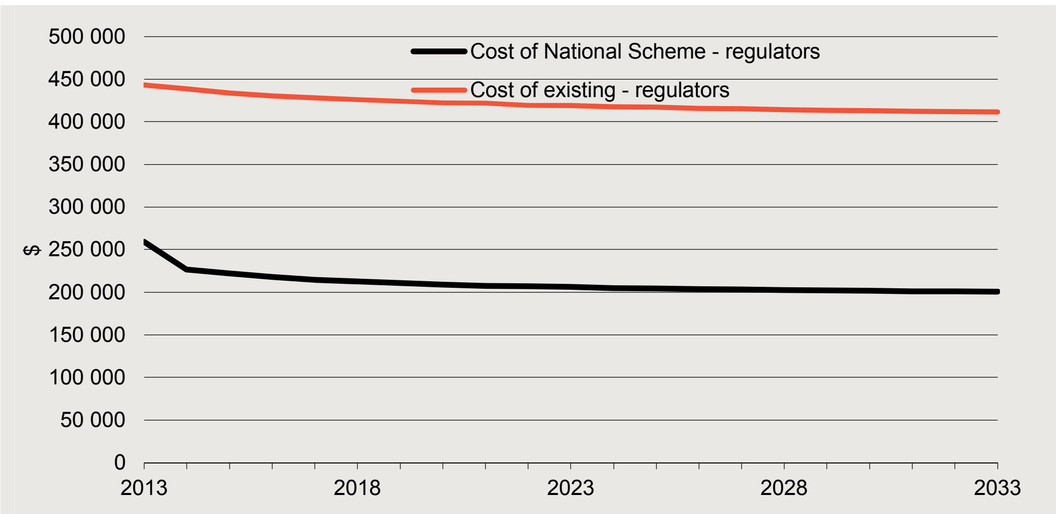
Data source: The CIE.

Chart 3 presents the costs to regulators under current arrangements and under NatVal. Under current arrangements there are approximately 3 Full Time Equivalents (FTEs) undertaking validation related tasks. Under NatVal we assume that 1.5 FTEs would be required for a national body. We assume the same remuneration package under both schemes of $115 257 (equivalent to an Australian Public Service EL1).

Apart from staffing there are other ongoing operating costs under both schemes (such as rental of office space) that are fixed irrespective of the number of units required to be validated in a given year.

Under the current approach and NatVal there are also the variable costs of engaging independent assessors. These costs depend on the number of new technologies requiring validation. These costs are assumed to be the same under the current arrangements and NatVal.

3 Cost to regulators under current approach and NatVal



Data source: The CIE.

Under NatVal there are also once-off setup costs such as the refurbishment of new office space which is estimated at approximately $22 000, based on the floor space required for 1.5 permanent staff.

In aggregate the cost difference for industry and regulators between the current approach and NatVal noted above results in a net benefit to industry of approximately **$0.97m** in Net Present Value (NPV) terms from reducing the number of validation studies required to be undertaken. There is also a net benefit to regulators of **$2.28m** in NPV terms from a lower level of resourcing under NatVal compared to current arrangements and the level of resourcing remaining fixed, irrespective of changes to the number of units requiring validation over time. In aggregate this results in a net benefit of **$3.25m** in NPV terms. This reflects the greater number of staff assumed under the current national architecture.

Net benefits from pooling knowledge

The national scheme is also expected to reduce the upfront capital and ongoing operating costs of new recycling schemes or generate health benefits from the pooling of knowledge into a single organisation. This is expected to deliver a more robust and accurate reflection of the pathogen removing performance of a technology as encapsulated by the default Log Reduction Value (LRV) credits issued for the technology. These cost savings are less certain, although could be much greater if they materialise.

This could be expected to deliver health benefits to the community by accurately estimating the performance of all technologies in the treatment train in terms of their ability to remove viruses and protozoa. That is, the quality of water produced by recycling schemes may be above or below the standard in the guidelines. The magnitude of the potential health benefits is difficult to measure given the limited knowledge of the current impact of recycling schemes on health outcomes.

Alternatively, a more accurate estimation of the performance of a technology has the potential to reduce capital and expenditure requirements of schemes where current schemes are 'over-engineered'. That is, under the current validation approach the LRV credits issued are likely to be more conservative for particular treatment technologies and each treatment barrier is built to a higher standard than required to achieve the total LRV credits for virus and protozoa as prescribed in the Australian Recycled Water Guidelines. Different default credits can also arise from validating the performance of the treatment train rather than the individual components - the theory being that the LRV credits for the whole treatment train may be greater than the sum of the parts.

Given the challenges of measuring the health benefits, we estimate the net benefits from pooling knowledge using the second approach, the downsizing of treatment barriers. Based on stakeholder consultation and analysis we assume that the savings are generated from higher LRV credits being issued for MBR technology, broadly equivalent to that currently issued by US regulators and similar to that issued by the South Australian Department of Health (although still lower than the performance demonstrated in some laboratory testing). This is expected to lower the capital and ongoing operating costs of new schemes, with the quantum of this reduction dependent on the flow capacity of new schemes and the current approach to validation in each jurisdiction.

This is expected to deliver net benefits of approximately **$8m** in present value terms for smaller schemes and **$80m** if all future schemes were medium sized schemes. The cost savings will differ between jurisdictions depending on their current validation approaches. For example, capital savings of $32 000 per scheme are possible in Victoria for small schemes and approximately $180 000 per scheme for medium sized schemes are expected to be possible under the Framework. In addition to this there are operating cost savings which vary depending on the size of the schemes (between $5 000 and $55 000 in Victoria). The capital and operating cost savings are smaller in other jurisdictions based on their different (current) validation approaches.

These estimated benefits are likely to be on the low side for a number of reasons:

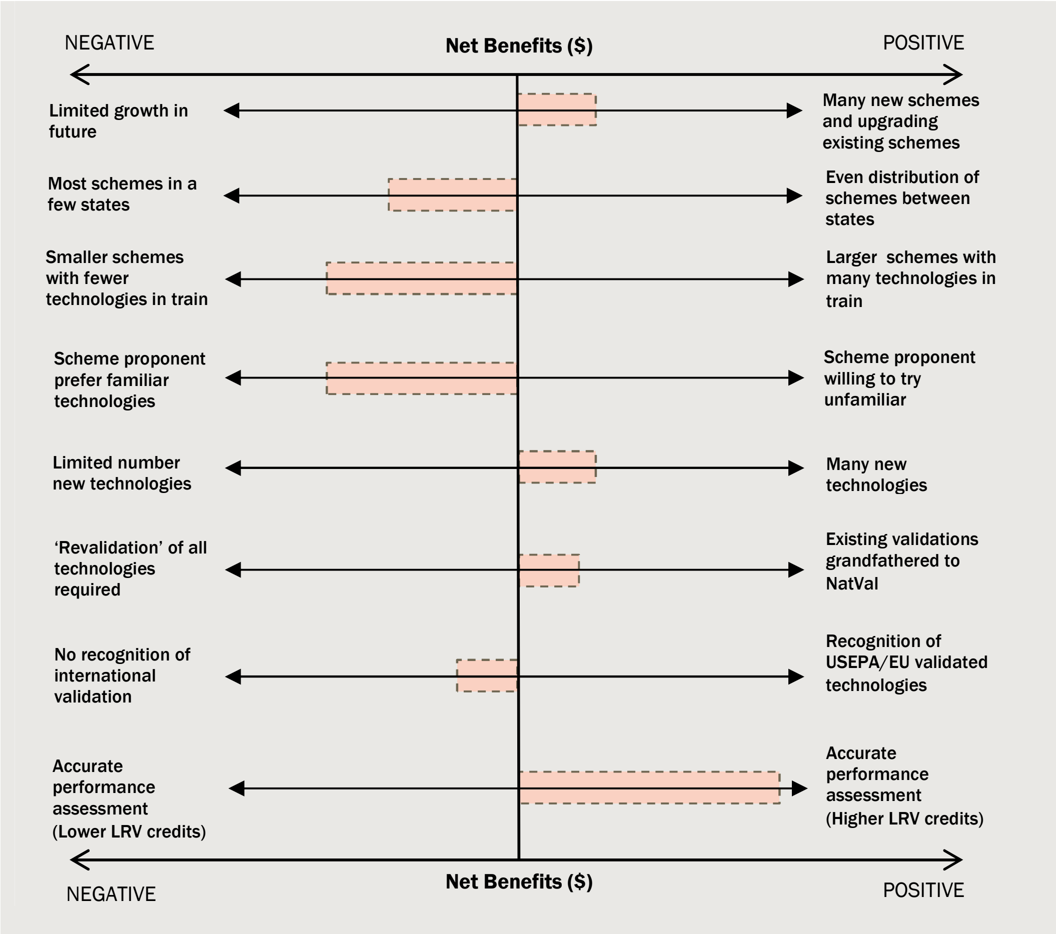
- The savings only relate to more accurate assessment of performance of MBR technologies in reducing protozoa. There are also potential cost savings from improved assessment of the virus reduction performance of MBRs.
- The savings assume that there is no opportunity to completely remove a treatment barrier, such as the UV barrier, only a 'downscaling' of the capacity. In practice there are likely to be opportunities to completely remove one treatment barrier.
- There are other technologies (not just MBRs) where the current assessments may not reflect the actual pathogen removal performance of the plants. For example, the performance of multiple barriers in combination may be greater than that of the sum of the individual components. The Centre has already commissioned a separate study to investigate this issue.

Conclusions

Based on our assessment, NatVal is expected to deliver net benefits of between **$11m** and **$84m** from adopting a nationally consistent approach to validating water recycling technologies. The expected benefits are largely due to potential cost savings from the pooling of knowledge resulting in a more accurate assessment of the pathogen removing performance of the treatment technology. In addition, there is expected to be net benefits from reducing duplication to industry and regulators. The magnitude of the benefits is likely to be relatively modest based on expectations of the future number of technologies that would require validation and the expectation that growth will largely be driven from NSW and, to a lesser extent, Victoria.

There is some uncertainty pertaining to a range of factors that could influence the magnitude of the net benefits. Chart 4 considers some of the factors that are central to the success of NatVal, which are each uncertain to some degree.

4 Drivers and possible range of net benefits



Data source: The CIE.

Based on our assessment:

- There is estimated to be some new schemes expected over the next 20 years, although fewer than that over the past 8 years for Queensland. Regulatory simplification arrangements in Queensland are expected to exclude most schemes (except larger schemes) from requiring treatment technologies to be validated. The assumption of the historical growth rate in other jurisdictions is likely to be on the high side, given the relaxing of the drought and the significant recycling investments already occurred.
- Most of the growth is expected to arise in NSW, with some schemes in Victoria and South Australia. Currently, 47 per cent of future growth is assumed to be in NSW, 30 per cent in Victoria, 9 per cent in Queensland and 3 per cent in South Australia. This diminishes the value of a national scheme, given that there is not likely to be significant duplication of effort if most of the growth is expected in one or two jurisdictions.
- It is expected that the growth over the next 20 years will arise from smaller schemes which use relatively few technologies in the train and are more inclined to adopt existing technologies that have already been validated.
- There is expected to be some new technologies entering the Australian market that will be required to be validated but this growth is expected to be moderate given the

relatively small size of the Australian market. There are expected to be a greater number of advancements to existing technologies that will not be required to be separately validated.

- It is expected that existing technologies that have already been validated by any jurisdiction will transition to the national scheme. Where this does not occur it will generate higher costs under NatVal given that existing validated technologies will require 'revalidation'.
- It is expected that there will be no recognition of technologies validated by the Environmental Technology Verification (ETV) schemes in the US and the European Union. This will mean a higher cost under NatVal, given that there is already some recognition under the existing state based schemes.
- It is expected that under NatVal there is likely to be a more accurate assessment of the performance of particular technologies,lowering the cost of schemes.

As highlighted in the chart 4, many of the drivers in the model suggest lower, rather than higher net benefits from a national validation scheme. The main exception to this is the ability to more accurately measure the performance of technologies which we believe will be the main driver of higher net benefits from the national approach.

There are potential benefits of extending the scheme to other sources of water such as stormwater. These are not expected to result in significant benefits, although the additional costs are also small. Therefore, we believe that there is merit in extending NatVal to cover stormwater sources, to pre-empt potential future validation by individual jurisdictions, where the potential duplication of effort can be avoided upfront by extending NatVal at a relatively modest marginal cost.

Sensitivity analysis

Sensitivity analysis conducted on alternative assumptions for these drivers and associated net benefits results are presented in table 5 (compared to the $11m noted above, assuming all schemes are small schemes with a flow capacity of 0.5ML per day). As noted earlier the potential capital and operating cost savings are expected to be significantly larger for new schemes in the future with greater flow capacity.

The sensitivity analysis indicates that if the annual growth rate in the number of schemes is slightly above or below that which occurred over the past 8 years, there would be some relatively minor change in the net benefits. However, it there are substantial changes like a 50 per cent reduction in the number of schemes each year in NSW compared to the recent past, then this would substantially diminish the net benefits (although they are still expected to be positive).

5 Sensitivity test

Sensitivity test	Revised net benefits $m
S1. Change in number of future schemes	
▪ S1.1. Assume all future recycling schemes in Qld will be subject to validation (base model assumes 25 per cent of schemes)	$11.3
▪ S1.2. 50 per cent increase in number of schemes in Vict, SA and WA due to growth in aquifer recharge	$13.6
▪ S1.3. 5 per cent per annum of existing schemes replace all treatment barriers	$18.1
▪ S1.3. 50 per cent reduction in future schemes in NSW reflecting change in drivers that diminish the growth rate in new schemes.	$9.3
S2. Increasing the average number of technologies in the treatment train from 3 to 4 per scheme	$11.3
S3. Increasing the annual growth rate in new technologies from 1 to 5 per cent per annum (and the same technology redundancy rate)	$11.2
S4. Assuming all technologies already validated by any jurisdiction to require 'revalidation' in the form of a review under NatVal (ie no grandfathering)	$10.2
S5. Alternative staffing levels	
▪ S5.1.Increasing in current regulator resources to 8 FTE, instead of 2.7	$18.4
▪ S5.2. Increasing NatVal from 1.5 to 4 staff (with no extra burden on state regulators)	$7.5
S6. Discount rate 4 per cent and 10 per cent	$16.7 - $7.7

Source: The CIE.

If existing schemes require upgrading then this could significantly increase the net benefits from NatVal. For example, if 5 per cent of existing schemes require upgrading in each year this increases the net benefit to $18.1m in NPV terms. This is largely the result of the pooling of knowledge leading to a reduction in the cost of upgrading for each scheme. This is likely to be a central determinant of the potential net benefits.

Changes to the assumptions regarding resourcing levels can also materially impact on the net benefits. If the current FTEs dedicated to regulation is higher than that required under NatVal then there are potential administrative cost savings from moving to the national framework. For example, if 8 FTEs are currently required to administer the state based regulatory approach then the net benefits rise to $18.4m in PV terms. Further, if the resourcing levels under NatVal are required to increase (from 1.5 FTEs to 4 FTEs) the net benefits fall to $7.5m in PV terms.

Where NatVal requires all technologies that have already been validated by each jurisdiction to be revalidated then this will increase the cost of the scheme, lowering the net benefits to $10.2m. Changes to the assumptions surrounding the number of technologies in the treatment train and technological growth rate do not substantially change the net benefits.

Implications for institutional structure

The results of the analysis provide some guidance on the institutional structure. In particular, given the uncertainty regarding a range of factors, the institutional structure needs to be flexible to the changing conditions. Having a relatively large amount of costs that are fixed (for example, permanent staffing costs), irrespective of the number of units requiring validation, could mean a higher level of redundant staff. This would appear to be the case under the analysis presented in the report – the number of units requiring validation declines over time but the assumed staffing levels under NatVal remain constant.

Further, where there are large setup costs, this would diminish the net benefits gained from removing the duplication of effort amongst jurisdictions.

It is possible that, at a later stage, the number of technologies required to be validated could increase significantly due to technological change or extending NatVal to drinking water schemes and to recycled stormwater projects. If this eventuates, then a 'large' architecture such as the Food Safety Authority and National Industrial Chemicals Notification and Assessment Scheme (NICNAS) could be considered at that stage.

The timing of which technologies are selected first on the NatVal database is also important to ensure that there is not competitive advantage given to particular organisations. Without careful consideration the database could inadvertently lead to a reduction in competition where some technologies are given a 'first movers' advantage.

Consideration should also be given to whether there are alternative ways of pooling knowledge that can result in lower scheme costs, without the need to establish a national body to manage the process. That is, whether there are cheaper ways for existing jurisdictions to come together to pool knowledge.

