SAFE AND SECURE WATER PROGRAM (SSWP)

Risk prioritisation, scoring and reasons fact sheet

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Water Quality Assessment Criteria

Overview

The *Australian Drinking Water Guidelines* describes a preventive, risk-management approach to managing drinking water quality. This approach moves away from relying on water quality testing to determine water safety, instead looking at risks to unsafe water and how these are controlled and monitored. The 12 elements of the framework for Management of Drinking Water Quality reflect this approach.

Water quality risks have been prioritised by applying this Framework, addressing a wide range of risks and mitigation measures for individual drinking water supply systems.

Objective

The water-quality component of the prioritisation framework assesses the risks to health posed by public drinking water supplies. The assessment focuses on risks in the source water, barriers in the drinking water supply system to manage these risks and management of the integrity of the distribution system. Pathogen contamination is the greatest risk to water supplies. Drinking water systems must maintain multiple robust barriers appropriate to the level of potential contamination in source water.

The assessment and ranking of water quality risks reflects the degree of control applied to contamination risks from specific water quality hazards: *Cryptosporidium*, other pathogens, cyanobacteria, chemical and radiological contamination, and aesthetic challenges. The score is based on an assessment of the potential hazards in the source water and barriers currently in place to prevent the public being exposed to them. The water quality risk score for a supply system is the highest score for any of the five water quality hazard categories.

The initial priority scores for water quality are based on *Cryptosporidium* risks and other pathogen risks. NSW Health has carried out a state-wide modelling assessment of *Cryptosporidium* risks to identify supply systems that may need a higher standard of operation or new infrastructure to deal with this chlorine-resistant pathogen. The model considered potential *Cryptosporidium* sources in the catchment(s) and any existing controls, such as reservoir detention and water treatment. The model uses information provided by water utilities to determine the *Cryptosporidium* risk and associated water-quality risk score. NSW Health has separately communicated the preliminary findings of this risk assessment to local water utilities. Councils have been invited to confirm the information in this assessment. The Department of Planning, Industry and Environment will update Safe and Secure Water Program risk impact scores where necessary.

Risks from other pathogens have largely been identified through the work of contractors engaged by NSW Health to support water utilities to implement drinking water management systems. NSW Health has provided support projects since 2014 and contractors provide reports to local water utilities at the end of each project. NSW Health notes that risks identified in earlier years may now have been addressed. Types of risks include:

- catchment risks
- treatment barriers not adequate to manage risks in source water
- potential for contamination of water in distribution systems
- operational monitoring equipment not adequate to determine if barriers are effective
- operational challenges and risks, particularly for key treatment barriers.

These risks may be managed with infrastructural and/or non-infrastructural solutions.

The cyanobacteria, inorganic chemical and radiological risk categories allow us to set priorities for supply systems as these risks are identified. We have not used aesthetic risks to determine priorities at this time.

We do not factor impact or population into the risk score. This approach is consistent with the Australian Drinking Water Guidelines, which does not allow a lower level of service, in terms of drinking water quality risk, for smaller populations compared to larger populations.

Note: No water quality risk assessment has been undertaken if the existing town water supply system has been declared to be a non-potable (not for drinking) system. We can assess risks and apply priorities where a council and the community wish to convert a non-potable system into a potable system or provide potable reticulated water to an un-serviced community.

The following table shows the water quality risk categories with the criteria for the risk scores from zero (lowest) to five (highest).

Table 1. Water quality risk scores with outcomes and examples

Score	Risk outcome	Risk examples
5	Drinking water management fails to effectively control chlorine sensitive pathogens.	New or additional treatment barrier needed to control pathogens effectively.
5	Drinking water management fails to effectively control chlorine resistant pathogens, such as *Cryptosporidium*.	High risk from *Cryptosporidium* as assessed by NSW Health.
5	Drinking water management fails to control health related chemical and radiological parameters.	Health related chemical and/or radiological characteristics consistently measured in drinking water above Australian Drinking Water Guidelines value, with no effective barrier available.
5	Drinking water management fails to control risks from cyanobacteria.	Evidence of raw water source experiencing potentially toxic cyanobacteria blooms, with no effective barrier available.
4	Drinking water management fails to effectively control chlorine sensitive pathogens.	Upgrade, repair or replacement of existing treatment barrier needed for effective primary disinfection. Improved process monitoring and control required to effectively manage barriers to pathogen contamination
4	Drinking water management fails to effectively control chlorine resistant pathogens, such as *Cryptosporidium*.	Medium-high risk from *Cryptosporidium* as assessed by NSW Health.
4	Drinking water management fails to control health related chemical and radiological parameters.	Health related chemical and/or radiological characteristics measured in drinking water above ADWG value due to ineffective operation of a treatment barrier.

