Monitoring optimisation

DEWNR Technical report 2015/46

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

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Foreword

The Department of Environment, Water and Natural Resources (DEWNR) is responsible for the management of the state's natural resources, ranging from policy leadership to on-ground delivery in consultation with government, industry and communities.

Water is one of our most important natural resources. The future health, well-being and prosperity of South Australia depends on reliable and secure water supplies.

High-quality science and effective monitoring provides the foundation for the successful management of our environment and natural resources. Water monitoring data informs water policy and water management decisions and enables today's decisions to be evaluated in the future.

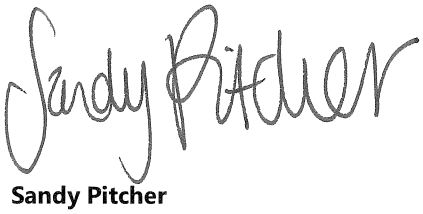
South Australia's water monitoring requirements continue to evolve, and water monitoring technology is rapidly changing. To remain up-to-date with these changes, our monitoring network needs to be coordinated state-wide, fit for purpose, adaptive and consistent.

DEWNR recognises that monitoring optimisation is a continuous process and is committed to a major review of the statewide water monitoring network every five years. This report is the outcome of the Monitoring Optimisation Project 2015, and represents the second major review of DEWNR's groundwater and surface water monitoring networks.

Like the first iteration in 2010, this review recommends modifications to the existing network. Once implemented, these modifications will optimise the state-wide water monitoring network, align it with the state's long term objectives, and enable a more holistic approach to the network's management.

The Monitoring Optimisation Project 2015 was a collaboration between regional and metropolitan DEWNR water data stakeholders. The recommendations reflect a shared understanding of the importance of maintaining a water monitoring network that is fit for purpose, adaptive and consistent.

The implementation of the report's recommendations will optimise the monitoring network and ensure it continues to provide the evidence base to successfully manage our water resources for the next five years.



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- Resource Monitoring Unit
- Internal Reference Group
- Regionally focused working groups
- Science, Monitoring and Knowledge Branch (DEWNR)

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Summary

The Department of Environment, Water and Natural Resources (DEWNR) is the lead water monitoring organisation in South Australia. In this role, DEWNR conducts approximately 95 percent of the state's groundwater monitoring and approximately 65 percent of the state's surface water monitoring.

The Resource Monitoring Unit (RMU) within the Science, Monitoring and Knowledge (SMK) branch of DEWNR has completed the second monitoring optimisation and review. This process has been guided by:

- the South Australian Water Monitoring Investment Framework and Strategy, which outlines principles and priorities for future monitoring investment to ensure monitoring activities continue to provide relevant, accurate and integrated data to inform decision making
- the Statewide Monitoring Co-ordination Group (SMCG) which has produced a water monitoring program logic which enables a shared understanding of water monitoring goals and high level outcomes and describes how these outcomes may be achieved.

This second iteration of monitoring optimisation considers all of DEWNR's monitoring networks and has refined earlier monitoring optimisation approaches through the development and implementation of a monitoring site classification system for DEWNR monitoring sites, and the collation of regional and statewide recommendations for modifications to the temporal and spatial aspects of the monitoring networks to ensure they are optimal. Groundwater and surface water sites have been classified as Baseline, Compliance and Impact, Operational, Regulatory or Project sites.

It is acknowledged that the monitoring network will need to remain fit for purpose, and therefore as the need for primary information changes, the classification of the sites may alter in response.

Outcomes of the report emphasise the importance of maintaining a quarantined Baseline network to provide the core data for both groundwater and surface water monitoring. The remaining non-Baseline sites serve to provide specific data for particular needs and supplement the Baseline network.

Variation between archival site records and the operational datasets was identified. This highlights the importance of recording network change accurately to ensure that relevant operational and archival records remain consistent.

Some sites have remained unclassified and it is recommended that further revision of these sites be undertaken by the working groups.

This report presents a 'point in time' view of the state's monitoring network and recognises that the monitoring network will be subject to continued change over time.

Recommendations from the project are presented in eight regionally focus sections. Recommendations that were applicable to two or more regions and or were of strategic importance were included in the Statewide Recommendations section of the report. It is envisaged that SMK will facilitate the implementation of the recommendations in this report in consultation with all affected parties.

A plan be established to oversee the prioritisation and implementation of the recommendations in the report.

The next five yearly iteration of network optimisation (2020) will focus on cross agency co-ordination of water monitoring and stakeholder involvement.

1 Introduction

1.1 Background

The Department of Environment, Water and Natural Resources (DEWNR) is the lead water monitoring organisation in South Australia. In this role, DEWNR conducts approximately 95 percent of the state's groundwater monitoring and approximately 65 percent of the state's surface water monitoring.

DEWNR's water monitoring networks were reviewed and optimised initially in 2010 through a project aligned with the South Australian Groundwater Program. This project was undertaken by Australian Groundwater Technologies (AGT) Pty Ltd and engaged stakeholders across South Australia's eight Natural Resources regions. This initial review focussed largely on collating and understanding what water monitoring was being conducted throughout the state and identifying who was conducting this monitoring. The associated AGT report (AGT 2011) identified whether the spatial and temporal aspects of the statewide monitoring network were sufficient to report on the state and condition of the water resources and dependent ecosystems. The Adelaide and Mount Lofty Ranges region and the Eyre Peninsula region were excluded from this report as those regions had at that stage recently undertaken reviews within their regions. Data collected from the AGT (2011), combined with the Adelaide and Mount Lofty Ranges and the Eyre Peninsula reviews informed this first iteration of network optimisation.

Recommendations from this initial optimisation of the networks have now been adopted.