1 Introduction

Over the past decade there has been a significant increase in the number of water recycling schemes. The increase in the number of schemes has also been accompanied by a shift in the risk management approach to regulating water recycling schemes.

The need for validation arises from the acceptance and implementation of the Australian Guidelines for Water Recycling (AGWR) and the need to protect public health. Based on the principle of preventive risk management, the AGWR requires treatment processes to be validated prior to the operation of the water recycling scheme. This approach shifts the focus from end point monitoring to process barriers and the operational monitoring of those barriers. In the case of pathogens, end point monitoring is expensive and does not identify water quality issues until potentially well after the public have been exposed.

This CBA evaluates the proposed NatVal framework for validating individual treatment process barriers and preventative measures used in the production of recycled water. Validation occurs through the substantiation by scientific evidence (investigative or experimental studies) of existing or new treatment technologies and the operational criteria to ensure capability to effectively control hazards, prior to installation in a water recycling scheme.

Current and proposed national validation approach

The validation of the individual technologies is currently the responsibility of the individual jurisdictions. Each jurisdiction may have a slightly different approach to validating technologies. The default LRV credits issued for the separate technologies may also differ between the jurisdictions.

The idea of establishing a NatVal framework arises in response to the current complexity and perceived inefficiency of water recycling validation across Australia.[4] Not only do regulations differ between jurisdictions, but even within jurisdictions requirements can differ between state and local government, between local government areas and between the private and public sector. For instance, it is argued that in the past, regulators have differed markedly in the extent to which professional judgement can be permitted as distinct from empirical science. Technology providers are acutely aware of this and have to tailor and adapt their tenders to suit the particular markets.

4 Attachment B provides a discussion on the common arguments used for a national regulatory approach compared to a state level framework.

In addition, there is currently no process for national recognition of validation activities undertaken either overseas or as part of approval processes within Australia.[5] Therefore, the idea of a NatVal framework is to minimise unnecessary costs and duplication and, to the extent that differences are required, provide transparency around those differences. It is not designed to directly influence the health/environmental performance of new or existing schemes, although this may be an indirect impact.[6]

A national validation approach is also expected to bring greater uniformity in the approach to validating treatment technologies. This will include having a consistent protocol to validate technologies and approach to validating technologies that will lead to consistent default LRV credits being adopted. Each jurisdiction will still be responsible for the validation of technologies and may choose a different approach than that issued by a national body.

The NatVal framework is initially focused on technologies for treating municipal/domestic sewage for specific urban uses, dual reticulation and irrigation of horticultural products. At a later stage, the NatVal framework may be extended to different water sources (such as stormwater) or end uses (for example, extended to drinking water). Further, the NatVal is only intended to apply to specific technologies that do not require 'in situ' validation (i.e. on a case-by-case basis).

This project

The CIE has been engaged to conduct an economic appraisal, in the form of a Cost Benefit Analysis (CBA) of the proposed National Validation (NatVal) framework.

The role of the CBA is to evaluate the merits of the national validation approach and whether or not it would result in a net benefit to the Australian society. The results can also provide guidance on alternative institutional architectures that can best realise these benefits but do not have a significant cost burden that would outstrip potential benefits.

Attachment A provides an overview of and the key steps involved in a CBA.

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5 Although, as noted later, individual jurisdictions may already accept validation protocols from overseas jurisdictions.

6 As noted later, this will be challenging to measure, particularly where the validation protocols proposed for a technology are not in place.

2 *Expected number of technologies to be validated – Baseline and NatVal*

The expected number of technologies that require validation will depend on a range of factors including:

- the number of existing schemes where validation of existing treatment technologies may be required; and
- the number of water recycling schemes expected in the future, which depends on:
  - the number of technologies in the treatment train;[7]
  - the number of existing technologies that have already been validated or have validation reports approved by the individual jurisdictions; and
  - the number of new treatment technologies expected to become available in the future.

Existing schemes

There are likely to be a range of existing schemes that require technologies to be replaced as part of their periodic maintenance schedule. There are also likely to be existing schemes that require upgrading either because the schemes currently do not meet the standards specified in the Guidelines or there is a change in the use of the recycled water which may now include human exposure.

For this study we have built up a database on water recycling schemes across Australia from publicly available data sources and data sourced from jurisdictions. It is based on the database compiled in the Radcliffe study and includes recycling schemes listed from an additional six sources (Appendix C).[8]

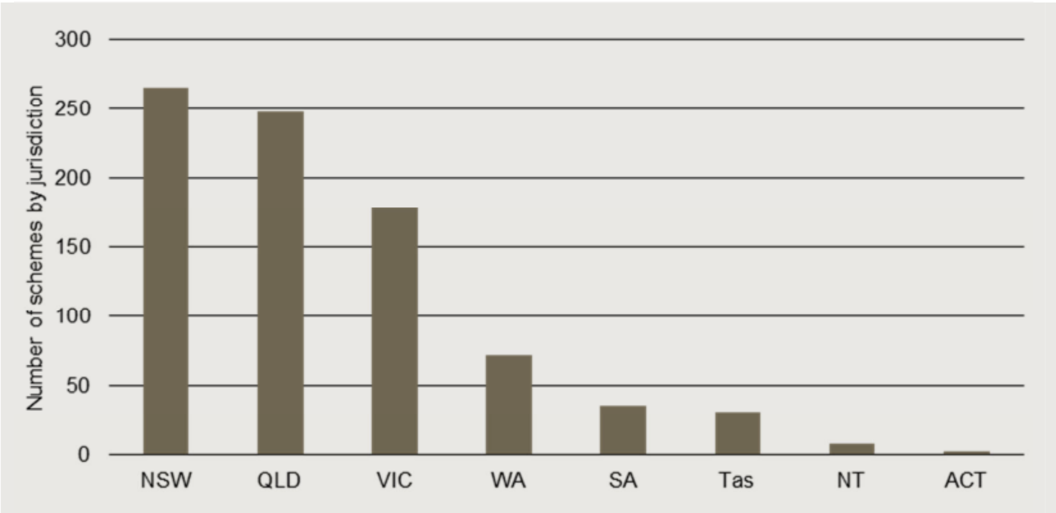
There are 815 reported schemes listed in the database. These are schemes predominantly based in New South Wales, Queensland or Victoria (figure 2.1). Out of the seven main data sources, only the Radcliffe study is comprehensive across all Australian jurisdictions

7 This will also depend on the LRV credits issued to each technology as well as the total LRV credits required under the Australian Recycled Water guidelines. For example, where higher LRV credits are issued for each technology type this would mean fewer treatment barriers would be required to meet the standards set by the Australian Recycled Water guidelines.

8 The constructed database pulls together available data on water recycling schemes across Australia. However, there are substantial gaps in the data. For instance, data on schemes in Western Australia, Northern Territory, the Australian Capital Territory and Tasmania is over ten years out of date. Because New South Wales has the most comprehensive data, information gathered from the data, such as treatment types and water uses, is biased towards the situation in New South Wales.

and the only data source for water recycling schemes in Western Australia, Tasmania, Northern Territory or the Australian Capital Territory. While the database is likely to be the most comprehensive listing of water recycling schemes currently available in Australia, there are likely to be gaps and some inconsistencies from pooling information from multiple sources. Nevertheless, it provides a sufficient basis from which to base our analysis.

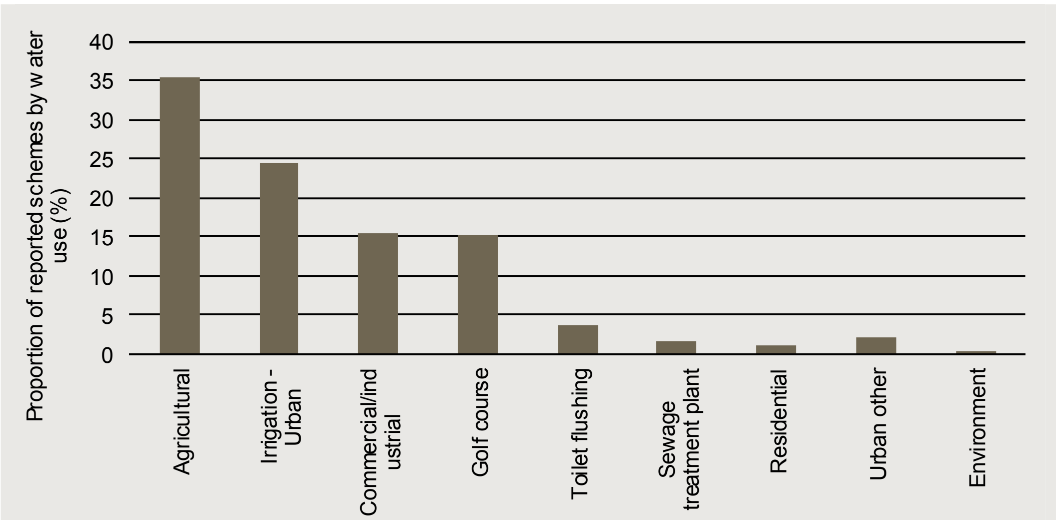
2.1 Reported water recycling schemes by jurisdiction



Data source: The CIE sources listed in Attachment C. Data for Western Australia is based on Marsden Jacob (2012, p55)

Of the 815 schemes, 662 reported the use of the recycled water. Approximately 35 per cent of these schemes treated water for re-use in agricultural purposes. The second highest reported use for schemes was for urban irrigation including irrigation of town parks and gardens and school ovals (chart 2.2).

2.2 Reported schemes by water use



Note: Urban other includes water uses such as pool backwash, roadworks, dust suppression, and tanker service. Irrigation – Urban includes water uses such as irrigating sports fields, parks and gardens, school ovals, and town amenities.

Data source: The CIE sources listed in in Attachment C, including for Western Australia.

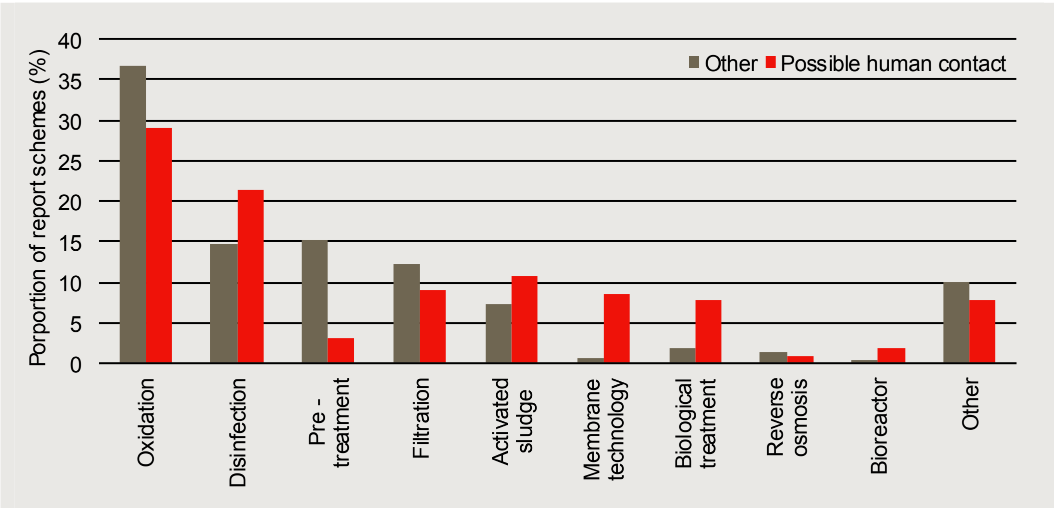
Of the 815 schemes, only 275 reported the water source and 74 per cent of the latter related to wastewater.

An individual scheme generally combines multiple treatment types to achieve the desired water quality. The 'treatment type' is only reported for 280 schemes in the database, leaving 64 per cent of reported schemes without known treatment type. Given this, we present the share of treatment technologies, rather than actual number of technologies.[9] Treatment types were grouped into ten subgroups. The oxidation sub-group[10] accounted for approximately 34 per cent of all treatment types, followed by the disinfection[11] sub-group which accounted for approximately 17 per cent of reported treatment types.

Chart 2.3 presents the treatment types utilised in schemes where there was a possibility of human contact with re-used water. Water 'uses' listed for schemes was used to identify the possibility of human contact and included uses such as irrigation of golf course and local sports fields, residential use, toilet flushing, dual reticulation and horticulture.

The treatment types used vary slightly depending on whether there is a possibility of human contact with the reused water. For example, there is a greater use of treatment types from the disinfection, membrane technology and biological treatment subgroups when there is a possibility of human contact (chart 2.3).

2.3 Proportion of treatment types by subgroup



Note: Alignment of treatment types to subgroups is provided in Attachment D.1.

Data source: The CIE sources listed in in Attachment C, including for Western Australia.

The mix of treatment types varies across jurisdictions which is likely to reflect the different types of schemes in each jurisdiction. Chart 2.4 presents the reported treatment

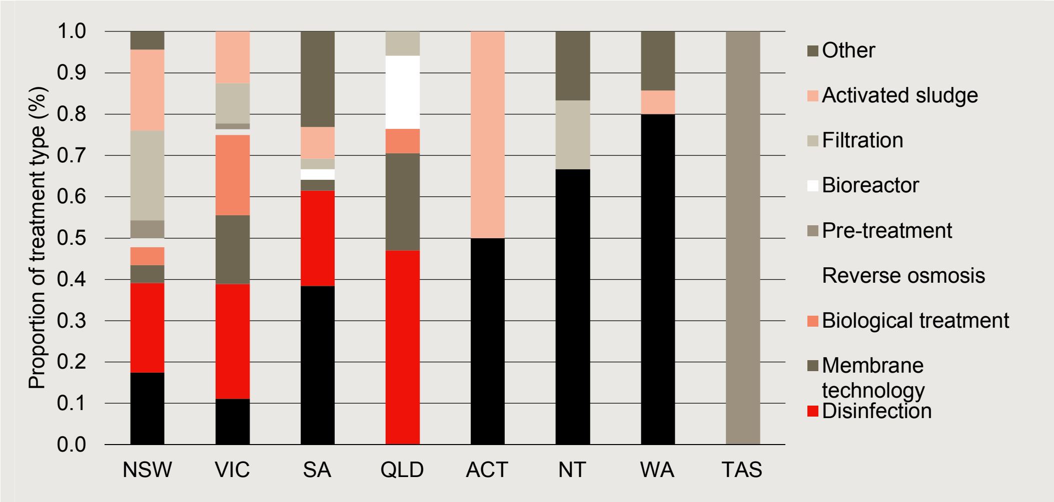
9 This assumes that the treatment types in the 280 schemes are a representative sample.

10 The oxidation sub-group includes treatments listed as oxidation pond, oxidation ditch, aerated lagoon, maturation lagoon, facultative lagoon, lagoon, polishing lagoon, balancing lagoon, aerated pond and extended aeration.

11 The disinfection sub-group includes disinfection, UV disinfection, chlorine disinfection, chlorination, UV technology, primary chlorine disinfection, oxidative UV disinfection, secondary chlorine disinfection and UV.

types for schemes where the end use has some human contact. In NSW, for example, approximately 18 per cent of reported technologies were described as 'oxidation' compared to almost 40 per cent in South Australia. The oxidation subgroup accounted for a high proportion of treatment types used in Victoria, the Australian Capital Territory, Northern Territory and Western Australia, but was not used by reported schemes in Queensland or Tasmania (chart 2.4). The disinfection treatment subgroup was not reported to be used, or used rarely in the Australian Capital Territory, Northern Territory, Western Australia and Tasmania.

2.4 Proportion of treatment type subgroups — possible human contact



Note: Alignment of treatment types to subgroups is provided in D.1.

Data source: The CIE sources listed in Attachment C, including for Western Australia.

While the database provides a reasonable basis to understand the existing schemes and their characteristics it does not provide information on the current performance of the schemes (relative to the Guidelines). This information is not readily available and would require some effort for the regulators in each jurisdiction to compile this information. Even if this information was available it is not clear that regulators would require the schemes to be upgraded.[12] There is also limited information for us to assess the extent to which existing schemes may be upgraded to reflect changes in the reuse of water to include uses where there is possible human contact.[13]

12 The exception to this is likely to be if there is a major water quality incident. However, given the lack of evidence to date of such incidents we would anticipate that the chances of such incidents to be extremely low. It is possible, however, this merely reflects the difficulty of observing the health impacts from the recycled water compared to the many other factors that could also be contributing to the health impact.

13 There are some examples of proposed upgrades to the existing wastewater treatment plants such as the Ballina and Lennox Heads treatment plants (constructed in the 1970s) in northern NSW that are currently at capacity and could potentially be upgraded with recycled water treatment facilities that would enable dual reticulation in nearby developments.