Score	Risk outcome	Risk examples
4	Drinking water management fails to control risks from cyanobacteria.	Evidence of raw water conditions known to encourage cyanobacteria blooms, with no effective barrier available.
3	Drinking water management fails to effectively control chlorine sensitive pathogens.	Poor operation and maintenance of reticulation infrastructure which fails to control risk from chlorine sensitive pathogens. Critical control points and procedures not documented appropriately.
3	Drinking water management fails to effectively control chlorine resistant pathogens, such as *Cryptosporidium*.	Medium risk from *Cryptosporidium* as assessed by NSW Health.
3	Drinking water management fails to control health related chemical and radiological parameters.	Improvement required for treatment barrier to ensure known chemical and/or radiological characteristics are managed effectively. No evidence of exceeding Australian Drinking Water Guidelines in drinking water.
3	Drinking water management fails to control risks from cyanobacteria.	Improvement required to existing barrier to manage potentially toxic cyanobacteria blooms.
2	Water quality management effectively manages water quality risks	
1	No assessed scores of 1, all water supplies have some level of risk	
0	No information available to make an assessment	

Water Security Assessment Criteria

Overview

Water security is important to ensure long term continuous access to reliable drinking water supply and water for sanitation. Uninterrupted long-term access to water allows communities to grow and thrive by contributing to good public health, economic development opportunities, social amenity and liveability and revenue needed for utilities to meet fixed costs.

Fresh water is a finite resource and is highly influenced by climate and weather patterns; therefore, all water supply systems are planned and sized to accommodate moderate levels of restrictions. The planning and sizing of town water supply systems in regional New South Wales (NSW) also takes into consideration historical and future consumptive needs, as well as climate, in consultation with the community. Australia, with its highly variable wet and dry weather patterns, depends heavily on the size of the surface and ground water storages, and access to these storages, for its water security.

Objective

The primary purpose of the water security component of the prioritisation framework is to assess the long-term risk a regional town water supply system faces in accessing a reliable water source. This access risk has been assessed after considering the frequency and duration of water restrictions and the availability of water in the systems to meet demand under moderate restrictions. The social and health impacts of water restrictions are significant, but the consequences of running out of water can be catastrophic, requiring water carting, immediate access to alternative drinking water sources or evacuation. To avoid running out of water, long-term planning for water security is always future focused, it considers the practicality of implementing tactical emergency measures, such as higher levels of restrictions and water carting.

To consider these tactical measures, we combine the inherent water security access risk with the population serviced by the water supply system. By accounting for the practicality of implementing emergency measures, such as water carting, we can arrive at an overall water security risk impact score. Water carting is generally not considered practical for populations over 1,000 people.

The water security access risk profile of a town water supply system in regional NSW is dependent on the type of the water source and the size of storage. There are four main fresh water source types used for drinking in town water supply systems across regional NSW. These are unregulated rivers, regulated rivers, groundwater and roof water harvested in rainwater tanks (i.e. in communities with no reticulated water supply system.

Water Security Deficiency Index (WSDI)

The water security deficiency index (WSDI) is the ratio of the water security access risk to demand. The water security access risk is the shortfall in a system's headwork capacity referred to as secure yield and the forecasted annual unrestricted drinking water demand placed by the community on the system's headworks. Secure yield is the highest annual drinking water demand that can be supplied from a water supply headworks system while meeting the 5/10/10 design rule. It is determined using a system specific hydrologic water balance computer model that incorporates historical and future metrological information.