Independently of South Australia's Groundwater program and the initial network optimisation, the Bureau of Meteorology's (BOM) Modernisation and Extension of Hydrologic Monitoring Systems Program (2007-2012) (BOM program), funded the modernisation and extension of water monitoring systems throughout Australia. One outcome in South Australia of this BOM program was the development of the South Australian Water Monitoring Investment Framework and Strategy, (Geraghty and Barrett 2012), which recommended the creation of a State Monitoring Coordination Committee (SMCG) and provided a single high level program to enable the alignment of the outcomes of the Groundwater program with those of the BOM program.

In early 2013 the SMCG convened a program logic workshop for key water data stakeholders. The workshop developed a statewide approach to water monitoring and provided partners with an understanding of the benefits of a shared and optimised network. The program logic developed during this workshop supports a shared understanding of water monitoring goals and high level outcomes and describes how these outcomes may be achieved. The workshop developed an agreed aspirational goal describing the 'end of program outcome' of optimisation:

"The water monitoring network in South Australia is efficient and supports management and policy.

Achieving this aspirational goal will result in:

- all information held by the SMCG partners is shared with all users
- monitoring infrastructure being shared across SMCG partners
- users of the water monitoring data are familiar with the data's quality and currency
- increased collaboration and integration across the state water monitoring network.

These outcomes will in turn contribute to realising strategic state goals such as:

- South Australia's water resources are managed within sustainable limits by 2018 (SA Strategic Plan, Target 75)
- Better planning and reduced risk
- Public are safer and more resilient in relation to water.

The program logic diagram is attached in Appendix 1.

The outcomes of South Australia's Groundwater Program and the BOM's Modernisation and Extension of Hydrologic Monitoring Systems Program have delivered many of the *foundational* and *influencing activities* outlined in program logic. Additional work is required to finalise activities in the program logic to realise the stated outcomes and goals, and enable the eight guiding principles outlined in Geraghty and Barrett (2012) to be delivered. Refer to Section 13 Statewide Recommendations for further information.

1.2 Principals and Governance

The Resource Monitoring Unit (RMU) within the SMK Branch of DEWNR, was tasked to deliver the second iteration of the monitoring network optimisation process for DEWNR's statewide groundwater and surface water surveillance networks. In planning and delivering this task, the RMU considered and integrated the eight guiding principles for water monitoring articulated by Geraghty and Barrett (2012). These principles are:

- monitoring is coordinated across the state
- monitoring is fit for purpose
- monitoring is adaptive
- monitoring is consistent
- monitoring information is accessible
- monitor once, use many times
- existing investment is leveraged
- collaborative partnerships opportunities are realised.

A governance structure (Appendix 2) was developed as part of the IRG's Terms of Reference to ensure that this project actively worked towards completing these above principles and in doing so, contributed to the realisation of a significant number of integrated outcomes and targets set in the State's strategic plans.

1.3 Optimisation project 2015

With reference to the background section, the 2015 optimisation project team was tasked to deliver the second iteration of network optimisation. This has required a more refined approach than the AGT 2010 optimisation. The 2015 project focuses on the eight guiding principles, the integration of the Groundwater program and the BOM Modernisation and Extension of Hydrologic Monitoring Systems Program outcomes and works towards the completion of *influencing activities* identified in the SMCG's program logic.

Of these *influencing activities* a particular focus on the '*analysis of monitoring site lists and linking of the proposed site status to site purpose*' has been identified as a priority, as this has not been addressed in earlier optimisations.

The second iteration of network optimisation has therefore concentrated on integrating site status and purpose into the monitoring network's management. This has involved the development, approval and implementation of a monitoring site classification scheme for South Australia's water monitoring networks. When fully implemented, site classifications will increase the visibility of an individual site's key purpose and therefore support improved and robust network decision making.

The aims and objectives of the Optimisation project 2015 were to:

- establish eight Regional working groups to promote collaborative discussion regarding water monitoring requirements from a community and state perspective

- develop and apply the primary site classification system (outlined in Section 3) to the statewide groundwater and surface water surveillance networks
- gather and record recommendations for additions and removals to existing surveillance networks to optimise both groundwater and surface water monitoring networks in all Natural Resources regions
- build an awareness of the purposes of water monitoring at individual site level (*one site, many purposes*) and to increase the general understanding of the state's water surveillance network
- identify and recommend tasks required to be undertaken to ensure that the state's water surveillance network is optimal including standards and procedures and knowledge management
- contribute to discussions related to the ongoing resourcing requirements for water monitoring.

In applying classifications to surveillance sites the working groups have captured comments to identify the 'Purpose' or uses of the data. This information is held in the project datasets for groundwater and surface water.

2 Methodology

2.1 Monitoring Site Classification System

As a result of extensive research and consultation RMU staff have developed a monitoring site classification system. This classification system informs the high level use that a site's data serves.

A site's classification informs how a site is operated and managed throughout its life cycle. In this context a monitoring site classification system supports the implementation of site quality assurance processes and allows gaps to be identified and addressed. A site classification system therefore progresses the work towards achieving the eight guiding principles for water monitoring listed in Section 1.2.

The site classification system developed is detailed in Section 3.

It was recognised through the development of the classification system, that many monitoring sites will likely meet two or more of the classification definitions and therefore potentially have two or more classifications. To address this complexity it was decided to prioritise the classification types as outlined in Section 3 and in Figure 3.1. This prioritisation enables the primary site classification to be decided upon and recorded for those sites with multiple uses.

Throughout the implementation of site classifications it became clear that some sites did not meet any of the classification definitions. These sites remain un-classified and are identified as such in this report. The presence of these sites in the project dataset, is potentially linked to the discrepancies between archival and operational monitoring lists and is discussed further in Section 2.5 Project datasets.

Recommendations for the treatment of un-classified sites are included in the relevant regional sections of this report.