Many replacement of assets are often on a 'like-for-like' basis.[14] Therefore, we assume that additional validation of the same technology would not be required. Based on stakeholder consultations, existing UV disinfection technologies are not required to be upgraded (although lamps, for example, will require regular upgrading).

Further, many of the smaller rural schemes typically involve standard combinations of secondary treatment, storage lagoons and chlorination (such as in South Australia). Unless there is a substantial increase in the quality of water required to be produced from these schemes, there is unlikely to be a substantial change in technology. The ability to fund the upfront capital and ongoing operating costs associated with upgrading the technology is also an issue for these smaller schemes.

For the purposes of our analysis we assume that there are no additional validations arising from the existing schemes. Alternative assumptions are tested in the sensitivity analysis.

Future number of water recycling schemes

Over the past decade there have been a range of drivers that have led to a significant increase in the number of recycling schemes. Table 2.5 provides an estimate of the historical growth in schemes where the end use involves some level of human exposure, based on the dataset discussed in the previous section.[15] This is for all sources of water.

14 For example, in 2009 as part of its routine replacements of membranes the Douglass Shire Council chose to use the same membranes as previously used because "no other manufacturer of membrane systems is able to supply membrane modules that are interchangeable with the KMS cartridges. Replacement membrane modules therefore need to be sole sourced from Koch Membrane Systems."(Ordinary Meeting notes, 28 October 2009, p2).

15 The dataset prepared does not provide a date for when the schemes commenced operation. However, the dataset provides two points in time, the Radcliffe dataset as at 2004 and the current dataset.

2.5 Growth in wastewater recycling schemes with human contact

Jurisdiction	2004-2012	Historical growth per annum (all source water)	Expected future growth per annum (wastewater only)
	no.	no.	no.
NSW	97	12.1	8.4
VIC	62	7.8	5.4
Qld	77	9.6	1.7[a]
WA	20[b]	2.5	1.8
SA	7	0.9	0.6
TAS	na	na	na
ACT	na	na	na
NT	na	na	na
Average	263	32.9	17.9

a Assuming that, under the regulatory simplification approach, only 25 per cent of future schemes will require technologies to be validated.

b For Western Australia the growth rate may be overestimated due to the necessity to draw on additional data sources.

Note: na means data not available for jurisdictions.

Data source: The CIE sources listed in Attachment C.

There is a range of potential drivers of this past growth. The drought over much of the past decade has been a key driver, with recycling schemes seen as part of a portfolio to meet water security objectives. In some cases, water recycling schemes have been introduced by water utilities as a way of avoiding costly upgrades to trunk mains and existing sewage treatment plants. In NSW the Basix programs (introduced in 2004) have also provided an incentive for new residential (and commercial) developments to introduce recycling so as to meet the water conservation targets for the site. Other factors that have contributed to the growth in historical schemes included the substantial government subsidies for the capital costs of the schemes.

The extent to which future growth will reflect past growth will depend on the extent to which the drivers noted above will continue. There have been changes to the drivers noted above that would mean that future growth may not reflect past growth. The key changes include:

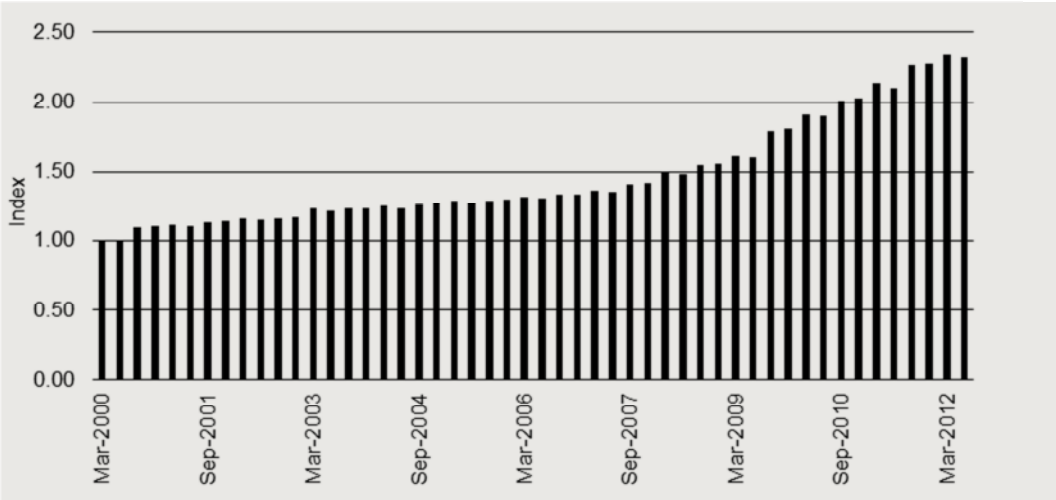
- The drought has ended in most jurisdictions and, while drought is a recurring phenomenon, the probability of another drought equivalent to the so-called Millennium Drought is very low.
- Security of supply is less of a concern currently in the major cities (with the exception of Perth). Storage levels in these centres are high and there have been significant investments in water security measures many of which have only recently been completed and others that have been switched off. There is also currently an oversupply of recycled water schemes. However, for smaller centres the storages can deplete rapidly and these centres are more likely to require additional water security measures in the near future.
- Many of the past schemes have relied on Commonwealth and State government funding to support their construction. The Government programs are nearing completion. At this stage it is unlikely that similar funding programs will commence

in the near future given the current budgetary concerns. Many schemes are unlikely to be viable without Government support (see Appendix E).

- The Queensland Government has recently proposed regulatory simplification legislation which would limit the requirement for validation for smaller schemes.
- In Sydney Water and Hunter Water Corporations' areas of operation, developer charges no longer apply. This reduces the cost for developers to connect to existing wastewater networks and reduces the incentive to introduce recycling facilities.[16]

Rising electricity prices has also been a factor that is likely to have diminished the commercial viability of recycled water schemes, particularly smaller schemes that pay the retail price for electricity. For smaller schemes the annual electricity costs are in the order of 20 per cent of annual operating costs.[17] Chart 2.6 presents a trend of the growth in retail electricity prices over the past decade.

2.6 Retail electricity prices, Australia, (index)



Note: Index numbers of average retail electricity price across Australia.
Data source: ABS 6401.0 Consumer Price Index, Australia,

These factors would imply that historical growth rates are likely to overstate future growth rates.[18] However, there are a number of factors that would encourage new

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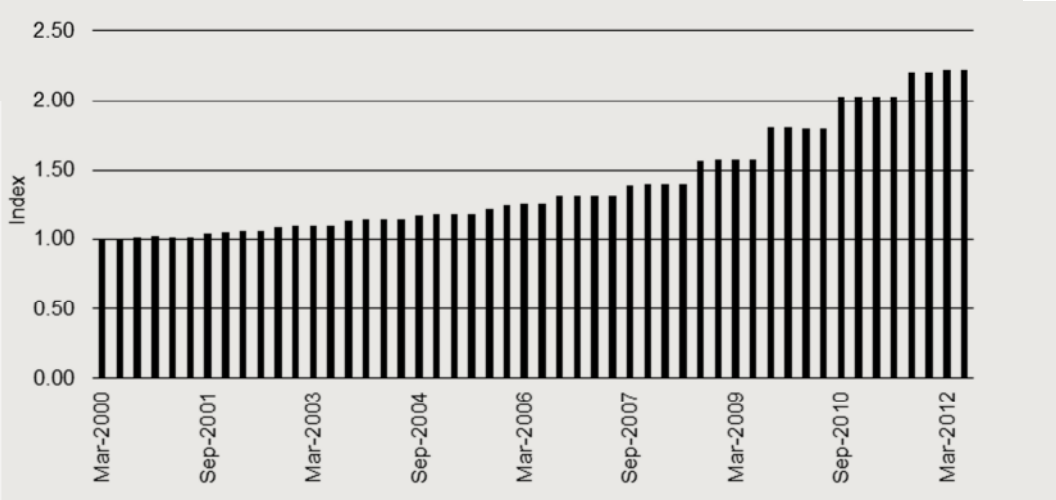
16 CIE (2011) provides information regarding the various taxes and charges that impact on the housing sector in each jurisdiction.

17 For the 1 ML per day facilities considered for Doncaster Hill, for example, the power consumption of the plant is between 1030 to 2230 kWh per day depending on the treatment train chosen. See Yabbie Pond (2010).

18 Consideration is also currently being given to amending the green buildings requirements where recycled water plants would be required to operate in order to receive green star ratings. Currently the ratings are based on the construction of the plant, irrespective of whether it is operated. A forthcoming study in Melbourne commissioned by the Victorian Health Department indicates that many recycled water schemes in green buildings are not operating – of the 14 respondents to the survey, 5 had been switched-off completely for the previous 3 months and 4 were still in the commissioning phase. The Basix program in NSW is also currently under review and could result in less stringent water saving requirements.

schemes to develop. The rising price of potable water, for example, would make recycled water schemes more competitive as an alternative source of water.

2.7 Increases in price of potable water



Note: Index numbers water and sewerage.
Data source: ABS 6401.0 Consumer Price Index, Australia,

On balance, we have used the historical growth rates noted above as a basis for projecting forward, however, we have made adjustments to the estimates for Queensland to reflect the fact that the regulatory simplification proposals would only require large schemes to be validated. Further, the plumbing code currently does not allow recycled water plants in buildings to release water to the sewer. There is also significant excess capacity of recycled water with South East Queensland Water's Western Corridor Scheme expected to be closed for the next 10 years.

Our assumptions of future growth are broadly in line with discussions with stakeholders:

- In NSW, IPART is expecting 5 new WICA licences each year over the next few years.[19] The Basix requirements and developer charges are likely to be a driver of growth in smaller regional areas.[20] An estimate of 12 new schemes per year for the whole of NSW would appear reasonable.
- In Victoria, there are a number of known schemes being considered. For example, in CityWest Water's area, there are 3 possible schemes being considered for construction over the next 10 years. Western Water currently has 7 recycled water plants, only one of which produces class A water.[21] There are approximately 10 new projects

19 The City of Sydney has also proposed 4 new schemes as part of its Decentralised MasterPlan. However, these are currently not viable and subsidies are required for the schemes to be "viable and effective". See GHD (2012, p88).

20 Sydney Water has stated in its Water Conservation Strategy 2010-2015 that recycled water will be considered as an option in providing integrated water services. However, schemes will only be implemented where it is financially viable and technically feasible to do so. According to appendix one of the conservation strategy Sydney Water has not identified any new recycling schemes to progress beyond 2015.

21 URS (2010, p15)

foreshadowed to upgrade existing plants and network augmentation (no new recycled water plants have been foreshadowed).[22] Yarra Valley Water also has planned recycled water schemes. The proposed Doncaster Hill facility has as yet not received planning approval. There are likely to be a number of other such schemes envisaged.[23]

- In the ACT, there is already excess capacity in existing schemes. New schemes are not proposed for the future, particular given that the Murrumbidgee River relies on releases from the treatment plants for flows. Also, indications are that the health regulator does not support smaller style schemes. There is also excess capacity in the current wastewater network such that it is cheaper for housing developments to connect to the existing network rather than install a recycled water plant.
- In the NT, two of the plants are currently being upgraded. By the time the NatVal is in operation it is likely that the technology train for these schemes would already have been validated. There are also a number of other options that are considered more cost effective than new recycling plants in order to meet future water security needs.
- In Western Australia, there are already a number of major schemes in place. There is expected to be an expansion in the use of recycled water. However, given the current capacity of the recycled water plants, the expansion in use is expected to arise from the expansion of the network pipes rather than new recycled water plants.

Table 2.5 above shows our assumptions on the expected future growth rates in each jurisdiction. Alternative growth scenarios are presented in chapter 5 as part of the sensitivity analysis.[24]

Expected number of barriers in new schemes

Recycled water plants typically have a number of treatment barriers. [25] Therefore, a single new scheme may result in a number of new technologies that are required to be separately validated. The number of barriers will depend on factors such as the end-use purpose and the volume of flow through the plant.

For the purposes of our analysis, we focus on those schemes with a human health impact. Based on discussions with stakeholders and other information, we would anticipate that the majority of new schemes will relate to the smaller decentralised types

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22 URS (2010, p20)

23 Yarra Valley Water's Water Plan 2009/10-2012/13 indicates $366m on "building new water and sewerage infrastructure to service Melbourne's growth including providing of major water recycling projects" (p.1). This funding appears to be related to network infrastructure to support the potential expansion of recycled water customers. New recycled water plants had already recently been constructed to service new subdivision at Beveridge and Wallan. This plant avoided the cost of upgrading the network to service these areas.

24 The growth in the *volume* of recycled water is likely to have increased by a greater amount than the *number* of schemes. AWRCOE (2012, p11) provides information on the growth in the volume of recycled water produced over the past decade.

25 Ecological Engineering (2006, p38) provides a list of the treatment technologies available for different types of developments and includes information about the footprint of the technologies, the upfront capital and ongoing operating expenditure.

of schemes, similar to those adopted in green building schemes or smaller decentralised schemes such as the Pitt Town scheme in Sydney and the Doncaster Hill schemes in Yarra Valley's area of operation.

The Pitt Town scheme has an ultimate capacity of 650 kL per day and has three treatment barriers (MBR/UV/Chlorine). Yarra Valley Water's Brushy Creek plant uses the same treatment train as the Pitt Town scheme. The recycled water facilities at the Pennant Hills Golf Course in Sydney uses three treatment technologies (MBR/UV/Chlorine). The proposed recycled water plant at Doncaster Hill uses 4 treatment barriers (MBR/UF Membrane/UV/Chlorination) for a 375 kL per day plant.[26]

For the purposes of our analysis, we assume that 3 treatment barriers are used with new schemes. In the scenario testing we test the implication if 4 treatment barriers are used.[27]

Expected number of technologies already validated

Over the past few years, each of the jurisdictions has gradually built up a pool of technologies that have already been validated (either overseas or within Australia) and approved for use in particular schemes. Membrane filtration, UV disinfection and chlorination technologies have been validated (or validation reports approved) in most jurisdictions throughout Australia. Ozone technology has already been validated in Victoria. MBR technology has also been validated/approved in South Australia.

The treatment technologies that are known to have already been validated in Australia include:

- for SA, prevalidated UF membranes (3-4 manufacturers plus 1 manufacturer with enhanced log reductions), prevalidated UV systems (3-4 manufacturers) and chlorination. Secondary treatment, DAFF and lagoons have also been separately validated; and
- for Victoria, prevalidated UF membranes (6 manufacturers), reverse osmosis (2 manufacturers), UV systems (9 different systems), ozone and chlorine.

Based on stakeholder consultations, we would expect that the existing membrane filtration, UV disinfection and chlorination technologies that have already been validated in Australia could be readily migrated to the national scheme. Given this, we would expect that there would be an existing pool of nationally validated technologies from which scheme proponents can draw. We assume that there is some commonality between the technologies validated. For the purposes of our analysis, we assume that there is overlap between the technologies already validated by the South Australian and Victorian regulators. Therefore, in total we assume that there are 18 unique technologies that have already been validated in Australia. These are all assumed to be 'grandfathered' to the national scheme.

26 Yarra Valley Water (2012, p.17)

27 The Glenelg Recycled Water Treatment Plant, for example, includes secondary treatment, UF membranes, UV disinfection and chlorine.

Rate of adoption of existing validated technologies

Based on our consultation and research it appears that scheme proponents often choose familiar technologies. For example, as noted above, Yarra Valley Water's Brushy Creek recycled water plant uses the same treatment train as the Pitt Town Scheme in Sydney. WJ Pratt Water Solutions also adopts very similar technologies for their plants. For example, in the 14 schemes listed on their website, 11 are listed as using an MBR product from Siemens Water Technologies.[28] The reason for these decisions relate to previous experience and understanding of particular technologies. It is often cheaper for scheme proponents to have a limited range of tried technologies where the scheme proponent has built up significant expertise in operation and maintenance requirements. It is also often cheaper for proponents to purchase technologies that are already validated, such as under the USEPA Ultraviolet Disinfection Guidance manual, than to use an unvalidated technology.[29]

Other scheme proponents such as property developers also have limited incentive to try unfamiliar technologies unless there are substantial cost advantages. Based on our discussions, it is common for scheme proponents to choose the same treatment train as previous projects. Technology installers such as Osmoflo have also noted that it now has a 'uniform' product that has already been accepted by regulators and can be utilised without further validation.