The WSDI is based on the 5/10/10 design rule for water supply headwork infrastructure, which states that the:

- duration of drought restrictions should not exceed 5% of the time
- frequency of restrictions should not exceed 10% of years

- severity of restrictions should not exceed 10% that is, the system should be able to meet 90% of unrestricted water demand during the worst recorded drought at the level where restrictions are imposed.

Communities that harvest **roof water** in rainwater tanks that is, communities with no reticulated water supply system, generally have a WSDI of 100%, as they can be expected to regularly run completely out of water during periods of below average rainfall. This problem cannot be economically addressed with larger household storages since the surface area of the roof is the primary determinant of refill volumes. During these times, it is more cost-effective for small communities to cart water. For communities in excess of 1,000 people, water cartage in the event of a supply failure is less feasible. Thus, for a small community, when the WSDI score and the population score is multiplied, the overall water security risk impact score will be lower compared to a larger community with the same score.

For town water supply systems that use **unregulated rivers** as their supply source, the WSDI is calculated using the methodology described in *Assuring future urban water security: assessment and adaption guidelines for NSW local water utilities*, which applies the 5/10/10 rule to calculate the secure yield. For town systems that do not currently have reliable assessment of secure yield, the guideline methodology was extrapolated to these systems to estimate the WSDI.

Town water supply systems serviced by **regulated river systems** typically have the most secure entitlements, owing to the large storage compared to the towns needs. These systems almost always receive 100% of their allocation as set out in the water sharing plan. However, during an extended dry period or drought, the water allocations to these town water supply systems could be significantly reduced as happened during the Millennium Drought. The department is completing drought reliability assessments, to determine the water security access shortfalls to towns, for the regulated river systems. To do this, it is using water sharing plan rules, water allocation principles and data from previous experiences. The findings of these studies, together with the location of these town systems in relation to the main regulating storage, have been used to calculate the WSDI to be in line with the 5/10/10 rule.

The town water systems that source water from **groundwater systems** have inherently varying water security risk depending on the type of aquifer and regional hydrogeology. In the absence of system-specific hydrogeological assessments, we have assessed water security risk based on past aquifer performances and general aquifer characteristics. The department considers water sourced from the Great Artesian Basin highly secure, with a WSDI of 5%. We consider town systems that are dependent on fractured rock type aquifers less secure with a WSDI of 20%. Town water systems with bores that draw on alluvial sources have security double that of the associated surface water system.

Methodology for Water Security Risk Ranking

The water security risk impact score is a combination of the inherent water security risk score and the impacted population, combined in accordance with the Australian Standards AS 4360/AS ISO 31000.

The inherent water security risk score is based on the: the higher the deficiency index, the higher the risk score. The WSDI takes into consideration the frequency and duration of access failures (of supply systems running out of water) and their possible consequential public health, social, environmental and economic impacts. The department undertook an analysis to determine risk thresholds, allowing it to assign an inherent risk score between 1 and 5 to each water supply system. Analysis suggests that the frequency of access failures is almost exponential with increases in the deficiency index and that the duration of failure significantly increases when the WSDI is equal to or greater than 11%. Based on these observations, the WSDI was assigned risk scores as follows:

Table 2. Inherent water security risk scores based on water security deficiency index.

Water Security Risk score	Water security deficiency index	Risk narrative
5	Equal to or greater than 11%	Generally, includes systems with no storages or small storage compared to consumptive needs and most communities that depend on harvesting roof water in rainwater tanks
4	Equal to or greater than 6% and less than 11%	Systems where the secure yield is significantly less than the future unrestricted annual consumptive needs circa 2040
3	Equal to or greater than 1% and less than 6%	Systems where the secure yield is less than the future unrestricted annual consumptive needs circa 2040
1	Less than 1%	Systems where the secure yield is at least equal to the future unrestricted annual consumptive needs circa 2040
0		No data available

The population risk score was established by grouping the serviced population into five groups. The higher population cut-off of 1,000 reflects the impracticality of implementing short-term emergency response measures. This is because drought affects a larger geographical area, meaning greater strain on regional resources, such as funds, water carters and operational personnel, and greater distance to reliable alternative water sources.