2.2 DEWNR network optimisation 2015

A DEWNR-based 'Internal Reference Group' (IRG) was established to assist in the development of a sustainable and adaptable operational management plan for the state water surveillance network. The IRG membership is comprised of key DEWNR water data stakeholders with strong knowledge and expertise in water surveillance in South Australia.

Eight regionally focused working groups were established to work closely with project team members to achieve the aims and objectives of the project.

Through the development of this project structure, the 2015 network optimisation has been undertaken across DEWNR in a collaborative manner with high level guidance from the IRG and implementation undertaken by eight regionally focused working groups.

The participation of regional staff was recognised as important for project success and six of the natural resources regions provided regional staff to support the project. The AW and NY regions were unable to provide staff to participate in the working groups. Regional managers from the AW and NY regions delegated responsibility for regional input to SMK science and monitoring staff.

The regional staff in each of the eight working groups were joined by metropolitan DEWNR staff with appropriate knowledge to assist the project achieve its objectives.

Through a series of workshop meetings in 2014 and early 2015 the regionally focused working groups together with project staff implemented the aims and objectives outlined in Section 1.3.

The working groups predominantly focused on classifying the surface water and groundwater networks from the perspective of water quantity (flow and water level). The classifications detailed in Sections 5 - 12 therefore reflect a focus on water quantity and should not be interpreted as an account of the state's salinity monitoring network.

DEWNR continues to undertake limited salinity monitoring of the Baseline network and in areas of high risk and/or strategic priority.

In regard to groundwater salinity monitoring:

- The statewide Baseline network for pumped salinity is comprised of only sites that have a dual purpose. These sites have a 'Current' status for both Standing Water Level (SWL) and Total Dissolved Solids (TDS[1]).
- Sites that were only 'Current' for TDS, have been made Historic as at July 2013/2014.
- In some regions additional Compliance and Impact salinity monitoring undertaken through irrigator submitted samples requires clarification of the ongoing implementation mechanism. It is DEWNR's intent that this monitoring be continued to support status reporting and water management objectives.

2.3 Treatment of Emergency Preparedness sites

The primary purpose of the majority of sites is to provide data for water management, either as Baseline or Compliance and Impact sites. However a secondary purpose of sites may include the provision of data to inform emergency preparedness. Emergency preparedness data informs on long term threats to the water resource system from climate change and drought and short term threats to communities such as flood events.

Where sites related to long term threats from climate change and drought they were classified as Baseline sites.

Sites related to flood monitoring were classified as either Baseline or Compliance and Impact as outlined in the next section.

2.4 Treatment of Flood Monitoring sites

Flood monitoring sites provide data that can be used to inform models used to forecast flood risk and events, allowing early warnings to be issued.

The BOM is reviewing its capacity to respond to future extreme weather and natural disaster events and to provide seasonal forecasting services. This BOM review has identified that there was a need to formalise and standardise service levels provided to emergency services and agree clear allocation of responsibilities to state and local government for flood management with defined boundaries on the BOM's role.

Aligning with these developments nationally, Working Group discussions throughout this project have highlighted a need to thoroughly review South Australia's flood monitoring network.

This project has identified 130 flood monitoring sites throughout the AMLR, NY, SAAL and SAMDB Natural Resource regions of the state. These sites were identified through working group discussions and from flood site lists provided to the project team from the BOM.

- 69 are primary flood monitoring sites operated by DEWNR. These are classified as Baseline sites.

[1] TSD relates to a naming convention for water quality within the project dataset that is being used to determine current and historical relationships of monitoring points.

- 61 monitoring sites classified as Compliance and Impact have also been identified as providing supplementary flood monitoring data. These sites need to be clarified in terms of the BOM standardising hazard related services review.

The project team is aware of numerous flood related sites operated by the BOM on behalf of various councils. The inclusion of these sites was beyond the project scope.

Flood hazard warning has been identified in the site purpose list detailed in Section 4 of this report.

A statewide review of the flood monitoring network is recommended in Section 13 in line with the new requirements from the BOM.

2.5 Project datasets

The groundwater and surface water sites included in this project were generally limited to DEWNR assets. In some specific cases, non DEWNR assets have been included in the datasets.

The inclusion of all sites throughout South Australia was beyond the project scope.

This optimisation has not focussed on project monitoring sites that gather specific data through a project funding cycle. It is envisaged that at the conclusion of projects, that project planning recommendations will advise a series of recommendations that either transfer monitoring sites to the state network, or decommission monitoring sites.

Where possible, the recommended optimised networks detailed in this report are cognisant of the water monitoring undertaken in the same region by agencies other than DEWNR or by private entities, however it is possible that monitoring from some organisations has been overlooked. In recognition that water monitoring is undertaken in South Australia by numerous stakeholders creating multiple monitoring networks, the SMCG has been tasked with ensuring that:

- monitoring infrastructure is used efficiently at a multi organisational level
- other agencies and private entities networks are not optimised in isolation from the DEWNR network.

Throughout the project, it became clear that variation existed between the archival site records stored in both SA Geodata and Hydstra which were used to establish the project site dataset, and the operational monitoring site report, '*Summary of Current Water Resource Monitoring Networks*' (McCullough 2011) used to manage and operate the monitoring network. This issue resulted in the unnecessary inclusion of some sites and the unintended omission of other sites, from the project dataset. Where possible, when sites omitted from the dataset were identified, these were added to the project dataset.

This issue highlights the importance of managing the records associated with any changes made to monitoring sites or networks to ensure both operational and archival records are maintained.