These are consistent with the views of the recent study of the EU ETV scheme that noted "customers are highly risk averse and prefer to buy market proven technologies".[30]

We assume that, on average, there are 0.3 validations required per new scheme. This is close to the historical average, although it is potentially overestimating the likelihood of adopting currently unvalidated technologies given the preference of scheme proponents for existing technologies, as noted above. Alternative assumptions are tested as part of the sensitivity analysis.

Expected technological changes

There is likely to be an expansion of new treatment technologies entering the Australian market. Some may be technologies that already exist overseas but haven't reached the Australian market. Others could be new technologies currently not installed in Australia or overseas.

The technological changes could be relatively minor such as new materials used in the membranes where it is possible that new validation studies are not required. Alternatively, they could be quite different technologies that will require separate validation studies to be undertaken.

Based on the international websites, we estimate that there are approximately 100 technologies that are available in the Australian market, of which 18 have already been

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28 http://www.wjpsolutions.com.au/Projects

29 Water Quality Research Australia Ltd (2011, p.185).

30 EPEC (2011, p15).

accredited. These include approximately 53 alternative membrane filtration products, 26 UV disinfection products and other technologies, a number of which may already have been validated.[31]

We do not expect that NatVal will generate an increase in new technologies. This is consistent with the experience in the EU ETV scheme. It noted,

> …..that a funding gap exists for certain developers, where they do not perceive the benefits of ETV to exceed its costs. Uncertainty regarding the expected future sales generated as a result of obtaining a verification was found to be the key reason for this result. This is primarily due to many developers having limited knowledge of the market they wished to enter (specifically SMEs) and consequently being conservative in their willingness to pay based on future sales.[32]

We assume that each of these technologies are unique and would be required to be separately validated. Aside from the 18 technologies already validated in Australia, we assume that the remaining 82 technologies are not validated in overseas jurisdictions.[33]

In regards to technological advancements, we assume a 1 per cent growth in the number of new technologies in each year.

Conclusions

Additional water recycling schemes are expected into the future. However, the number of new schemes is expected to be lower with less need for immediate additional investments in drought security measures over the short term. Further, based on discussions with utilities, it appears that the more cost-effective recycling schemes have already been completed. It appears that no new recycling schemes, beyond those already committed, are being considered by the utilities.

The projection of the number of technologies requiring validation is presented in chart 2.8. This is based on an assumption of maintaining the same growth in the number of schemes as occurred over the past 8 years. The growth pattern has differed in each jurisdiction, with the majority of future growth expected to occur in NSW and the remainder in Victoria. Queensland has previously experienced significant growth in the number of recycling schemes. However, the 'regulatory simplification' amendments currently being considered in Queensland would effectively remove the need for validation for the majority of Queensland's schemes. Therefore we assume no future growth in the number of technologies requiring validation in Queensland. Based on recent history and stakeholder consultation, we assume no additional technologies requiring validation in the Northern Territory, WA and the ACT.

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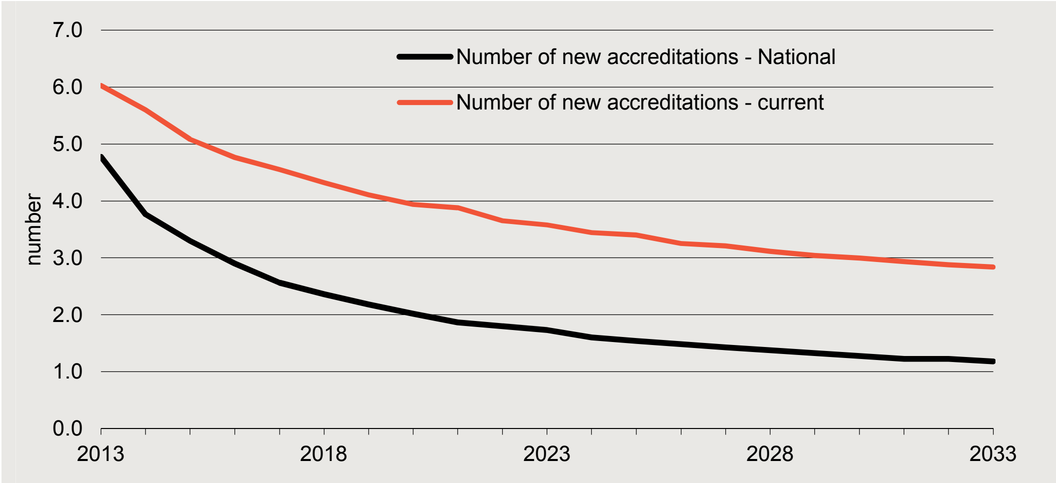
31 Ecological Engineering (2006, p37) provides a summary of treatment technologies that were available in the Australian market at that point in time. It lists 26 different types of technologies under the following 4 categories 'chemical, biological, hybrid and physical" (p30).

32 EPEC (2011, p11).

33 As noted later, we assume that the average cost of validation is $100 000 per technology, if required. If some portion of the 82 technologies are already validated overseas then the average cost per validation would also need to be lower.

2.8 Projected number of technologies requiring validation



Source: The CIE

The vast majority of new schemes are expected to be smaller schemes such as decentralised systems and ‘green building’ schemes. Based on this we expect that natural technologies are less likely to be used. Membrane filtration, UV disinfection, MBR technology, reverse osmosis, ozonation and chlorination are likely to be the main types of technologies used in these schemes. We assume that the new schemes will have three treatment barriers which is common in smaller schemes.

Chart 2.8 indicates that there are slightly more units required to be validated under current arrangements, assuming that there is limited recognition of validation between jurisdictions. Over time the number of technologies required to be validated declines reflecting the fact that once a technology is validated it no longer requires validation. Technologies are assumed to be selected for validation at the time the technology is being selected for a particular scheme. That is, we assume that there is upfront validation of all technologies, irrespective of the likelihood of use by scheme proponents.[34] We assume a 1 per cent rate of growth in the number of new technologies each year. We assume that technologies that have already been validated by each jurisdiction will be ‘grandfathered’ to the national scheme.

34 An alternative is to assume that all potential technologies are validated upfront which would result in significant validation costs, irrespective of whether or not the technology is likely to be used by scheme proponents.

3 *Expected benefit from removing duplication*

As noted earlier, the NatVal framework is intended to minimise unnecessary costs for technology manufacturers/users and regulators by reducing duplication of effort. The magnitude of the cost savings will depend on the *current* tasks undertaken in each jurisdiction to validate technologies and which tasks will be removed/reduced as a result of NatVal. The cost savings from removing duplication will differ:

- between jurisdictions depending largely on the existing arrangements in place (for example, the extent to which a jurisdiction is already willing to accept international technology validation protocols);
- by technology type. For example, some technologies have already been validated or had pre-validation recognised by the jurisdiction. For other technologies, there are currently no agreed validation protocols which will need to be developed as part of the NatVal framework.

In this chapter we consider the expected future costs of validation under the current arrangements as well as the expected costs if NatVal were in place.

Current validation costs

There are a number of steps currently required in the validation process. The current cost of validation includes the following:

- time to develop and agree on a methodology for validating the particular technology, including time for government agencies, regulators, private proponents/manufacturers and independent third parties;
- direct costs of undertaking on-site sampling, operating pilot plants and laboratory testing;
- interpretation of the results and preparation of a validation report. These costs are paid for directly by private proponents or shared, for example, between the utility proposing to use the technology. Independent third party verification may also be required; and
- time to finalise and agree on findings.

Cost to industry

Based on discussions, costs to industry[35] in undertaking validation studies in excess of AU$100 000 are not uncommon.[36] Estimates of costs to technology suppliers varied

35 In this context, 'industry' includes manufacturers of the technology of scheme proponents that can also incur costs relating to validation.

between UK£30 000 for OFWAT certification and AU$200-300 000 for on-site unvalidated technologies.[37] The chemical and microbiological monitoring costs (including commissioning verification) were more than AU$500 000 for the Water Corporation of Western Australia's Groundwater Replenishment Trial Advanced Water Recycling Plant. It took approximately one year to receive approval for the plant from the Department of Health.[38]

There is a range of estimates of the costs of undertaking validation studies. The Road Map Report presents estimates of direct costs of sampling and analysis along with some indication of staff time for a selection of schemes.[39] Other additional costs not presented in the table could include additional plant operational costs associated with recycling plant operation and instrumentation and, potentially, online monitoring during the period of operation when water cannot be provided to the intended user.[40]

Given that the future schemes are expected to be dominated by smaller decentralised schemes, we have assumed that the cost to industry of validating a technology is $100 000 per technology.

Cost to regulators

The Road Map Report presents estimates of the regulators' time spent to validate technologies.[41] The time spent varies on the experience of the proponent and the type/size of the scheme. In stakeholder consultation, regulators have indicated that there is no additional information available, beyond that provided in the Road Map Report.

Based on this information we have estimated that there are 3 FTEs in Australia currently engaged in validation tasks. While there are a lot more personnel involved, only a portion of their time (assumed to be 30 per cent) is involved with validating technologies. In NSW and Victoria we assume close to 1 FTE is currently involved in validation tasks, with 0.5 FTEs in South Australia and lesser amounts in other jurisdictions. The lower amount in other jurisdictions also reflects the fact that some jurisdictions accept technologies validated by other jurisdictions, for example, the Queensland regulators accept technologies already validated in Victoria. In many jurisdictions, for smaller schemes, the regulatory effort may be spent on other ways to manage risk rather than on the validation aspects of risk management. In South Australia, for example, on-site controls are often used in schemes where recycled water has restricted uses.

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36 This is consistent with Water Quality Research Australia Ltd (2012), *Street Map 8 – Technology Supplier Perspectives,* p.204.

37 Water Quality Research Australia Ltd (2012), *Street Map 8 – Technology Supplier Perspectives*, p204.

38 Water Quality Research Australia Ltd 2011, *Street Map 7 – Proponent perspective on a National Validation Framework for Water Recycling*, p195.

39 Road Map Report, Table 2, page 25.

40 Note that this data may involve technologies (for example, biological processes) where site-specific validation is still required and a NatVal scheme may not reduce costs.

41 Road Map Report, Table 3, page 26.

We have assumed that the regulators time is charged at an Australian Public Service Level of EL1 which equates to a total package of $ 115 257 per annum.[42]

There are other operating costs such as rental for office space and utility bills. We assume the same rates as those applying for NatVal (discussed below), pro-rated for different staffing assumptions.

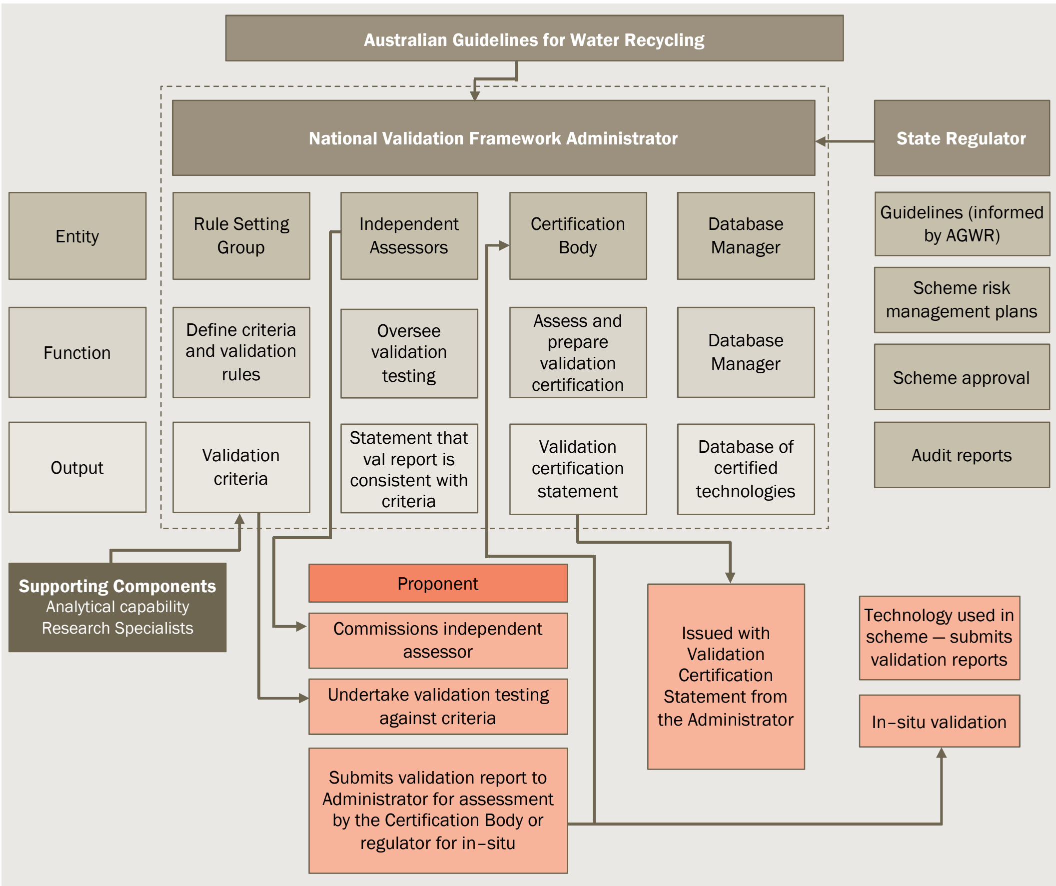
Alternative assumptions for the staffing levels and salary package are tested in the sensitivity analysis.

Costs of validation under NatVal

The NatVal architecture

The NatVal framework sets out an institutional architecture (chart 3.1) that would enable the independent validation of water recycling treatment technologies according to a national set of criteria.

3.1 Institutional architecture for delivery of NatVal framework



Data source: Muston & Halliwell, 2011

42 The same assumption is used for staffing at NatVal, as discussed below.

The key elements include the following:

- Framework Administrator – establishing a central point of coordination with the responsibility of implementing the framework and coordinating both the technical and administrative components;
- Rule Setting Group – establishing a Working Group to develop and approve the protocols/criteria against which all technologies will be required to be validated. The composition of the Working Group may include regulators, industry bodies and independent experts;
- Independent Assessors – engaging third party assessors to oversee the validation testing and endorse validation studies upon completion. Assessors will be individuals or organisations that are not associated with technology providers;
- Certification Body – establishing a body responsible for assessing and providing validation certification for both specific technologies and in situ processes; and
- Database Manager - establishing a body that will manage a centralised database of certified technologies and maintain a record of validation guidelines. The database would contain information on certified technologies and in situ processes, including operating parameters and hazard reduction values (Street Map 6, p.153).[43]

Supporting elements include the following:

- Analytical Capability – engaging certified facilities, commercial, government or university facilities, to conduct analytical tests for both ex situ and in situ technologies and prepare analytical and validation reports; and
- Research and Specialists – involving working groups to undertake research and development to support validation of recycled water.

Validation costs

While the NatVal architecture described in the RoadMap provides a structure of alternative functions it does not specify the resources dedicated to each function. Therefore, assumptions are required regarding the level of resources.

Comparison agencies

There are a number of alternative bodies with similar functions which can provide a benchmark of costs for the NatVal architecture. The Food Safety Authority and NICNAS are examples of alternatives. FSANZ currently regulates over 2000 different food products and there are over 40 000 different chemicals listed on the Australian Inventory of Chemical Substances which are the responsibility of NICNAS.[44] NICNAS employs approximately 69 staff, 49 of which were fulltime, and has annual expenditure

43 Manufacturers have raised some concerns regarding the details of use and release of data from such a database (StreetMap 7, p181.)

44 There are approximately 70 000 products on the Australian Register of Therapeutic Goods regulated through the Commonwealth Department of Health and Ageing.

of approximately $9m per annum.[45] FSANZ has 170 fulltime and 22 part time staff and annual expenditure of approximately $22m per annum.

The EU's Environmental Technology Verification (ETV) Scheme is another possible comparator. Its coverage is much wider and includes a wide range of different sectors such as water filtration, air pollution and energy generation. The EU scheme envisages approximately 60 new technologies requiring validation each year.[46]

Given the number of technologies requiring validation, as noted in the previous chapter we do not believe that these agencies are useful comparisons. Instead, we believe that it would be more appropriate to build up the costs from first principles as noted below.

Staffing costs

Given the challenge of finding a comparable body, we have based our cost estimates on the NatVal architecture. Currently in NSW and Victoria there are approximately 3 persons (in the health regulators and utilities) that are involved in technology validation on an as-needs basis.