The risk impact scores, which are the combination of water security risk scores and the impacted populations, are categorised into five priority risk ranks, in line with the Australian Standards AS 4360/AS ISO 31000. The table below shows how we calculate risk impact scores based on these two factors.

Table 3. Water security risk impact scores based on population size and inherent risk score.

		Inherent risk score				
		5	4	3	1	
Population	>1000	5	4	3	1	Risk impact score
	>500-1000	4	4	3	1	
	>200-500	3	3	2	1	
	>100-200	2	2	2	1	
	≤100	1	1	1	1	

Environment Assessment Criteria

Overview

Sewage (wastewater) needs to be safely managed to prevent it negatively affecting public health or the waterways that receive it. The NSW Environment Protection Authority, as the regulator of council owned and operated sewerage systems, uses a risk based outcome focused regulatory approach.

Objective

The environment component of the prioritisation framework assesses the risk that sewage management poses to both public health and the uses and values of sewage receiving waterways. The assessment focuses on existing treatment technology and/or the management barriers used to manage these risks. Discharging untreated or partly treated sewage has serious consequences, it can potentially cause death or severe illness in affected communities and significantly affect waterways. Sewerage systems may require improvement to existing management practices, such as pumping sewage for treatment at different plants or the use of modern technology to implement new / additional barriers.

In regional NSW, sewage is generally either managed on-site or collected and transferred to an off-site sewage treatment plant. Sewage handing and treatment facilities (collectively referred to as sewerage and sewage treatment systems) are generally owned and operated by the local council under the *Local Government Act 1993 No 30* (LGA Act). Sewage treatment systems are regulated by the NSW Environment Protection Authority with or without an environment protection licence issued under the *Protection of the Environment Operations Act 1997*. Licences are generally not required for smaller sewage treatment systems if they can be operated without causing environmental pollution and where industry guidance can be followed to avoid pollution. On-site systems are regulated by the local council under section 68 of the LGA Act.

For the purposes of this risk prioritisation framework, sewerage and sewage treatment systems in regional NSW are grouped into three types.

1. **Sewered communities with unlicensed systems**, these systems are generally small with a processing capacity at or below the equivalent of 2,500 people or 750 kilolitres per day. Effluent management is generally by evaporation, reuse, such as for irrigation, and/or discharge.
2. **Sewered communities with licensed systems**, these systems typically service populations over of 2,500 people and use a discharge and/or reuse.
3. **Unsewered communities and towns**, these are generally small communities with populations below 500 people, but there are some communities with populations over 1,000. Sewage is managed through on-site treatment and soil adsorption systems.

The department has developed two risk assessment methodologies: one covering the first two types of systems and the other covering the third system. In both methodologies, the risk to public health and the risk to waterway uses and values exist equally. However, in order to consistently prioritise between this environmental risk framework and the water security and water quality risk frameworks, we prioritise the impact to public health.

The practicality of tactical measures in emergency situations depends on the size of the affected community. Therefore, the overall environmental risk impact score takes account of population size as well as the inherent environmental risk score.

Methodology for assessing environmental risk in type one and two systems

The risk assessment for sewered communities uses four risk criteria: regulatory action; performance; loading/capacity; and condition/age.

The following table outlines the basis for assigning the inherent risk score for each risk criteria. Inherent risk scores of between 1 and 5 will be assigned, with a score of 5 representing the highest environmental risk and a score of 1 the lowest environmental risk. A score of 0 is given where there is no information/data.

Table 4. Overall environmental risk impact scores for sewered communities.

Risk Score	Criterion one, regulatory action	Criterion two, performance	Criterion three, load/capacity	Criterion four, condition/age
5	• Pollution reduction program (PRP), effluent quality driven • PRP, asset design, condition or effluent quality driven	• Mismatch of sewage treatment plant (STP) technology and effluent management and wastewater quality deficiency index is greater than or equal to 20%	• Population exceeds capacity by greater than 10% and with high imminent growth prospect • Dry weather overflows	• Pre-1950-built facility or facility with condition rating of 5
4	• PRP, reuse driven • PRP, overflows and by-pass driven (I/I) • PRP, mass and volume limits driven • PRP, biosolids driven	• Opportunistic reuse with possible public contact but not to appropriate standards (AGWR and EPA) • Mismatch of STP technology and effluent management and/or wastewater quality deficiency index is less than 20%	• Population exceeds capacity by less than 10% and with high medium-term growth prospect • Wet weather overflows with high downstream user risk • Daily flow volume exceeds licence limits with high impact to receiving environment	• 1951–1970built facility or facility with condition rating of 4