2.6 Outputs

The project has produced the following outputs:

- A generic 'purpose' list for all groundwater and surface water surveillance is presented in Section 4.
- Regional summaries (Sections 5 to 12) include:
    - an outline of the primary classification of groundwater and surface water surveillance sites operated by DEWNR branches and regions
    - a breakdown of sites within each primary classification
    - optimised network for groundwater and surface water sites with general comments

- recommendations for site reductions and additions
- other recommendations specific to the region.

- Outcomes and associated recommendations that had a statewide application or strategic significance are presented in Section 13.
- Where appropriate, recommendations include time lines and lead regions, branches or units responsible to action. It is understood by the optimisation project team that resource requirements will influence which recommendations are prioritised therefore associated time lines will need to be nominated.
- Site classification records (MS Excel format .xls) for all groundwater and surface water sites that were included in the project's datasets.

The outcomes presented in this report and in the associated site classification records are the products of the completed five yearly review of the monitoring network. While these outcomes provide a forensic account of the network, it is important to view this account as a 'point in time' version that is subject to change as DEWNR's water information requirements demand.

The above outputs will inform discussions related to the ongoing resourcing requirements for water monitoring.

It is envisaged that SMK will facilitate the implementation of the recommendations in this report in consultation with all affected parties.

2.7 Project terminology

Throughout this report, the use of the term *'surveillance of water resources'* reflects the activity of gathering water data from specific locations at regular intervals, over extended periods of time. The use of the word 'Surveillance' in water resource optimisation infers that the data serves as points of reference for diverse purposes including but not limited to supporting science and research, economic development and the sustainable management of the resource. This is distinct from 'monitoring', which is commonly defined from a business and management perspective as, '*supervising activities to ensure they are on target and on schedule to meet objectives'*.

Formal collections of specific sites are often referred to as Networks.

While it is considered that the difference between surveillance and monitoring is subtle and the two words have often been used interchangeably, it has been decided to use the word surveillance to describe the activity in the optimisation process.

3 Primary site classifications

The IRG has approved the following primary classification categories and associated definitions.

3.1 Baseline surveillance

Regular observations to allow evaluation of the state and condition of a water resource and to inform knowledge of the long term baseline trend of the resource. Baseline surveillance sites provide a continuous long term data-set that provides information for assessing the health of a resource over time.

3.2 Compliance and Impact surveillance

Compliance and Impact monitoring primarily supports WAP implementation and ongoing management to ensure an equitable distribution of the resource is achieved between competing uses. Compliance and Impact sites are required for the duration of the associated management action however the location of sites may alter over time reflecting development and land use change.

3.3 Operational surveillance

Surveillance conducted to support an organisation's business function. This monitoring may provide data to assist the organisation's management and decision making. Operational sites are required for the duration of the business functions that are supported by the sites' data.

3.4 Regulatory surveillance

Surveillance conducted to meet an organisation's legislative obligations or development approval agreements. Regulatory sites are required for the duration of the organisation's obligations under relevant legislation or development approval agreements.

3.5 Project surveillance

Surveillance to allow an increased understanding of the spatial and temporal quantity and quality of a specific water resource, and the impacts of development on the water resource. Project surveillance may be focused on achieving increased understanding to inform the sustainable level of use of a water resource, i.e. the development of a Water Allocation Plan. Project sites are required for the duration of the associated project.

Due to changing monitoring requirements, the classification of any given site may change over time and hence the number of sites in any classification quoted later in this report should not be considered final.

A decision tree was developed by the project team following the first round of working group meetings to prioritise site classification options, allowing those sites with multiple classifications, to be allocated a primary classification. The decision tree is detailed in Figure 3.1.