Based on this we would estimate that permanent staffing equivalent to 1.5 FTEs would be sufficient. This includes the costs associated with the Scheme Administrator, Rule Setting, Assessor, Certification and Database Management. These are considered to be fixed costs. The database management could readily be undertaken with minimal resources.[47]

We assume that all staff would be equivalent to APS EL1 with a total package of $115 257. Based on a permanent staff of 1.5 persons the total staffing costs for NatVal is around $172 886 per annum.

Independent assessor costs

Additional variable costs also include consulting costs for the engagement of independent experts and assessors that would contribute to the development of the validation protocols as well as the assessment and certification of products. Estimates of up to $20 000 have been provided for reviewing the services. We assume costs of $10 000 for

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45 NICNAS performs the public health and occupational health and safety assessments related to an industrial chemical. The Department of Sustainability, Environment, Water, Population and Communities conducts the complementary environmental assessment for NICNAS. State and territory input into NICNAS's public health assessments and recommendations is coordinated by the Environmental Health Committee (enHealth), a subcommittee of the Australian Health Protection Committee. Coordination of the state and territory input on NICNAS' environmental risk management recommendations occurs through the Standing Committee on Environment and Water. The states and territories are responsible for monitoring and enforcement of NICNAS'recommendations.

46 The estimated fixed staffing cost was €50 000 to €90 000 per verification. http://www.etv-denmark.com/files/etvinfo/ETVPreProgrammePresentation.pdf

47 The database listed on the US EPA's ETV site would be sufficient. This includes information about the technology type and provides information about the validation study and the operating conditions for which the technology has been validated.

reviewing validation reports where technologies have already been validated from overseas jurisdictions.

There are also additional costs of getting independent expert reports to develop the validation guidelines. We understand that the Centre has already commissioned some reports at a cost of around $500 000. These costs have already been incurred irrespective of whether NatVal is implemented.

Other operating expenses

In addition to the validation costs there are annual operating expenses such as rental, electricity and telephone services and photocopier leases. These costs are typically related to the number of staff and floor space required.

The floor space required for staff will depend on a wide range of factors such as whether board room and kitchen facilities are required. For the purposes of our analysis we assume a FTE to floor space ratio of 23 sqm per FTE, the average office space for the public service.[48] An organisation with 1.5 FTEs requires 34.5 square meters of floor space.

In regards to rental costs we assume that the staff will be located in Canberra. The rental cost in Canberra is currently $325 per sqm based on a B grade building in 'midtown'.[49] This equates to $11 213 per annum in rental costs.

Electricity and phone bills are estimated based on other small businesses and pro-rated per FTE. The annual lease costs of a printer are also based on other small business requirements of approximately $2 000.

Setup costs

There are also expected to be once-off costs of establishing the new entity. This includes items such as fitout costs including cabling for communication services, new computers, desks and other miscellaneous items. The fitout costs can vary significantly, from $400 per sqm for a low end fitout to $1 000 per sqm for a superior fitout. We use the fitout costs for an 'average' quality of $650 per sqm.[50] The transition costs could be much larger where, for example, redundancies are required to be paid for existing regulators staff that would no longer be required.

Summary of net benefits from removing duplication

Chart 3.2 below illustrates the expected costs to industry (including manufacturers and utilities) of the current approach and NatVal based on the profile of technologies requiring validation as noted in the previous chapter. The cost differences reflect the differences in the number of units requiring validation.

48 Warren C (2004, p.8).

49 Colliers International July 2012.

50 http://officefitoutprofessionals.com.au/about-us/commonly-asked-questions/

3.2 Cost of validating technologies under current approach and NatVal

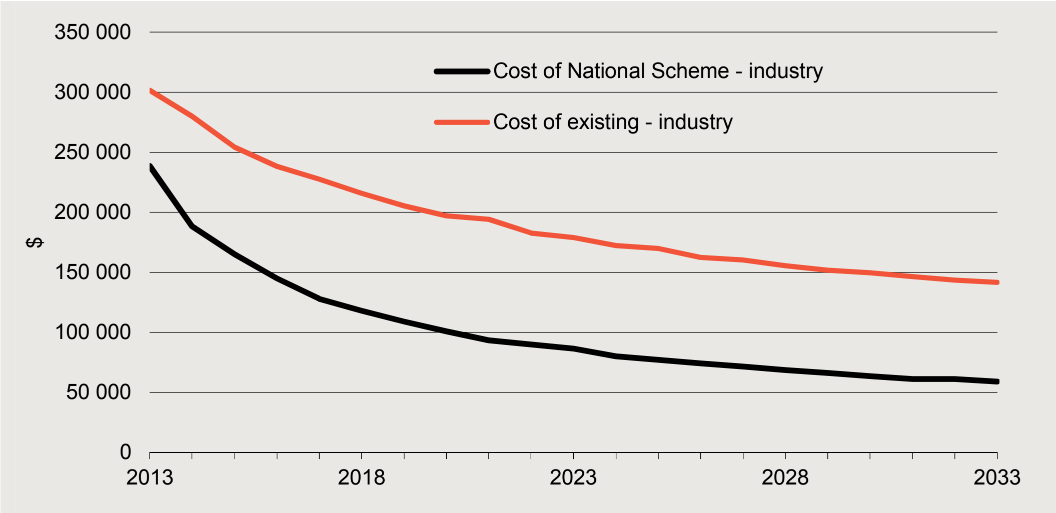
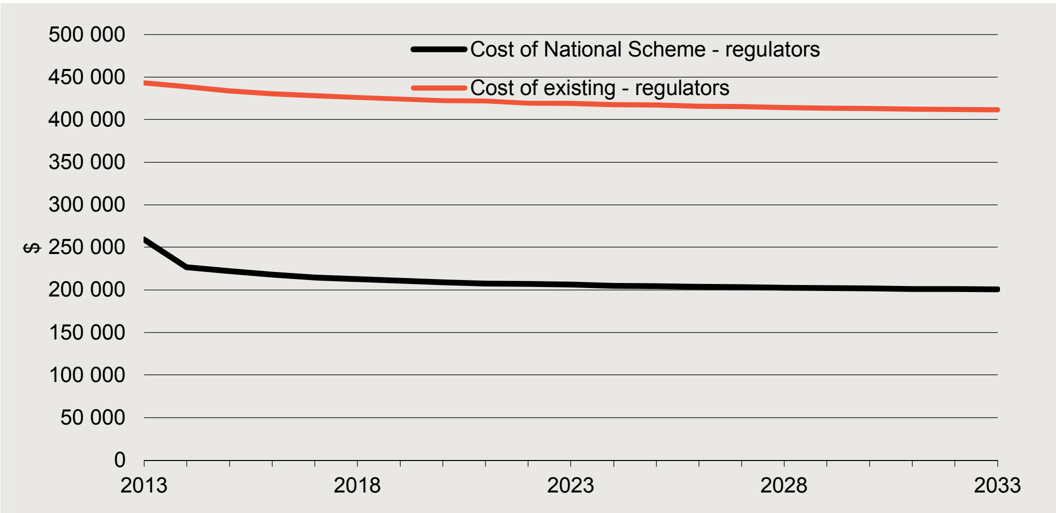


Chart 3.3 presents the costs to regulators under current arrangements and under NatVal. These include ongoing operating costs (such as rental costs) as well as the costs associated with validating technologies. Under the current approach and NatVal there are fixed as well as some additional costs attributed to independent assessors that are incurred with each technology requiring validation. As noted previously, we assume that under NatVal 1.5 permanent staff will be required, in addition to the independent assessors.

3.3 Cost to regulators under current approach and NatVal



In NPV terms there are net benefits to industry and regulators of approximately **$0.97m** and **$2.28m**, respectively, from reduced validation effort and the removal of duplication.

4 Expected benefit from pooling knowledge

The pooling of knowledge by drawing together the resources currently embedded in each jurisdiction into a single body with a dedicated focus on validating recycled water technologies is expected to deliver a more robust and accurate reflection of the performance of a technology. The potential cost savings from pooling knowledge are less certain, although could be large if benefits from pooling knowledge are realised. This chapter considers the expected benefits.

Overview of benefits

There are two potential elements to the benefits from pooling knowledge. First, this could be expected to deliver health benefits to the community by accurately estimating the performance of all technologies in the treatment train in terms of their ability to remove viruses and protozoa. The magnitude of the potential health benefits is difficult to measure given the limited knowledge of the current impact of recycling schemes on health outcomes.

Based on stakeholder discussions, there is no evidence of health incidents aside from issues arising from cross-connections. This is not to say that there are no potential health risks associated with the current assessment of performance. Rather, it may reflect the challenges of measuring impacts.

The other potential benefits from a more accurate estimation of the performance of a technology is the potential to remove the need for more barriers. It is argued that under the current approach the LRV credits issued are likely to be more conservative and more treatment barriers are required to achieve the total LRVs for virus and protozoa as prescribed in the Australian Recycled Water guidelines. Different default credits can also arise from reviewing the performance of the treatment train rather than the individual components. The theory being that the LRV credits for the whole treatment train may be greater than the sum of the parts.

The two aspects of the benefits are non-additive. That is, the knowledge could either be used to improve the health performance (while maintaining the same treatment train) or reduce costs (by removing a treatment barrier). This second element is more readily measured for the purposes of a CBA. The challenge, however, is to gauge the extent to which the new validation protocols envisaged under NatVal will lead to higher (or lower) default LRV credits for each of the technologies.

Estimated benefits

For the purposes of our analysis we estimate the potential benefits arising from a more accurate estimation of the performance of a technology, as embodied in the LRV credit, creating a potential cost savings by removing a component of the treatment train.

Based on our consultation, MBR technologies are expected to be a central feature of the future recycled water landscape, particularly where it is dominated by smaller scale schemes. This has been the growth trend globally and Australia is expected to follow this trend.[51] This treatment technology has a small footprint and produces high quality effluent.[52]

MBR is also a technology where there is some contention regarding the performance in removing viruses and protozoa. For other technologies, such as membrane filtration and UV disinfection technologies, we envisage that the current default LRV credits already reasonably reflect the performance of these technologies.

Based on discussions, the same MBR systems are believed to receive different default LRV credits for removal of virus and protozoa. Some manufacturers have argued that the MBR system would be given a 0 LRV credit for virus removal by the Victorian Department of Health, 1.5 LRV credit from the NSW regulators and 2.0 from South Australia. In comparison, the manufacturers believe that their technology would receive a 3 LRV for virus removal by the Californian regulators.

There is some uncertainty regarding the actual LRV credits that will be issued for MBR technology by individual state regulators. In Victoria, for example, there have been no formal assessments of validation relating to proposed MBR technologies.[53] In NSW there has been one scheme that used MBR technology which received some level of validation by the health regulators. However, the scheme proponents sought a relatively low LRV credit for the performance of the MBR technology (given the other treatment barriers). In SA there has been one scheme using MBR technology that was validated by SA Health.

Through the pooling of expertise, it is reasonable to expect that the MBR technology would deliver a higher LRV credit than that currently issued by each jurisdiction. This would largely relate to a greater understanding of the ability to operationally monitor the pathogen removing performance of MBR technology.

In order to estimate these benefits we assume that the benefits only arise from a more accurate assessment of the performance of the MBR technology in removing protozoa which results in changes to the size and operating costs associated with the UV treatment barrier.

51 Chapman S, Leslie G and Law I (undated), Membrane Bioreactors (MBR) for Municipal Wastewater Treatment – an Australian Perspective, p1.

52 Ecological Engineering (2006, p35). One of the disadvantages of MBR's is the higher capital cost and energy costs compared to other treatment systems.

53 While there are schemes in Victoria that currently use MBR technology, these are typically on-site treatment within buildings which has historically not been regulated by the health department.

MJM Environmental was commissioned by the Centre to undertake additional analysis to test the alternative capital and operating cost savings from alternative LRV credits issued for the MBR technology.

Costings have been provided for two 'typical' sized sewer mining schemes (0.5ML per day and 5ML per day) with MBR/UV/Chlorine treatment train to meet the Australian Recycled Water Guidelines where the water would be used in a dual reticulation scheme. The analysis provides costings for 4 alternative scenarios of assumed LRV credits issued for the MBR technology in removing protozoa (0, 1, 2 and 3 LRV credits). Under each scenario, alterations (in terms of scale and intensity of use) are required to the UV plant depending on the LRV credits issued for the MBR technology in removing protozoa. These are presented in the table below. The capital and operating costs of the MBR barrier and other aspects (for example, chlorine) are the same for all scenarios.

4.1 Capital and operating expenditure of UV plant

Technology	0.5ML/day		5ML/day	
	Capital cost ($'000)	Operating cost ($'000 pa)	Capital cost ($m)	Operating cost ($'000 pa)
UV 3 LRV, MBR 3 LRV	118	13	196	60
UV 4 LRV, MBR 2 LRV	118	16	196	62
UV 5 LRV, MBR 1 LRV	120	17	331	107
UV 6 LRV, MBR 0 LRV	151	19	382	115

Source: MJM Environmental analysis

The capital and operating costs associated with the UV plant will depend on the protozoa removing performance of the MBR plant. For example, if the MBR achieves 3 LRV credits for protozoa then the UV plant would be required to achieve 3 LRV credit as well in order for the scheme to meet the Guidelines. The capital cost of the UV barrier for a 0.5ML per day recycling plant is $188 000. If the same MBR plant was only issued with 1 LRV credit for protozoa then a larger UV plant (with a capital cost of $120 000) would be required to achieve a 5 LRV.

The relationship between the scale of the UV plant and the LRV credits issued is non-linear. For example, if the UV plant is required to achieve an extra credit for protozoa reduction (say from 3 LRV to 4 LRV) there may be no change in the capital cost due to the modularised nature of each UV unit. While there may be no change in the capital costs, the operating costs will change due to changes in intensity of use of the lamps.

For the purposes of our estimates, we assume that the Victorian Health regulator issue no LRV credits for protozoa for MBR barriers[54], NSW issues equivalent to 1 credit and South Australian health regulator 2 credits. For the purposes of our analysis we assume that the pooling of knowledge will result in MBR technologies receiving 3 LRV credits for protozoa removal. The cost savings for each jurisdiction are presented in the table below.

54 This is consistent with the assumptions used in the recent planning of the recycled water plant in Doncaster Hill which included 4 treatment barriers, including an MBR barrier.

4.2 Estimated UV cost savings per scheme

	0.5ML per day		5ML per day	
	Capital $	Operating $ per annum	Capital $	Operating $ per annum
Victoria	32,131	5,973	186,163	55,437
NSW	1,325	4,025	135,150	46,755
South Australia	-	3,469	-	2,208

Source: MJM Environmental

In South Australia the benefits are relatively small given that the capital costs of a UV plant for 3 or 2 LRV credits for protozoa removal are the same. This also highlights the fact that there are still significant gains even if NSW and Victoria were to adopt similar credits to that currently issued by SA Health.

As a comparison, the operating cost savings noted above are lower than that projected by SA Water. SA Water is in the process of estimating the operating cost savings that it has been able to achieve by 'depowering' the performance of the treatment barriers which were previously performing above the minimum requirements specified by the health regulator. The research is due to be completed in early 2013. Preliminary estimates for two different plants indicate operating cost savings of $37 000 and $54 000 from the reduction in chlorine dosing, and reducing UV power consumption and general maintenance costs. These case studies also further indicate that the savings presented in table 4.2 are likely to be conservative and there is likely to be further potential to reduce the operating cost of recycled water schemes.

Expected net benefit

Based on the above, the pooling of knowledge is expected to deliver net benefits of approximately **$8m** in present value terms for smaller schemes and **$80m** if all future schemes were medium sized schemes. The is some uncertainty regarding these benefits, given that it is not clear that MBR technologies will be issued with a higher LRV credit than currently issued by each of the state regulators. It is possible, for example, that the pooling of expertise may result in LRV credits for MBR technologies that are closer to that currently issued by the Victorian Department of Health. On the other hand, the pooling of expertise could also result in accepting a validation approach that focuses on the whole treatment train rather than LRV credits for individual components. This is also expected to reduce the 'over-engineering' of schemes and reduce the costs of future recycling schemes. Therefore, it is possible that the net benefits noted above may underestimate the potential benefits from a pooling of knowledge.