Risk Score	Criterion one, regulatory action	Criterion two, performance	Criterion three, load/capacity	Criterion four, condition/age
3	• PRP, odour or noise issues	• Appropriate plant for effluent management (discharge and/or maximised reuse) **but** wastewater quality deficiency index greater than or equal to 20% • Dry or wet load bypasses or overflow in excess of state median	• Population equals capacity and with low medium-term growth prospect • Wet weather overflows with medium downstream user risk Daily flow volume exceeds licence limits with medium impact to receiving environment	• 1971–1990built facility or facility with condition rating of 3
2	• PRP, administrative • PRP, trade waste policy or implementation	• Appropriate plant for effluent management **but** wastewater quality deficiency index less than 20% • Opportunistic reuse with **no** public contact but not to appropriate standards (AGWR and EPA)	• Capacity exceeds population by greater than 10% and with low medium-term growth prospect • Wet weather overflows with low impact to receiving environment • Daily flow volume exceeds licence limits with low downstream user risk	• 1991–2010built facility or facility with condition rating of 2
1		• wastewater quality deficiency index of 0% • No known issues with reuse	• No known capacity Issue • No known volume limit exceedance	• Post-2011built facility or facility with condition rating of 1
0	• Insufficient Information	• Insufficient Information	• Insufficient Information	• Insufficient Information

The inherent environmental risk is taken as the highest score from any of the above 4 criteria. As described below, this inherent environmental risk score is then multiplied with the population score to obtain an environmental risk impact score.

Methodology for assessing environmental risk in type three systems

The table below outlines the basis for assigning the risk score for unsewered towns and villages.

Table 5. Overall environmental risk impact scores for unsewered communities.

Risk outcomes	Score based on risk
Primary health and high environmental impacts: wastewater from on-site wastewater management facilities has direct impact on drinking water supply source and/or with widespread direct primary contact impact to resident population and/or high impact on waterway uses and values.	5
Secondary health and medium environmental impacts: wastewater from on-site wastewater management facilities has localised direct primary contact impact to resident population and/or medium impact on waterway uses and values.	4
Tertiary health and low environmental impacts: wastewater from on-site wastewater management facilities may potentially contribute to public health impacts and/or with low impacts on waterway uses and values.	3
High risk on-site wastewater management facilities but has **no evidence** of public health impacts and/or impacts on waterway uses and values.	2
Medium risk on-site wastewater management facilities but has **no evidence** of public health and/or impacts on waterway uses and values.	1

The above environmental risk score is then multiplied with the population score to obtain an environmental risk impact score.

Methodology for Environmental Risk Priority Ranking

Combination of the inherent environmental risk score (likelihood of a hazard) and population (severity of impact) provides an environmental risk impact score. These impact scores are categorised into five priority risk ranks in accordance with the Australian Standards AS 4360/AS ISO 31000.

The population risk score was established by grouping the serviced population into five groups, with the highest population group, greater than the equivalent of 2,500 people, reflecting the POEA Act threshold.

The risk impact score, which is the combination of the environmental risk score and the population, is categorised into five priority risk ranks in line with the Australian Standard, AS 4360/AS ISO 31000. The table below shows how the risk impact scores will be ranked between 1 and 5.

Table 6. Environmental risk priority ranking based on population size and inherent risk.

		Inherent risk score					
		5	4	3	2	1	
Population	>2500	5	4	3	2	1	Risk impact score
	>1000-2500	4	4	3	2	1	
	>500-1000	3	3	2	2	1	
	>100-500	2	2	2	1	1	
	≤100	1	1	1	1	1	

Socio-Economic Factors Assessment Criteria

Socio-economic capacity does not influence the risk impact score. It is used to consider hardship and affordability issues faced by the **community** (not the proponent) affected by the identified risk or issue. The socio-economic criterion ensures that prioritisation considers the challenges faced by socially disadvantaged and/or remote communities.