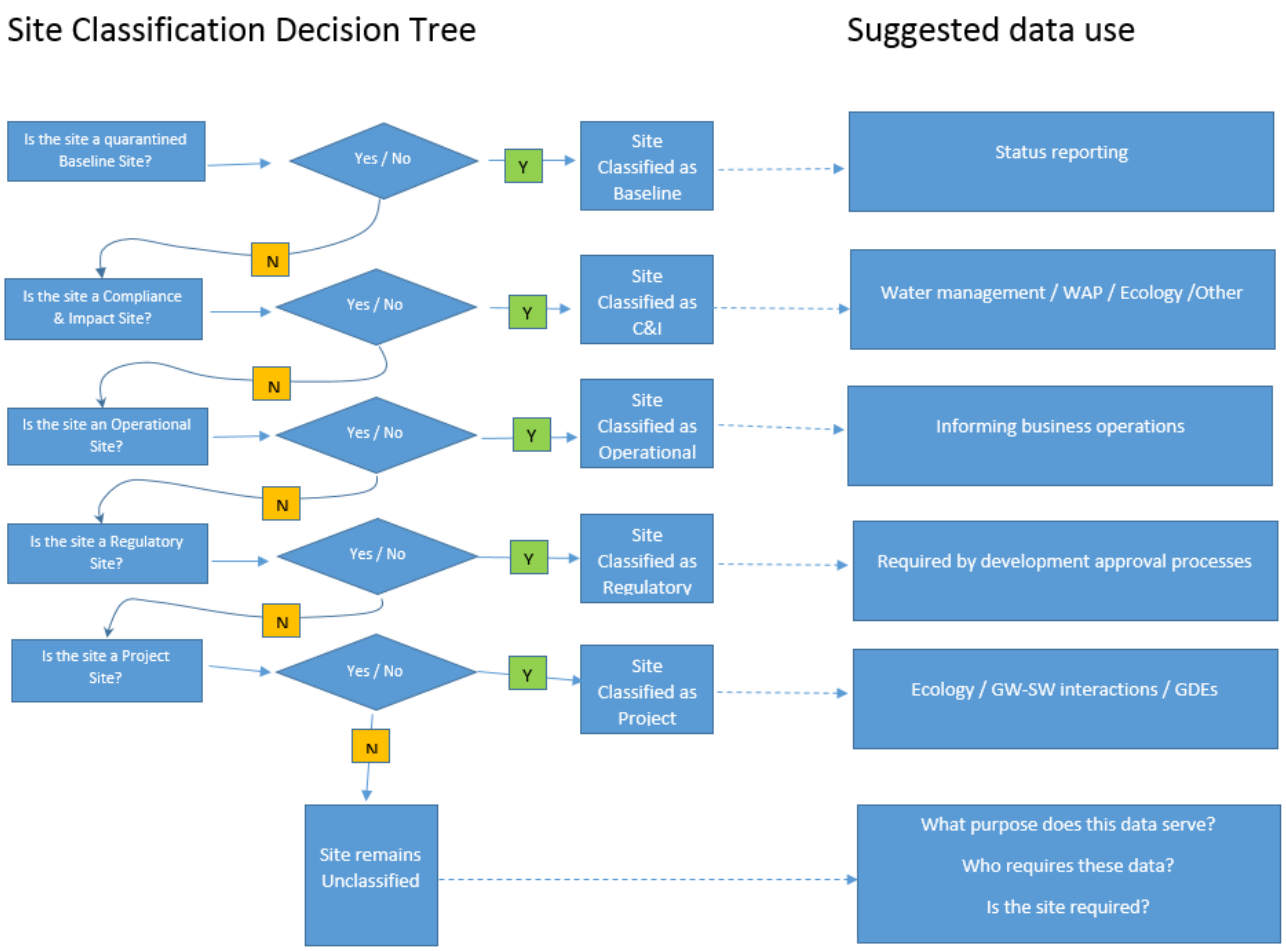


Figure 3.1 Classification decision tree

This decision tree emphasises the importance and significance of the Baseline network. These sites provide the foundation for the statewide network. The Baseline sites provide a long term continuous dataset, to support the assessment of the resource and to monitor the impact of climate change on the resource.

The Baseline network also incorporates numerous Emergency Preparedness flood related sites, further reinforcing the importance of this network.

4 Site Purpose list development

Each of the eight working groups were asked to contribute to the development of a comprehensive 'site purpose' list that encompasses all groundwater and surface water surveillance site purposes throughout the state.

The implementation of a 'site purpose' system, (in conjunction with the site classification system), will allow greater visibility of the key water monitoring drivers and will support improved understanding of the state's water surveillance network.

For example: management will be able to identify the number of Baseline sites located in a particular region, and also interrogate the data further to reveal the purposes that each of the Baseline sites serve (i.e. of 100 Baseline sites in a specific location; 50 may be used for *extraction & abstraction* surveillance, 35 may be related to *statutory responsibilities,* and 15 may be *dryland salinity* related*).*

Note that it was considered out of scope to consider implementing this site purpose list as part of this project, however it is recommended that this be undertaken in the future. The site purpose list as developed across the eight working groups is presented in Table 4.1.

Table 4.1 Site Purpose List

Code	Site Purpose	Definition of Purpose
SRS	***Statutory referral sites***	*Statutory responsibility surveillance*
MBP	***MDBA Basin Plan***	*Surveillance as required through the MDBA Basin Plan.*
SR	***Status Reporting***	*Surveillance of Baseline sites supporting Status Reporting*
EF	***E. Flow***	*Environmental flow surveillance*
HER	***Hydro-ecological response modelling***	*Surveillance to develop and confirm hydro-ecological response models*
GDE	***Groundwater dependent ecosystem (GDE)***	*GDE surveillance, Groundwater and Surface water relationship*
SWDE	***SWDE***	*Surveillance to understand flow regimes that enable persistence and connectivity in the landscape which support flora and fauna.*
E&A	***Extraction and abstraction***	*Surveillance of water resource response to extraction (irrigation) and abstraction (farm dams) and effectiveness of rehabilitation and practice improvement*
LU	***Land use change***	*Water resource response to land use change*
MC	***Water resource model confirmation***	*Development and confirmation of GW and or SW models*
PV	***Policy validation***	*Verification of WAP science program (i.e. V-WASP) and water resource management policy*
UWU	***Urban Water use***	*Urban water use surveillance*
MAR	***MAR***	*Managed Aquifer Recharge surveillance*
SIS	***SIS Scheme***	*Salt Interception Scheme surveillance*
FCF	***Flood catchment flow***	*Flood hazard, catchment flow surveillance*
DGHT	***Drought***	*Drought surveillance*
SWI	***Seawater intrusion***	*Seawater intrusion surveillance*
DLS	***Dry-land Salinity***	*Dry-land salinity surveillance*
SLR	***Sea level Rise***	*Sea level rise surveillance*
REG	***Impact of Mining and resource development***	*Development exploration, approval, operations and closure surveillance requirements*

5 Adelaide and Mount Lofty Ranges

The Adelaide and Mount Lofty Ranges (AMLR) working group classified primary surveillance sites for groundwater and surface water within the region. The majority of sites were identified as Baseline (including emergency preparedness, flood monitoring sites), Compliance and Impact sites and Project sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the NR AMLR region in Sections 5.1 and 5.2.

Section 5.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the AMLR region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

5.1 AMLR: Groundwater site classifications

The AMLR working group considered 1492 groundwater sites within the AMLR region. All Baseline groundwater sites were identified through a review conducted by a DEWNR Principal Hydrogeologist. This review incorporated the longevity of water-level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 5.1.