While our focus has been on the performance of MBR technologies, there is also potential for more accurate estimation of the performance of other treatment technologies. For example, the Ultrafiltration Membranes in the Glenelg Recycled Water Treatment Plant were initially given a 2.0 LRV for municipal applications, subject to further challenge testing. The challenge testing revealed that 2.5 LRV was a more accurate reflection of the performance of the UF membranes. This result was subsequently accepted by the South Australian health regulator.[55] Another example was the Rouse Hill recycled water plant in Sydney which installed ozonation and continuous micro-filtration barriers. The ozone disinfection process was subsequently decommissioned as it was not required to meet the minimum standards set by NSW Health.[56] There are also some examples of regulators in the United States allowing a single treatment barrier for UF Membrane technology (Australian regulators will not provide more than 4 LRV credits for a single treatment process).[57]

These estimated benefits are likely to be on the low side for a number of reasons:

- The savings only relate to more accurate assessment of performance of MBR technologies in reducing protozoa. There are also potential cost savings from improved assessment of the virus reduction performance of MBRs.
- The savings assume that there is no opportunity to completely remove a treatment barrier, such as the UV barrier, only a 'downscaling' of the capacity. In practice there are likely to be opportunities to completely remove one treatment barrier.
- There are other technologies (not just MBRs) where the current assessments may not reflect the actual pathogen removal performance of the plants. For example, the performance of multiple barriers in combination may be greater than that of the sum of the individual components. The Centre has already commissioned a separate study to investigate this issue.

55 The UF membrane technology was already installed in several South Australian metropolitan alternative water schemes including the Glenelg-Adelaide Recycled Water Scheme, the Aldinga Southern Urban Reuse Scheme and the Christie's Beach "C-Plant"upgrade. (Regel R, Heidenreich C and Keegan A 2012)

56 Fairbairn (2006, p.2).

57 Street Map 2 (p.70).

5 Expected Net Benefits and Sensitivity Analysis

This chapter summarises the expected net benefits arising from the removal of the duplication of effort as well as that arising from the pooling of expertise. It also undertakes sensitivity analysis to test the impact of alternative assumptions.

Expected Net Benefits

Based on our assessment, NatVal is expected to deliver net benefits of between **$11m** and **$84m** from adopting a nationally consistent approach to validating water recycling technologies, assuming a 20 year time horizon and 7 per cent real discount rate.[58]

The net benefits are largely driven by the expected savings from reducing the cost of recycling schemes. There are also some net benefits to industry and government from reducing the potential duplication of validation effort.

Sensitivity analysis

Sensitivity analysis conducted on alternative assumptions for these drivers and associated net benefits results are presented in table 5.1 (compared to the $11m noted above, assuming all schemes are small schemes with a flow capacity of 0.5ML per day). As noted earlier the larger the size (i.e. flow capacity) of new schemes will result in greater expected capital and operating cost savings.

The sensitivity analysis indicates that if the annual growth rate in the number of schemes is slightly above or below that which occurred over the past 8 years, there would be some relatively minor change in the net benefits. However, there are substantial changes like a 50 per cent reduction in the number of schemes each year in NSW compared to the recent past, then this would substantially diminish the net benefits (although they are still expected to be positive).

If existing schemes require upgrading then this could significantly increase the net benefits from NatVal. For example, if 5 per cent of existing schemes require upgrading in each year this increases the net benefit to $18.1m in NPV terms. This is largely the result of the pooling of knowledge leading to a reduction in the cost of upgrading for each scheme. This is likely to be a central determinant of the potential net benefits.

58 It is assumed that the framework will be in place in one year and will commence from 1 July 2013.

5.1 Sensitivity test

Sensitivity test	Revised net benefits $m
S1. Change in number of future schemes	
▪ S1.1. Assume all future recycling schemes in Qld will be subject to validation (base model assumes 25 per cent of schemes)	$11.3
▪ S1.2. 50 per cent increase in number of schemes in Vict, SA and WA due to growth in aquifer recharge	$13.6
▪ S1.3. 5 per cent per annum of existing schemes replace all treatment barriers	$18.1
▪ S1.3. 50 per cent reduction in future schemes in NSW reflecting change in drivers that diminish the growth rate in new schemes.	$9.3
S2. Increasing the average number of technologies in the treatment train from 3 to 4 per scheme	$11.3
S3. Increasing the annual growth rate in new technologies from 1 to 5 per cent per annum (and the same technology redundancy rate)	$11.2
S4. Assuming all technologies already validated by any jurisdiction to require 'revalidation' in the form of a review under NatVal (ie no grandfathering)	$10.2
S5. Alternative staffing levels	
▪ S5.1.Increasing in current regulator resources to 8 FTE, instead of 2.7	$18.4
▪ S5.2. Increasing NatVal from 1.5 to 4 staff (with no extra burden on state regulators)	$7.5
S6. Discount rate 4 per cent and 10 per cent	$16.7 - $7.7

Source: The CIE.

Changes to the assumptions regarding resourcing levels can also materially impact the net benefits. If the FTEs currently dedicated to regulation is higher than that required under NatVal then there are potential administrative cost savings from moving to the national framework. For example, if 8 FTEs are currently required to administer the state based regulatory approach then the net benefits rise to $18.4m in PV terms. Further, if the resourcing levels under NatVal are required to increase (from 1.5 FTE to 4 FTEs) the net benefits fall to $7.5m in PV terms.

Where NatVal requires all technologies that have already been validated by each jurisdiction to be revalidated then this will increase the cost of the scheme, lowering the net benefits to $10.2m. Changes to the assumptions surrounding the number of technologies in the treatment train and technological growth rate do not substantially change the net benefits.

Changes to the discount rate do materially impact the level of net benefit, however, it still remains positive under the alternative scenarios.

A Overview of a CBA

The evaluation utilises a CBA framework as the basis for the analysis. A CBA is typically used to evaluate alternative decisions by quantifying and valuing *changes* from the 'do nothing' case. It does not seek to find the *optimal* outcome, only to determine which alternatives evaluated are superior.

A CBA framework is focused on the social welfare of the community. That is, in selecting among available options, the option that delivers the highest *net social welfare* (or economic *efficiency*) is considered to be the best option for society.

The measure of net social welfare ideally takes account of all potential impacts (for example, the health, environmental and economic impacts) of particular actions. Each of the different types of impacts are quantified and valued on a common basis so that they can be compared and understood. The 'values' are based on the values that the community places on a particular impact. For example, from an economic perspective the environment does not have an intrinsic value. It only has a value that is placed on it by society.

The different types of impacts are aggregated into a single metric that enables a systematic treatment of trade-offs arising from the decisions. Given this, a CBA is commonly used by policy makers in situations where proposed actions have differential impacts throughout the community. As a result, policy-makers are required to consider trade-offs and decide whether the community as a whole is better or worse off. In a CBA framework, the concern is whether the aggregate impact across the whole of society is positive or negative. Equity issues are typically considered separately as part of the decision making process.

A CBA framework also considers the timing of each of the impacts. Under a CBA approach, future impacts are 'converted' into today's terms (the *net present value* concept) so that they can be meaningfully compared. A CBA, for example, will enable an evaluation of policies that deliver different streams of benefits and costs over time.

Not all impacts will be known with certainty. Therefore, in a CBA framework, the impacts are typically presented in terms of an *expected* impact (or the results presented probabilistically), recognising that it reflects a probability of occurrence. Sensitivity analysis is also commonly used to test the extent to which the impacts and results change under alternative assumptions.

The robustness of the CBA results will depend in part on the extent to which impacts can be meaningfully quantified and valued. Where there are information gaps, a CBA is necessary but not sufficient. In these instances, for example, qualitative information can be used to support the overall evaluation of the merits of the policy.

The key steps of a CBA are presented in box A.1

A.1 Key steps in a CBA

- **Articulating the decision that the CBA is seeking to evaluate.** The way in which the CBA is framed and the information requirements will differ depending on the decision being evaluated.
- **Establishing the reference point** (or 'baseline') against which to assess the potential socioeconomic and environmental impacts of the proposed NatVal framework.
- **Quantifying the changes** from the baseline resulting from the specific decision being considered. This will focus on the incremental changes to a range of factors (for example, environmental, economic, social) resulting from the decision. The changes may be certain or could also be defined in probabilistic terms. The quantification should focus on elements and scenarios that will be utilised in the valuation stage.
- **Placing values on the changes and aggregating these values** in a consistent manner to assess the outcomes. It is important to distinguish between short-term and long-term changes, recognising that the impact on parties is likely to be greater in the short term given that there is limited time to adapt to these changes.
- **Generating the Net Present Value** (NPV) of the future net benefits cashflow stream, using an appropriate discount rate, and deciding on the Decision Rule on which to assess the different options.
- **Undertaking sensitivity analysis** on a key range of variables, particularly given the uncertainties related to specific environmental benefits and costs.
- **Presenting the CBA conclusions** on the option that is best for society. The ultimate decision on the preferred option is made by the decision maker (not the CBA analyst). In practice, additional information, aside from the CBA results, may also be utilised when deciding on the preferred option.

B The case for a national validation approach

Australia's background as a collection of states provides many benefits but can also impose considerable costs. The Constitution, drafted for an earlier time, gives the Federal Parliament specific powers, such as those related to quarantine, currency, bills of exchange, bankruptcy, copyright and corporations. But if responsibility for an area is not specifically given to the Federal Parliament, then it is usually a matter for the states.

Economists have long recognised that in certain situations, the centralisation of regulation can bring great benefits. And over time there has been a trend for certain aspects, such as income taxation, to become the responsibility of the Federal Parliament. In addition to the possibility of extracting economies of scale in regulation, the 'federalisation' of regulation could be more appropriate for a time when there has been increased national scope and globalisation of markets.

With the advances of technology, transportation and communication, the geographic boundaries of many activities are no longer localised. Many companies, for example, operate in multiple jurisdictions. That is, today's markets are often national or international.

Banks (2006) from the Productivity Commission provides an excellent summary of the state-of-play in regards to a national regulatory approach. As Banks (p.4) notes:

> One century after Federation, there are clearly advantages in workers and businesses in Australia being able to operate as seamlessly as possible across State borders. Unnecessary variations and inconsistencies in regulatory requirements between jurisdictions add to the costs and complexities of doing business.

However, even though there are many compelling reasons for the federalisation of regulation, many areas of regulation remain the responsibility of state governments. That is, the case for a national approach to regulation is not uniform across policy areas. The discussion below summarises Bank's discussion on some of the key factors that need to be considered when reviewing the relative of merits of a national versus state based regulator regime. These include:

- the scale of the activity;
- the extent to which actions in one jurisdiction impact on others;
- the degree of differentiation in circumstances or preferences across jurisdictions;
- the ease and costs of administration; and
- the state of knowledge about the best regulatory approaches.

Regulation that is best conducted at a federal level does not need to satisfy all these, but the extent to which each of these is satisfied makes an argument for a national approach stronger.

Scale of economic activity

The case for a national approach to regulation is strongest in markets that have substantial scale. This makes it likely that there is a large market, and that there will be large firms in the market that will operate across state boundaries. For instance, the regulation of food safety has shifted to a national approach, largely administered by Food Safety Australia New Zealand (Productivity Commission, 2009). At the time of the review it was found that approximately 150 Acts and secondary instruments controlled food in Australia, and concluded that the regulatory framework was 'complicated, fragmented, inconsistent and wasteful'. The review recommended an integrated and coordinated national food regulatory system with nationally uniform laws and a co-regulatory approach. This reflects today's reality that food can be easily produced in one region and consumed in another.

As firms operate across state boundaries it becomes burdensome for them to comply with different rules in those states. An outcome whereby they do not enter the state would mean lost economic benefits.

In the case of water recycling the scale of future activity does not compare with the number of products that commonly require regulation at a national scale. For example, Food Safety Australia New Zealand administers over 2 000 different food products. The Theraupetic Goods Administration under the Commonwealth Department of Health and Ageing administers 70 000 different therapeutic goods including medicines, medical devices, blood and blood products. NICNAS also regulates over 40 000 different chemicals.

Further, in the recycling industry the only economic agents whose activities span multiple jurisdictions are the manufacturers of the technologies that are typically large global firms. The scheme proponents, such as water utilities, operate in small geographic areas. Even property developers who may install recycled water plants also often have particular geographic locations that are their focus.

Given these factors, it is unlikely that economies of scale provides a strong argument for a national approach, but harmonious and transparent standards would make it easier for an overseas company to operate in multiple jurisdictions in the Australian market.

Spillovers onto other jurisdictions

In some situations the subject of regulation will have jurisdictional spillovers and an individual legislature may not make a decision that is collectively efficient. In this case there may be efficiencies that can be obtained by federal, rather than state or local, regulation.

One example of this is the Murray Darling Basin with the interconnected catchments meaning that actions in one jurisdiction (upstream) can impact on other downstream states. In this case the response has been a national approach through the Murray Darling Plan, although each of the jurisdictions play a significant role in regulating actions in their own jurisdictions. Similarly, in the case of regulations relating to roads and vehicles, regulations imposed by one state, will affect others (Castalia, 2009).

In the case of water recycling, this is unlikely to be the case in general although it is possible that at the jurisdictional borders there may be some spillover effects, but these are likely to be minor and infrequent.

Different preferences

In some instances communities in different jurisdictions may have different preferences. The many local beer varieties that once existed, for example, were designed to satisfy local tastes. If preferences are homogenous, then regulation conducted at a federal level is more likely to be more appropriate than if preferences vary across communities.

In the case of water recycling, it may be the case that rural areas communities may be more willing to accept more frequent water restrictions, rather than pay significantly higher water prices to invest in recycling related infrastructure to improve reliability of supply, compared with urban areas. Such a difference could also be due to a community's historical ability to cope with drought.

It is difficult to measure different preferences in relation to water restrictions. The 'right' measure would also depend on the nature of industry in the area. If there is a greater industrial use of water, then it might be the case that there is a lower willingness to accept scarcity and a greater willingness to pay to avoid shortage.

Given the move toward common drinking water quality and recycled water quality guidelines, it is reasonable to think that there are broadly similar preferences in regards to health risks associated with recycled water and drinking water across Australian jurisdictions. Having said this, the current validation approaches in each jurisdiction can be argued to reflect different risk preferences. For example, technology manufacturers have noted that they receive different log reduction credits for the same technology in NSW, Victoria and South Australia. The Victorians are believed to adopt a more cautious approach.

It is difficult to know whether such differences reflect genuine differences in risk aversion or different assessment of the specific risks attached to given levels of tolerance of remaining pathogens.

Overlap, duplication or inconsistency

Efficient expansion of recycled water requires that productive efficiency be encouraged. This involves, in part, keeping scheme implementation costs to a minimum. Arguably one of the most frustrating aspects for participating businesses of the current regulatory system is the potential for overlap, duplication and inconsistency in regulation.

Overlap in regulation could occur when there are two states, both with regulations that must be satisfied. Duplication in regulation occurs when the same requirement must be met for different authorities. Inconsistency occurs when regulations in one state do not match the regulations in another.

It may be expensive for a business to satisfy heterogenous state-based regulations. The costs could be direct or indirect for instance in earnings forgone. The Productivity Commission (2010) argued that the requirement that an architect register in each state that they want to work in is a barrier to cross-jurisdictional work. Because of this the Productivity Commission said that a national register should be used.

Inconsistent regulations are particularly concerning because a working alternative is easy to point to. There are well-known arguments for a national approach to regulation of rail safety for this reason—trains can be expected to regularly cross state lines and so the costs of inconsistent regulation would be high. On the other hand, there are stricter product standards that apply to child carry seats for bicycles in Western Australia and Tasmania than apply in the other states. The implication is a restriction of trade for businesses and increased transaction costs for consumers when moving between states.

As the Road Map report has highlighted there is scope from removing duplication of effort and establishing a more consistent approach to validation between the states. This is also likely to be another argument of moving toward a national validation framework.

Knowledge about what works best

It could be possible that differences in regulation reflect uncertainty as to exactly what needs to be regulated and the best way to do it. For instance, there are many trades that are subject to different licensing requirements between states. For instance, a plumber must register in each state that he wants to work in. And there are some where a licensing requirement exists in some states and not in others. The implication is that there is not a clear and consistent rationale for the regulation.

In the case of water recycling, one objective relevant to proposed schemes may be an environmental improvement. But in a situation in which there is uncertainty about the best way to achieve these goals, different regulations may be put in place by different jurisdictions, even though they all seek the same broad outcome. This is even more likely in the case where there is specialised knowledge and skills in order to put in place and enforce regulation, as is the case in water recycling.

The implication of the current differences in approaches to validation suggests that there is no agreement on what works best. In contrast, a federal approach, through the National Validation framework, could come up with a set of guidelines that are generally thought to be the most appropriate regardless of which state or territory to which it applies. That is an agglomeration of knowledge would assist in understanding what works best.[59]

An analogous situation is the regulation of chemicals and plastics, which is a science-based task. The Productivity Commission (2008) found that a national body would be preferred for the regulation of chemicals and plastics because the alternative of sub-national jurisdictions duplicating the chemical assessments of others would be inefficient, as is any divergence in assessments. The pooling of knowledge via a national body would

59 The Australian Institute of Sport provides one example of the benefits of pooling of knowledge.

enable it to maintain greater technical expertise, rather than have such scarce technical knowledge scattered amongst multiple jurisdictions and agencies.