Importantly, these criteria should help prioritise co-funding for a risk or issue that may have been previously identified but remained unmitigated for several years due to an inability to pay for the mitigating works.

Socio-Economic Capacity Criterion

Index of relative socio-economic disadvantage (IRSD)

The Australian Bureau of Statistic's socio-economic indexes for areas (SEIFA) product is a prime indicator for the socio-economic state of a community. It compares relative socio-economic characteristics, in terms of people's access to material and social resources and their ability to participate in society. Of the four SEIFA indexes, the index of relative socio-economic disadvantage (IRSD) is commonly used to rank the relative disadvantage of areas. It provides an objective measure to assess the funding needs of communities. The indexes include variables such as:

- percentage of low-income households
- unemployment rate
- percentage of low-skilled occupations and people without qualifications
- percentage of households without a car
- percentage of people living in overcrowded dwellings
- percentage of people with a disability
- other socio-economic variables that relate to people and families.

We have used the index of relative socio-economic disadvantage as an indicator for ranking this prioritisation criterion, as it reflects relative capacity of communities to pay for services.

Accessibility and remoteness index of Australia (ARIA+)

The accessibility and remoteness index of Australia (ARIA+) is a geographic measure of remoteness. It divides Australia into five classes of remoteness, based on relative access to services. The classifications are major cities of Australia, inner regional Australia, outer regional Australia, remote Australia and very remote Australia.

Difficulties in providing services and the cost of services may increase as remoteness from main service centres increases. We have used ARIA+ as an indicator for ranking this prioritisation criterion to further emphasise the special needs of remote communities. IRSD covers the main socio-economic factors associated with remote areas, except for the relatively higher costs of providing services in a remote community, a factor that may make services more unaffordable. We therefore consider a lower weighting on this indicator appropriate. There are other indicators that better reflect the relative cost of water services (discussed below).

Operation, maintenance and administration cost per property

Water supply and sewerage operation, maintenance and administration cost per property represents the relative cost of providing services, averaged over a three-year period. Operation, maintenance and administration cost reflects factors such as economies of scale and density, topography, discreteness of water services schemes, complexity of treatment process, cost of materials and labour and resourcing costs due to remoteness.

Prioritisation Matrix

Table 7. Socio-economic criterion prioritisation matrix.

Criteria	Indexes	Score	Weight (%)
Index of relative socio-economic disadvantage (lower index means more disadvantage)	Nominal local water utilities scale indexes developed based on Australian Bureau of Statistic's local-government-area or suburb indexes.	Scored 20–100 continuously with the most disadvantaged local water utilities scoring 100 and the least disadvantaged scoring 20	40
Accessibility and remoteness index of Australia (higher index means more remote)	Major cities (1) Inner regional (2) Outer regional (3) Remote (4) Very remote (5)	Scored 20–100 continuously with the most remote scoring 100 and the least remote scoring 20	20
Operation, maintenance and administration cost per property	Each local water utility: Water operation, maintenance and administration cost, and Sewerage operation, maintenance and administration cost, three-years average	Scored 20–100 continuously with highest operation, maintenance and administration cost scoring 100 and the lowest operation, maintenance and administration cost scoring 20	40

Prioritisation

Once we calculate the overall socio-economic score for each local water utility using the matrix above, we use it to prioritise water supply and sewerage risks only within their risk impact band.

This will ensure all priority risks ranked 5 are prioritised ahead of any risks ranked 4 and so on. The first risk prioritised for funding will have a risk impact score of 5 in the council area with the lowest socio-economic profile (Central Darling Shire Council), followed by any other risks with impact scores of 5 in the same council area. Below those will be projects with a risk impact score of 5 in the next lowest socio-economic council area (Bogan Shire Council) followed by any other risks with an impact score of 5 in that council area and so on.

Note: In the example above, there are other councils with a comparatively high socio-economic score but no risks scored 5.

This means all major impact risks (with a score of 5) will be prioritised council by council in order of highest to lowest socio-economic disadvantage, with funding allocated accordingly.