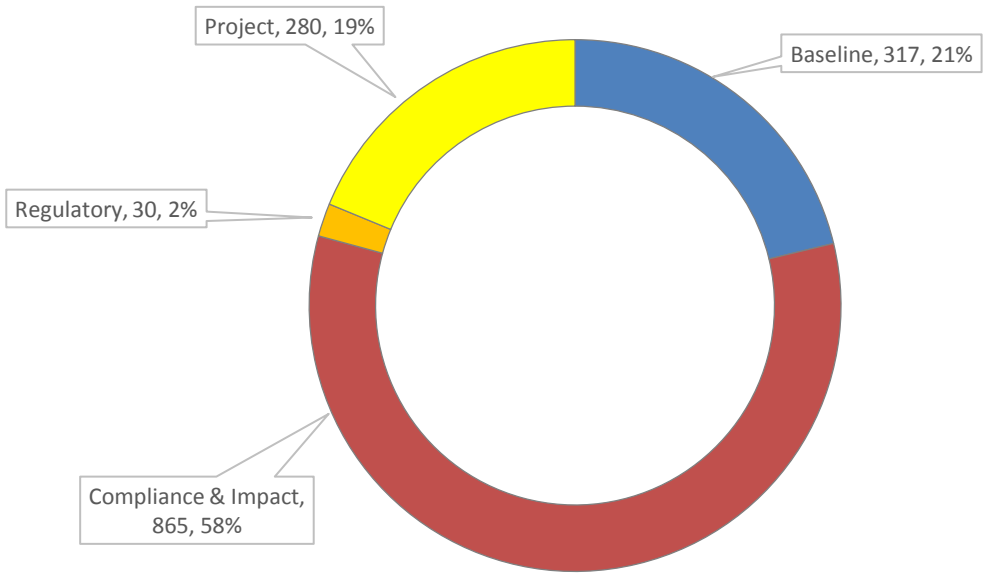


Figure 5.1 AMLR groundwater classifications at January 2016

A breakdown of the groundwater classifications for the Baseline, Compliance and Impact and Project networks is shown in Figures 5.2 to 5.4 and in the text associated with each figure. The breakdown for the Regulatory classification is discussed in text.

Baseline groundwater sites:

- Barossa Prescribed Water Resources Area (PWRA): 36 sites
- Central Adelaide Metro network: 50 sites
- Dryland salinity - Keynton and Barossa regions: 26 sites
- National Centre for Groundwater Research and Training (NCGRT) new Adelaide metropolitan sites: 12 sites. Additional NCGRT sites are classified as Project sites.
- Echunga: 4 sites
- Western Mount Lofty Ranges PWRA: 19 sites
- McLaren Vale Prescribed Wells Area (PWA): 55 sites
- Northern Adelaide Plains (NAP) PWA: 77 sites
- One Tree Hill: 4 sites
- WMLR PWRA, High Impact and High Demand zones (*Charleston, Inverbrackie, Hindmarsh Tiers and Myponga)*: 34 sites. Additional sites for these regions may be identified through the WMLR WAP implementation process.

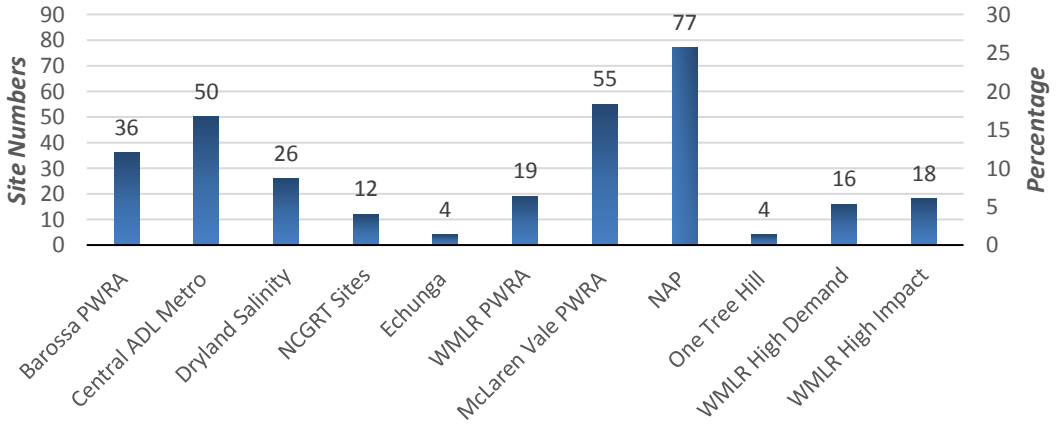


Figure 5.2 AMLR groundwater baseline sites

Compliance and Impact groundwater sites:

- Natural Resources AMLR operated sites located throughout the region (*Adelaide Central and Metro networks, Barossa PWRA Loggers site*): 3 sites
- McLaren Vale PWA: 17 sites. These sites support WAP Implementation.
- 'Nominally' Compliance and Impact sites within the region: 252 sites. These sites may be used to support WAP implementation and/or review, but are not specifically listed as 'required' Compliance and Impact sites.
- '*Licensed Irrigation Wells':* 593 sites. These sites are a requirement of the water allocation planning process and monitor regional water quality (TDS). Irrigator self-collected water samples are submitted to DEWNR for laboratory testing. State allocated funding for the administration and laboratory testing of these samples was ended in 2013–14. Review of these sites from a risk management perspective is currently underway. The outcome will inform future resourcing requirements and options.

- Additional Compliance and Impact sites may be identified from WMLR WAP implementation processes, i.e. groundwater high demand zones.