The importance of pooling of knowledge is likely to provide the strongest case for a national approach to validation. There may be a number of different models for the pooling of knowledge.

Summary

There are many arguments for the use of national, rather than state-based, regulation. However, most of them come down to the fact that so much economic activity now occurs on a national, rather than state, basis. Many of the issues raised above are artefacts of an earlier time, when this was not the case.

There are few argument for the use of state-based regulation when considering imposing new regulations. A national approach has the potential to generate cost savings from avoiding administrative duplication/inconsistency and also from the pooling of knowledge.

However, there may be a number of different approaches to capturing these benefits. For example, the National Competition Policy reviews of a range of state-based regulations of various trades and professions highlighted the benefits of regulatory reforms providing mutual recognition as an alternative to federal government regulation. It would be worth considering this as a potential alternative model to the proposed national validation framework.

C Data sources

C.1 Coverage of data sources

Source	Details available for reported schemes					
	Name	Location	Date	Water use	Treatment types	Coverage
NSW Water 4 Life[a]	✓	✓	✓	✓	×	NSW
Radcliffe[b]	✓	✓	×	✓	✓	Australia
NatVal StreetMap Compendium[c]	✓	✓	✓	×	✓ (in some cases)	Select schemes across Australia
WJP Solutions[d]	✓	✓	×	✓	✓	Select schemes across Australia
Queensland DERM[e]	✓	✓	×	✓ (in majority of cases)	×	QLD
Definition of Decentralised Systems in the South East Qld Context[f]	✓	✓	×	✓	✓ (in some cases)	QLD
South Australia DEWNR[g]	✓	✓	✓	✓	✓	SA
Victorian Department of Health[h]	✓	✓	×	×	×	VIC

[a] NSW Government Water 4 Life, *Water recycling projects* http://waterforlife.nsw.gov.au/recycling/water_recycling_projects [b] Radcliffe, 2004, *Water recycling in Australia: a review undertaken by the Australian Academy of Technology Sciences and Engineering.* Australian Academy of Technological Sciences and Engineering. [c] Halliwell, D, Roeszler, G, (Eds) 2012., *NatVal Compendium of Street Map Reports: the map to a national validation framework for water recycling schemes.* [d] WJP Solutions [e] Queensland DERM via communication. [f] Cooks, S., Tjandraatmadja, G., Ho, A., and Sharma, A., 2009. *Definition of decentralised systems in the South East Queensland context. Urban water security research alliance technical report No. 12.* [g] South Australian Department of Environment, Water and Natural Resources (DEWNR) via communication. [h] Victorian Department of Health via communication.

Source: The CIE.

D Treatment type subgroups

D.1 Alignment of treatment types to subgroups

Treatment type subgroup	Treatment type	
Oxidation	Oxidation pond Pond Oxidation ditch Aerated lagoon Maturation lagoon Facultative lagoon	Lagoon Polishing Lagoon Balancing Lagoon Aerated pond Extended Aeration
Disinfection	Disinfection UV disinfection Chlorine disinfection Chlorination UV technology	Primary chlorine disinfection Oxidative UV disinfection Secondary chlorine disinfection UV
Membrane technology	Membrane filter technology Membrane Membrane operating system Membrane filtration Reverse osmosis	Desalination (secondary membrane system) UF membrane Secondary reverse osmosis
Biological treatment	Biological treatment Biological treatment process Biological nutrient removal	Biological de-nitrification Biological reactor
Pre-treatment	Secondary Tertiary	Tertiary filtration High-rate primary
Bioreactor	Bioreactor Aerobic membrane bioreactor	MBR membrane plant
Filtration	Filtration Microfiltration Ultrafiltration Wetland filtration Sand dune filtration	Disc filters Sand filtration Trickling filter High rate trickling filter
Activated sludge	Activated sludge Activated sludge (IFAS/MLED plant) Activated sludge SBR/BNR	Integrated fixedfilm activated sludge Activated sludge BNR Pasveer channel
Other	IDEA Port Macquarie tank Bathurst box Dentrification Deionisation Imhoff tank Alum dosing	Dissolved air floatation and filtration Winter storage Septic tank effluent disposal scheme Add N and P Add P

Source: The CIE.

E Government subsidies

The state and federal governments have provided substantial subsidies over the past decade to promote recycled water schemes. This is likely to have been a key driver of the recent growth in the number of schemes. Many of the schemes are not commercially viable and without Government subsidies, it is unlikely that the schemes (particularly smaller schemes) would have been constructed. Therefore, the future growth in recycled water schemes will depend to a large extent on availability of future government grants to support the schemes. In the longer term, however, if Indirect Potable Reuse is accepted this will increase the financial viability of these schemes.

Overview of Commonwealth and state schemes

A list of some of the rebates for water recycling projects recently available are detailed below for each jurisdiction.

National

National Urban Water and Desalination Plan

The National Urban Water and Desalination Plan, a key component of 'Water for the Future', invested $1 billion to establish new sources of water supply through the use of desalination, water recycling and stormwater harvesting.

The Government committed a minimum of $200 million under National Urban Water and Desalination Plan for urban stormwater harvesting and reuse projects that reduce the demand on potable water supplies. Common uses of harvested stormwater include the irrigation of parks, ovals and golf courses and other municipal and commercial purposes. Support will be provided through a competitive grant process over two funding rounds. The outcomes of the first round have been announced and the Government is providing $86 million for thirteen stormwater harvesting and reuse projects in Brisbane, Melbourne, Geelong, Ballarat and Adelaide

The second round is open and applications for stormwater harvesting and reuse projects may be submitted until the closing date of 10 February 2010. Project funding is available for 50 per cent of eligible capital costs. The minimum project size is $4 million (eligible for funding of $2 million). While there is no maximum project size, funding is capped at $20 million (GST exclusive) per project. Funding is available for project work to be completed by 30 June 2013.

Third round - The Stormwater Harvesting Program funded under the National Urban Water and Desalination Plan provides funds for urban stormwater harvesting and reuse projects. In 2010 the Program was expanded, making an additional $100 million available for a competitive grants round and two specific projects in South Australia (Waterproofing Eastern Adelaide and Waterproofing Greater Gawler). In 2011, funding of $50 million was scaled back from the project due to government wide-savings measures. Applications for this round closed in December 2011. Likely to be the last round. Available to projects with a minimum cost of $2 million, maximum project funding is 50 per cent and project work must be completed by June 2016.

Water Smart Australia

The $1.5 billion Australian Government's Water Smart Australia Program aimed to accelerate the development and uptake of smart technologies and practices in water use across Australia. Across Australia, Queensland, Victoria and New South Wales received the majority of this funding, 35 per cent, 28 per cent and 24 per cent respectively.

In some cases the proportion of project cost funded through the Water Smart Australia Program was greater than 50 per cent, with a selection of projects completed in New South Wales receiving 60 to 70 per cent of the project cost in Federal and State government funding combined (table E.1).

E.1 Select projects funded under the Water Smart Australia Program

Name of project	State	Federal funding	State funding	Total cost of project	Total cost funded by government[a]
		$m	$m	$m	%
Berrindale Sewage Treatment Effluent Reuse -Coolamatong Golf Course	NSW	1.0	0.85	3.1	60
Braidwood Sewage Treatment Plant Upgrade	NSW	3.3	3.3	10.19	65
Chatswood CBD and Civic Place Stormwater Management	NSW	2.38	1.88	7.14	60
Tumbarumba Water Treatment Plant Upgrade	NSW	2.0	0.73	4.03	68
Glenelg to Adelaide Park Lands Water Recycling Project	SA	30.15	0	76.25	40
Geelong Shell Water Recycling Project	VIC	20.0	0.0	93.84	21
Bendigo Water Recycling	VIC	6.3	0.0	47.0	13
Western Corridor Recycling Plant	QLD	408		2 500	16

[a] Proportion of cost funded includes both Federal and State government funding.

Source: Australian Government Department of Sustainability, Environment, Water, Population and Communities, *Water Smart Australia projects sorted by state.* www.environment.gov.au/water/policy-programs/water-smart/projects/index.html

New South Wales

Climate Change Fund

The Water Savings Fund component of the Climate Change Fund allocated $46.5 million across 82 recycling, water efficiency, harvesting and groundwater projects. Approximately 60 per cent, $27.6 million, of the Water Savings Fund was allocated to 32 projects specific to water recycling. In some cases, government funds contributed 30 per cent of the project's total cost, for example:

- Construction of a wastewater treatment plant at Pennant Hills Golf Club. The total project cost was $3.5 million, of which 31 per cent, $1.1 million was funded through the NSW Water Savings Fund.
- Sydney Airport Water Recycling Project. The total cost of the project was approximately $10 million, of which 30 per cent, $3 million, was funded through the NSW Water Savings Fund.

Central Coast Water Savings Fund

Under the NSW Climate Change Fund, $2 million a year is provided under the Central Coast Water Savings Fund.

Eleven recycling projects were recently funded under the Central Coast Water Savings Fund, receiving a total $1.8 million in funding (table E.2).

E.2 Recycling projects funded under Central Coast Water Savings Fund

Project name	Proponent	Project activity	Funding ($)
Recycling to Save and Survive	Aqua Jet Car Wash Pty Ltd	Installed wastewater recycling system	36 500
Sanitarium Integrated Water Strategy	Australian Health and Nutrition Association Limited	Installed reverse osmosis plant	287 363
Process Water Recycling and Stormwater Harvesting Project	Effem Foods Pty Ltd	Introduced microfiltration and reverse osmosis technologies	725 000
School recycled water reuse project	Gwandalan Public School	Installed pipeline	55 000
Waste Water Recycling for Cooling Tower Make-up	Ingham Enterprises Pty Limited		367 373
Kincumber Golf Club Connection to Gosford City Council Recycled Water Main	Kincumber Golf and Sports Club Limited		33 345
Kincumber is Sustainably Saving (KISS)	Kincumber Public School	Upgraded irrigation system to be connected to Gosford Council's recycled water pipeline	56 679
Swimming pools backwash recycling project	Mingara Recreation Club Ltd	Introduced ultrafiltration, reverse osmosis treatment and chlorine disinfection	114 300
Ozone laundering for aged care facility	Sanctuary Point Developments Pty Ltd	Installed ozone generation and water recycling system	32 850
Recycled water to salvage gardens in aged care facilities	Uniting Care Ageing - Hunter, Central Coast and New England	Installed pipeline to deliver treated water from local STP	80 000
Green Central - Water Catchment, Treatment, Recycling and Education	Youth Connections	Integrated rainwater harvesting, wastewater recycling and groundwater harvesting	23 000

Source: The CIE

NSW Public Facilities Program

This program provided $30 million over 5 years for non-profit public or educational facilities for projects that save, harvest and recycle water. There are 2 funding rounds per year.

LGSA Water Loss Management Program

Provided $22 million for local water utilities to adopt innovative and practical water-saving solutions

Queensland

Queensland Sustainable Energy Innovation Fund (QSEIF)

The Queensland Sustainable Energy Innovation Fund provided grants of up to $200 000 for specific projects relating to renewable energy, energy efficiency, water and biomass. One finalised project, completed by Water Gurus in 2007, related specifically to water recycling. The project adapted an existing blackwater and greywater filtration system to be used for domestic greywater treatment purposes. QSEIF provided $194 400 towards this project.

The QLD Department of Environment and Heritage Protection stated the Queensland Sustainable Energy Innovation Fund, which includes QSEIF, was identified for savings. As such no funding will be available for further QSEIF projects.[60]

Victoria

Victorian Smart Water Fund

The Smart Water Fund is an initiative of the Victorian Water Industry and the Victorian Government established in 2002. The five funding partners include City West Water, Melbourne Water, South East Water, Yarra Valley Water and the Department of Sustainability and Environment.

Over eight funding rounds, approximately $25 million has funded approximately 180 projects to date. A new round opened in March 2011 providing $100 000 to $500 000 to support projects that investigate new technologies and approaches to water management, and demonstrate a benefit to Victoria's Water Industry.

Stormwater and Urban Recycling

Stormwater and urban recycling projects have been funded under two funds;

- Stormwater and Urban Water Conservation Fund (SUWC); and
- Stormwater and Urban Recycling Fund (SUR).

60 Queensland Department of Environment and Heritage Protection, *Queensland Sustainable Energy Innovation Fund (QSEIF)*. http://www.ehp.qld.gov.au/qseif/ (Last updated 24 May 2012).

Round two of the Victorian Government's Stormwater and Urban Recycling Fund closed for applications in August 2010.

Table E.3 includes a selection of projects funded under the Stormwater and Urban Conservation Fund. The majority of projects received between 40 and 50 per cent of the total project cost in funding from the Stormwater and Urban Water Conservation Fund.

E.3 Selection of projects funded by Victoria's Stormwater and Urban Water Conservation Fund

Project name	Proponent	Total funds requested	Total cost of project	Proportion funded by SUWC
Water Saving Wachter Wetlands	City of Greater Dandenong	61 100	130 657	47%
Sunbury Recycled Water Project (Clarke Oval, Sunbury College and Salesian College	Hume City Council	175 000	270 000	65%
Catani Gardens Stormwater Capture and Re-use project	City of Port Phillip	250 000	527 250	47%
Hampton Primary School Stormwater Conservation for Environment and Education Project	Bayside City Council	10 000	20 000	50%
Edendale Water Wise Community Nursery and Gardens	Nillumbik Shire Council	76 000	152 000	50%
The Ballam Project	Frankston City Council	250 000	2 590 000	10%
Greening our future - Woodend Racecourse Reserve	Macedon Ranges Shire Council	181 750	393 330	46%
Recycled Water Supply Project - Gisborne Sportsground and Botanic Gardens	Macedon Ranges Shire Council	53 000	106 000	50%
Footscray Park - Stormwater Recycling Project	Maribyrnong City Council	250 000	767 000	33%
Sorrento Stormwater Reuse Project	Mornington Peninsula Shire	249 900	577 900	43%
Sustainable Irrigation Initiative - Lake Guthridge	Wellington Shire Council	75 000	150 000	50%
Water Reuse Project - Aerodrome Ovals Recreation Complex	Mildura Rural City Council	176 700	371 000	48%
Stormwater re-use for the Charlton Community	Buloke Shire Council	69 000	154 800	45%
Demonstration of system for treatment and processing of stockyard solid waste, recycling of wash-down and stormwater for reuse	City of Ballarat	81 000	162 000	50%
Combining Stormwater and Recycled Water Usage at Flinders Community College	South East Water Ltd	115 100	230 200	50%
Mernda Villages ASR Scheme	Stockland Development Pty Ltd	250 000	1 105 000	23%
DMS Glass Conservation and Recycling of Potable Water, while reducing landfill	Don Mathieson & Staff Glass Pty Ltd	192 632	568 421	34%
Stormwater use at Lyco Industries	Lyco Industries Pty Ltd	30 000	60 000	50%
Water Recycling at Bulace Dyeing	Bulace Dyeing Pty Ltd	40 000	80 000	50%

Source: Victorian Department of Sustainability and Environment, Stormwater and Urban Water Conservation Fund. http://www.water.vic.gov.au/__data/assets/pdf_file/0017/10448/Round1BusinessandOtherprojects.pdf

Importance of Government grants for water recycling projects

The importance of the Government grants for the viability of future recycled water schemes is highlighted in the tables above. Government subsidies make up a large proportion of the upfront capital costs of the scheme.

The recent Decentralised Water Master Plan 2012-2030 for the City of Sydney also highlights the reliance on Government funding. The Plan lists 4 possible new schemes that are being considered and the level of subsidies required to ensure the viability of the schemes. The Plan notes that currently the schemes are not viable and subsidies are required for the schemes to be "viable and effective".[61]

Similarly, in May 2011 Yarra Valley Water decided not to proceed with the implementation of a recycled water network for Wonga Park. Based on the construction tenders received, the cost of the infrastructure required to provide recycled water to Wonga Park is approximately $10.4 million. Yarra Valley Water was prepared to contribute $1 million toward this project.

The extent to which the federal and state Governments will continue funding water recycling schemes into the future is uncertain.

Recently State and Federal governments have cut back funding for water and energy efficiency programs to meet budget constraints. For example, the funding bucket for the national Stormwater Harvesting Program (part of the National Urban Water and Desalination Plan) was reduced from $100 million to $50 million in 2011. In Queensland, funding ceased for the Queensland Sustainable Energy Innovation Fund.