A map that lists socio-economic scores of all councils across NSW follows on the next page.

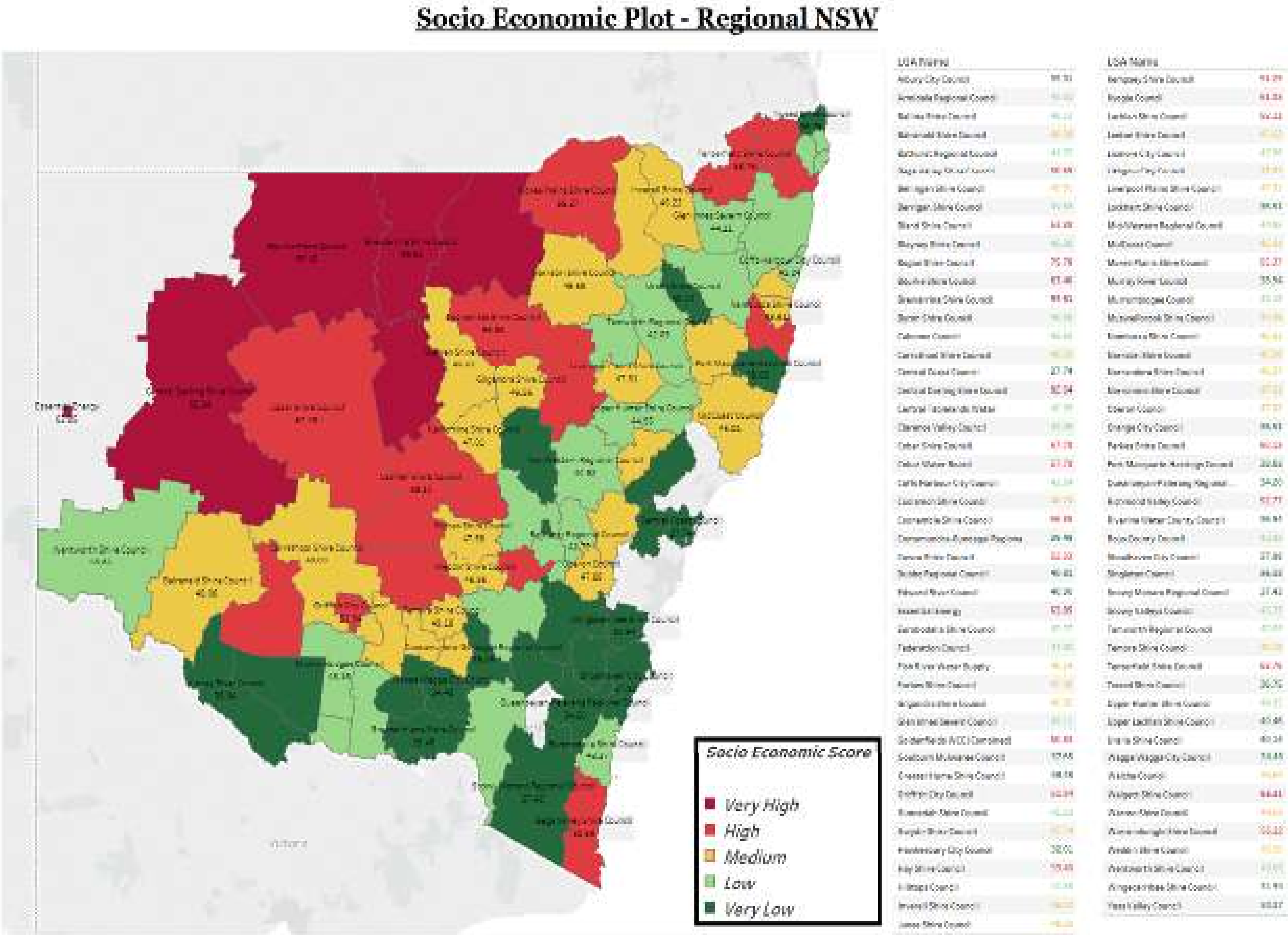

Figure 1. Map of regional NSW local government areas showing socio-economic score