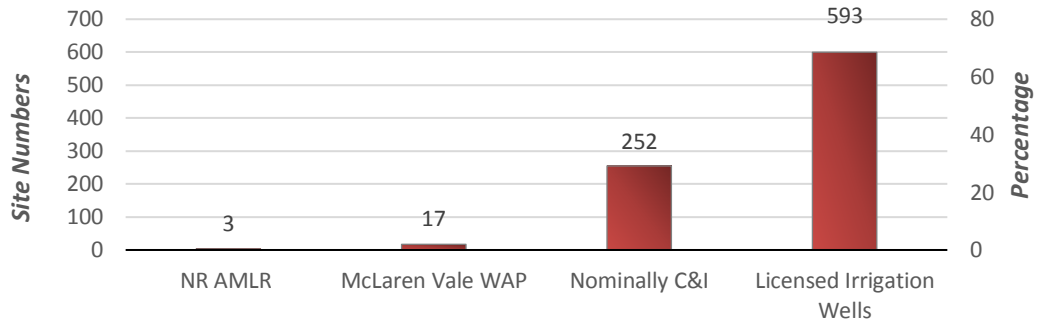


Figure 5.3 AMLR groundwater compliance and impact sites

Project groundwater sites:

- Mount Lofty Ranges Groundwater Recharge Investigations: 42 sites
- Northern Adelaide Plains – Seasonal, Virginia perched aquifer: 21 sites
- Virginia Pipeline Scheme: Test pumping: 19 sites
- Northern Adelaide Plains Shallow Water Quality – shallow piezometers: 33 sites
- Willunga Super Science project: 156 sites. These sites were developed through an NCGRT project (*the Australian Super Science Initiative*), and provide a dedicated groundwater infrastructure facility throughout the McLaren Vale region.
- NCGRT Adelaide metropolitan sites: 9 sites. These 9 NCGRT sites are recommended for further review. Additional NCGRT sites are classified as Baseline.

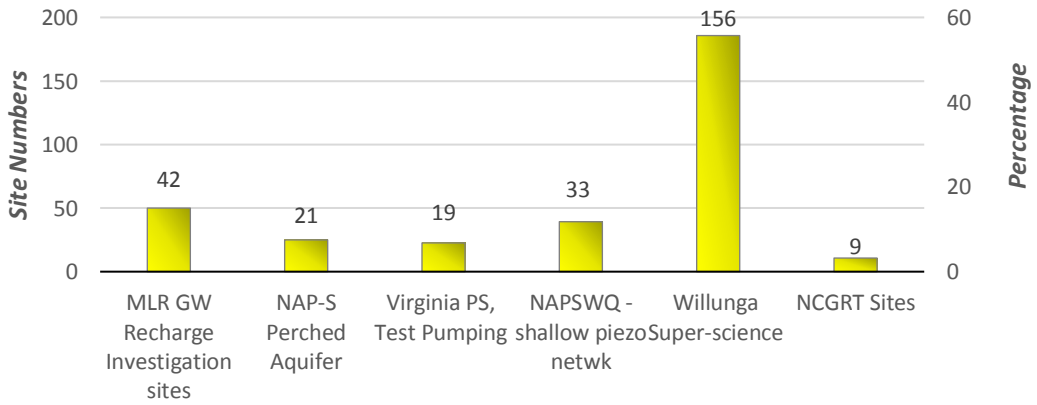


Figure 5.4 AMLR groundwater project sites

Regulatory groundwater sites:

- EPA statewide water quality monitoring: 25 sites. Additional EPA sites may overlap with other classifications and may not be immediately identifiable without detailed analysis of the site listings.
- Golden Grove extractive zone: 5 sites

5.2 AMLR: Surface water site classifications

The AMLR working group considered 132 surface water sites within the NR AMLR region. The site classifications identified for these surface water sites are shown in Figure 5.5.

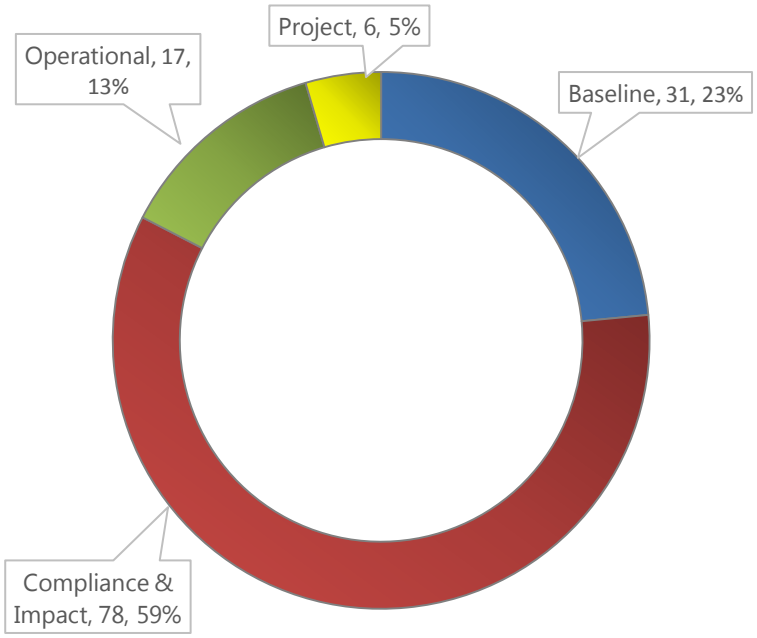


Figure 5.5 AMLR surface water classifications at January 2016

A breakdown of the surface water classifications for the Baseline, Compliance and Impact, Operational and Project networks is shown in Figures 5.6 to 5.9 and in the text associated with each figure.