Given this trend, it appears unlikely that the substantial funding, as has been available in the past, will be available for medium to large-scale water recycling projects in the near future.

Rebates for small scale recycled schemes to fund the households' purchase and installation of water efficiency appliances still remain available from some jurisdictions. Examples of these schemes include the New South Wales government's *Water 4 Life Program* and the Victorian government's *Living Victoria Water Rebate Program.*

61 See GHD (2012), Assessment of Conceptual Water Recycling Initiatives, Report for City of Sydney- Decentralised Water Master Plan, p88

F Qualitative assessment of potential benefits

The estimated expected net benefits presented in the main body of the report have been confined to those upon which it has been deemed reasonable to assign a dollar value. They have been estimated by restricting analysis to projected growth in demand for technologies

- where the recycled water to be produced by the technologies requiring validation is for non potable use but involves some material risk of human contact;
- where the proposed treatment process does not require on- site validation.

The quantified benefits from the establishment of a NatVal scheme estimated in the present study may be augmented by further gains if, for instance, the validation process, or elements of it, were extended to technologies involved in

- treatment of sewage for non potable uses other than those where risks associated with possible human contact, and therefore pathogen removal, is the focus;
- treatment of water for non potable use from sources other than sewage, particularly stormwater and grey water;
- treatment of water for potable use either from primary (bulk water) or recycled (indirect or direct potable recycling) sources, or from desalination.

Extension to wastewater schemes where human contact probabilities are low

As currently proposed, NatVal certification of the ability of an individual treatment barrier and the system in which it is proposed to be embedded is directed at managing pathogen levels in sewage source water where uses could involve human contact. The underlying rationale for validation rests on perceived risks to human health given the risk of human contact because of the type of use. From the available data fewer than half of the existing wastewater/sewage- based schemes documented in this study are likely to be serving 'human contact' uses (around 40 per cent). The remainder, which involve little if any assessed risk of human contact, refer to uses like industrial cooling and other contained processes, water used for woodlot irrigation etc and to cases where human contact risks are managed through regulated application. (This would include restricted time of use irrigation to minimise human contact on playing fields etc.)

To contribute to the assessed benefits of NatVal, extension of the framework to include some of these schemes would have to satisfy one of the following:

- assessed risks of contact and related adverse health risks are currently understating true risks which application of a NatVal approach would reduce. That is, despite assessed low or negligible risks of human contact there are nevertheless sufficient remaining health risks to justify bringing what have previously been 'validation free' treatment schemes under what would be a uniform national requirement;

- there may be measurable environmental risks which would be mitigated as a spillover benefit from NatVal
- while any residual health risks are acceptable, current methods of managing any such residual risks are not cost effective when compared with the application of NatVal.

To quantify these prospective gains from an extension of NatVal would require assembly of some evidence that at least one of these propositions holds. As noted in the body of this report at least one state (Queensland) appears to be implicitly rejecting the first of these prospective benefits in its proposal to reduce the breadth of wastewater treatment schemes requiring validation of technology.

A case for extending NatVal's application to wastewater reuse schemes beyond the equivalent of 'Class A' wastewater treatment and reuse is helped by the large number of these schemes, provided validation itself is deemed to offer net benefits compared to the status quo. However, an unknown but possibly large proportion of such schemes rely on either treatment barriers that would require in-situ validation or replacement of existing treatment components with ones not pre-validated.

Extension to stormwater treatment for recycled use

Unlike treated wastewater, stormwater treatment for reuse, even in relatively high exposure cases which might parallel 'Class A' recycled wastewater uses, is not widely subject to validation requirements. NSW is the only jurisdiction where validation requirements are imposed and then only to high exposure end use cases for schemes that are regulated by the WIC Act that governs private sector schemes.[62] The authority responsible for issuing licences under the WIC Act is IPART and it can impose validation as part of licensing requirements. As the NSW Office of Water explains:

> 'Before a scheme begins commercial operation, a network operator licensee is required to prepare an Infrastructure Operating Plan and a Water Quality Plan demonstrating how the licensee will comply with the 12 elements of the risk management framework, *including a plan to validate and verify the infrastructure*.' (our italics, NSW Office of water p.65)

There are indications that validation requirements may be extended in NSW beyond the WIC Act to all high exposure schemes. This would include some council run schemes. In all jurisdictions, local councils in many cases have the responsibility for their construction and operation. In NSW, according to the Office of Water some larger councils are already voluntarily undertaking validation and verification measures.

Whilst available reliable data is again dominated by NSW sources and so should be treated cautiously in generalising, stormwater re-use schemes where there is prospective human contact represent more than half of the documented cases. This result contrasts with wastewater re-use where, as noted, human contact schemes are a minority.

62 See, for example, Metropolitan Water Directorate (2012) *Urban Water Regulation Review - Discussion Paper,* November.

The *Australian Guidelines for Water Recycling: Stormwater Harvesting and Re-use* (2009 p.17, hereafter referred to as the *Stormwater Guidelines*) suggest a standard approach for the management of health and environmental risks from 'an urban stormwater re-use scheme involving the irrigation of small to medium scale open space irrigation schemes' such as playing fields, golf courses, parks and gardens etc. A distinction is made between schemes (particularly large ones) which involve applications other than these and schemes where a third party is supplied with the product.

The *Stormwater Guidelines* suggest that where stormwater is a source of open space irrigation arising in a sewered, largely residential catchment, management of health risks may be undertaken in either of two ways:

- on site access controls to minimise exposure;
- additional treatment.

In the latter case, treatment criteria in the form of suggested log reduction parameters for disinfection to manage viruses, bacteria and protozoa are set out along with E. coli limits. The typically lower turbidity of stormwater compared to sewage as a source allow lower LRV targets for protozoa, bacteria and viruses to be set. Turbidity and iron recommended limits are also set out. The *Stormwater Guidelines* refer specifically to UV disinfection and chlorination and recommend validation of UV disinfection units as part of risk management regimes. They also recognise the wide variations in retention of indicator bacteria in 'conventional' stormwater treatment measures such as constructed wetlands and state that 'If these measures are to be used as the only technique for managing health risks their retention of reference pathogens or suitable surrogates must be validated'.[63]

While the *Stormwater Guidelines* emphasise disinfection as the key treatment component for small-to-medium reuse schemes (possibly preceded by filtration to deal with turbidity) they state that 'large schemes involving dual reticulation may need to incorporate more sophisticated treatment, such as membrane filtration, reverse osmosis or lagoon storage with disinfection'.[64]

Given the apparent relative frequency of 'human contact' stormwater recycling schemes, and the suggested need for validation of disinfection measures and of conventional treatments there would appear to be reasonable scope for extending NatVal to cover this apparently growing component of water recycling. However, it is noted that this extension requires clarification in the way in which the term 'validation' is interpreted for wastewater versus stormwater treatments to which NatVal procedures might apply. It also requires further consideration of the relevant technologies for stormwater treatment and the extent to which use of currently unvalidated technologies might drive demand for validation services should validation become a much more widespread requirement.

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63 EPHC (2009) *Australian Guidelines for Water Recycling: Stormwater Harvesting and Re-use,* p26.

64 EPHC (2009) *Australian Guidelines for Water Recycling: Stormwater Harvesting and Re-use,* p64.

In situ requirements and turbidity issues – small and medium schemes

Unless the scope of NatVal validation processes were extended to include in-situ requirements, NatVal would not be an appropriate vehicle for validating 'conventional' constructed wetland treatment approaches where these are not supplemented by further treatment steps. The *Stormwater Guidelines* nevertheless call for 'validation' with respect to retention of reference pathogens (p.26). This necessarily entails on site monitoring of these types of systems before declaring them operational. This is not within the ambit of NatVal as currently proposed.

Turbidity is an issue for treatment effectiveness for health risk management for both wastewater and stormwater, and for drinking water. High levels of turbidity of the source stormwater appear to be a limiting factor in extending the application of NatVal, and its perceived benefits, to this source, at least for small and medium schemes because of the potential need for cost effective in-situ components to deal with turbidity.

A subset of stormwater schemes may nevertheless fit within the NatVal framework. These would include situations identified where turbidity falls within acceptable limits. The *Stormwater Guidelines* (p.74) suggest the following:

> 'Treated stormwater with turbidity 0–2 NTU (95th percentile), with occasional short-term peaks (turbidity <5 NTU) can be disinfected using standardised, validated processes. The installation of standardised processes that have been previously validated (off-site or at another site) for similar quality surface water disinfection, can obviate the need for site specific, in situ validation testing. Ongoing verification testing during operation (weekly E. coli monitoring) is required.'

If this view were widely accepted by approving authorities, proposed schemes with these characteristics would seem to fit within the NatVal framework and would enlarge the application of its activities, as site- specific requirements for validation would not apply. The dimensions of the NatVal database would require some expansion to accommodate stormwater- specific treatment parameters and guidance.

The source of net benefits from this extension would be limited and would not fully align with those quantified benefits from the application of NatVal to future wastewater treatment schemes. The estimated quantitative net benefits from applying NatVal to wastewater to replace existing validation arrangements for individual state jurisdictions rely on:

- removal of duplication of validation effort; and
- the prospect of reducing the number of treatment steps mandated as a result of improved certainty about the pathogen reduction capabilities of MBR- based systems – specifically the possibility of reduced UV treatment..

The *Stormwater Guidelines* suggest (p.64) that 'the most appropriate approach to stormwater treatment for small- to- medium reuse schemes is disinfection, possibly preceded by filtration for turbidity control.' The criticality of UV disinfection for stormwater schemes means that whilst there would be benefits from reduced duplication of validation effort applied to UV and chlorination disinfection under NatVal, there is unlikely to be scope for reducing the UV treatment step via NatVal participation unless

MBR or equivalent technology precedes it. The number of stormwater schemes where 'MBR plus' treatment is the norm is likely to be small.

Furthermore, the reference in the *Stormwater Guidelines* for the scope to use 'standardised', pre-validated technologies means the duplication of effort- saving gains from applying NatVal would be limited in many of these small scheme cases. However, there would be some savings in avoided search costs for scheme proponents – predominantly local councils and some private enterprises – from ready access to a national database assembled and maintained under NatVal which documented already validated technologies with relevance to stormwater treatment.

The role of managed aquifer recharge for NatVal extension.

Aquifers, particularly confined aquifers, used to store stormwater provide various 'treatment' benefits which vary with the residence period of the pathogens in the raw stormwater being injected for storage and later reuse. The turbidity levels of water recovered from these aquifers will typically be significantly lower than raw stormwater, with related benefits in pathogen reduction prior to any post- recovery treatment – disinfection or other. This means that the proportion of stormwater reuse schemes amenable to treatment via standardised pre-validated treatment components will be higher the more prevalent is the use of this type of aquifer recharge. Reduced duplication of validation effort which would result from extending NatVal to these cases would be limited to cases where new, or yet- to- be- validated technology was proposed.

Extension to drinking water treatment

The scope for beneficial extension of NatVal services to drinking water depends in part on the current and likely future risk management approaches in this dominant part of the water sector. An important change is required in the *Australian Drinking Water Guidelines* (ADWG) and their implementation if drinking water technologies are to be subject to nationally consistent validation along the lines envisaged for recycled water.

The ADWG are 'a Framework for management of drinking water quality based on a preventive risk management approach' (p.4-1) rather than fully stipulating objective treated water quality standards. They advocate a multiple barrier approach as part of that strategy, in common with the recycled and stormwater guidelines. In some cases specific acceptable threshold values are given for guidance in operational monitoring (e.g for a list of toxic chemicals like dichlorobenzine etc). There is also detailed disinfectant dosing information and target levels of turbidity for post filter water and for residual chlorine are stated. However, unlike the wastewater guidelines envisaged as underpinning NatVal, the ADWG do not set out pathogen reduction targets in terms of LRVs for use in technology validation for membranes/ microfiltration, UV disinfection, chlorination plants etc. While the ADWG do call for validation of new equipment and upgrading (ADWG 3.9.3) as an integral part of the overall risk management strategy, no specific pathogen reduction targets are addressed. Rather, stakeholders are referred to the USEPA Drinking Water Guidelines manuals for these technologies.

While these technologies are variously represented in Australian drinking water treatment systems, their frequency varies with raw water supply quality. In systems with high quality raw water supplies treatment may be restricted to chlorine dosing (e.g. Melbourne). Where filtration to deal with the low concentrations of protozoa and bacteria is deemed necessary, in many cases it is confined to a basic sand medium filtration step. Where lower quality source water (e.g. from 'run of the river' extractions rather than from protected catchment reservoirs) additional treatment is common. However, in important instances basic filtration and disinfection is the method of choice even where source water is of lower quality (e.g. North Richmond in the Hawkesbury catchment).

Of the different kinds of membrane filtration processes, microfiltration is the most widely used in water treatment in Australia, becoming increasingly popular for small-scale water treatment plants supplying smaller communities in rural and regional Australia. This is because it is an effective treatment and is simple to operate. At present, there appears to be limited use of technologies which have been identified in this report as those where NatVal is likely to yield benefits in terms of increased certainty and reduction in treatment steps (MBR). They may have wider future application in small systems where source water is poor quality and where the ADWG are not being followed now but will be in future.

Through time, existing aging water treatment plants will be replaced with opportunities for new technology systems to be introduced which may require validation. A new pressurised membrane filtration system supplied by Siemens replaces a traditional 1964 large scale treatment plant in East Chicago. Similar instances may arise in Australia in coming years.

The pressure of population growth on drinking water sourced from traditionally 'clean' protected dam storages that have serviced most of the major Australian cities may in time open opportunities for both indirect potable recycling and possibly direct potable recycling (IPR and DPR). Limited surface water sources available to small and remote rural communities may also be an opportunity. In the case of IPR, there are already examples of the use of MBR technology as the treatment enabling drinking water to be supplied as a reuse product in small rural communities in dry areas. The settlement of Cloudcroft in New Mexico with a fluctuating population of up to 2000 is an example, according to MBR system suppliers Koch.

Conclusions

The application of the *Stormwater Guidelines* recommendations on validation appear to bring a significant number of existing and possible new reuse schemes under the potential umbrella of NatVal. However, the extension of NatVal - to stormwater reuse schemes is unlikely to bring large net benefits for the following reasons.

- While the proportion of human contact schemes (current and future) where stormwater treatment is required may be relatively high, many of these are likely to be small to medium sized schemes where either of the following apply:

  - Site-specific components of validation will persist for many schemes because of the physical heterogeneity of sites.
  - Where turbidity conditions permit, those schemes that do not require on site validation will frequently be adequately served by use of standardised prevalidated disinfection technology (UV and chlorination).
- For those larger schemes that involve aquifer recharge and storage, post- recovery treatment by technologies requiring validation is likely to be relatively uncommon.
- There may be limited opportunities to exploit the increased certainty from membrane technology treatment and MBRs that make possible reductions in future operating costs of some UV and chlorination steps in wastewater treatment because of the much more variable quality of stormwater.

A precondition for extending NatVal to cover validation of drinking water supply technologies is not currently met. Even though the range of technologies and treatment sequences used or open to drinking water suppliers are common to wastewater treatments, the target value of parameters for pathogen reduction in drinking water are not spelt out in the current guidelines.

According to stakeholders interviewed for this report, the need for LRV targets in the drinking water guidelines is currently being debated, but widespread support from jurisdictions is not assured. For NatVal to be applied to drinking water systems validation, perhaps as a second stage development of the Framework, agreement on the use of LRV targets would seem to be a precondition for generating any benefits of reduced duplication.

There are potential benefits from the implementation of the Australian Drinking Water Guidelines in instances where these are not followed at present. Validation of technologies is part of the risk management strategy presented in those guidelines. There is limited evidence on the current extent of such validation or even of compliance with the guidelines more broadly. It is therefore difficult to know the extent to which current human health risk levels are higher than they would be with national validation. The absence of explicit pathogen reduction targets from the guidelines makes any such assessment impractical. If there is a widespread trend to validation of new drinking water schemes in particular there is a similar case for avoiding jurisdiction-specific requirements as exists for wastewater systems validation, provided explicit pathogen reduction targets can be agreed.

The various unquantified benefits from extension of NatVal to accommodate stormwater and drinking water treatment appear to be modest, at least in the short term. However, the costs of opening the Framework up to cover stormwater treatment technologies where there is significant potential for human contact are also likely to be modest. The demand for validation services to cover this form of recycling could probably be covered initially without any substantial increase in NatVal resources. Therefore there is some benefit in extending NatVal to cover stormwater sources, to pre-empt potential future validation by individual jurisdictions, where the potential duplication of effort can be avoided upfront by extending NatVal at a relatively modest marginal cost.

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