Baseline surface water sites:

- Status reporting requirements and the assessment of the state's water resources: 19 sites. The secondary purpose of 9 of these sites is emergency preparedness - flood monitoring.
- DEWNR also operates 12 stand-alone emergency preparedness - flood monitoring sites in watercourses across the NR AMLR region.
- In total there are 21 Baseline emergency preparedness – flood monitoring sites across the AMLR region

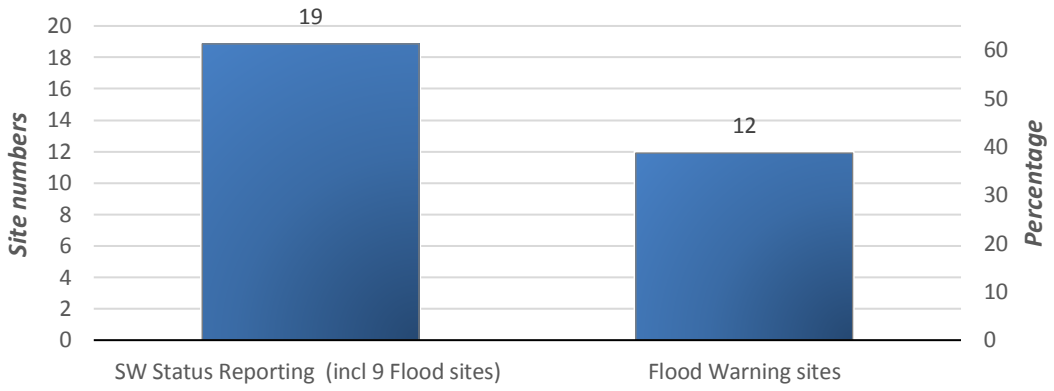


Figure 5.6 AMLR surface water baseline sites

Compliance and Impact surface water sites:

- All 78 C&I sites are logged. 39 of the 78 sites are logged and telemetered.
- There are 43 sites required by NR AMLR as part of WAP implementation.
- AMLR Board operated flood monitoring sites: 18 sites
- Other flood monitoring sites: 17 sites

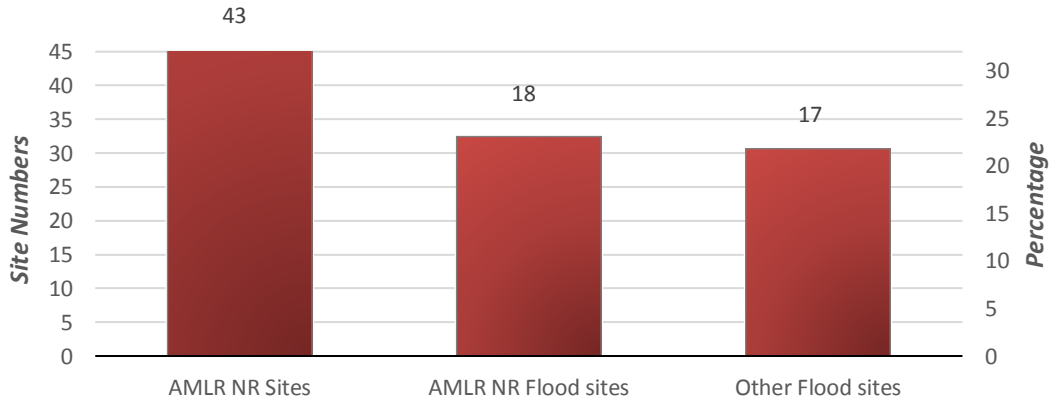


Figure 5.7 AMLR surface water compliance and impact sites

Operational surface water sites:

- SA Water operational: 11 sites
- Automatic Weather Stations (AWS) located throughout the NR AMLR Region: 6 sites. These sites provide weather data to inform land management throughout the region.

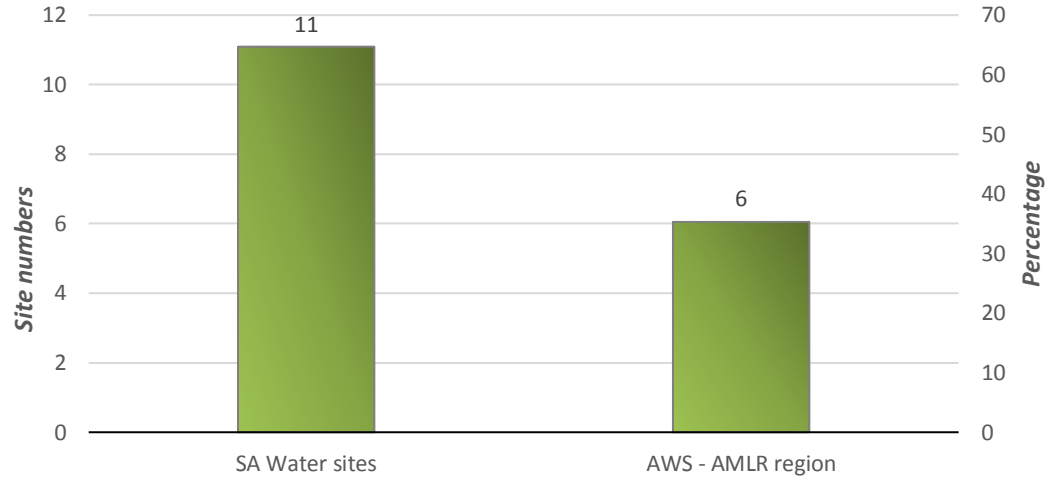


Figure 5.8 AMLR surface water operational sites

Project surface water sites:

- AMLR and SA Water projects: 1 site. Site A5031012, *Onkaparinga River u/s Clarendon Weir*, is focused on environmental flows.
- NR AMLR regional projects: 5 sites:
  - 4 NR AMLR project sites study surface water and groundwater interception by plantation forests on the southern Fluerieu Peninsula:
    - A5011021, *Wither Swamp downstream of Dam*
    - A5011024, *Deep Creek downstream of Foggy Farm*
    - A5011031, *Second Valley HQ*
    - A5011037, *Delamere Forest Pluvio @350m SE dam*
  - 1 NR AMLR Project site is identified as A5041050 *Hope Valley Scour Downstream of Hope Valley Reservoir*.

Figure 5.9 AMLR surface water project sites

5.3 AMLR: Optimised network

The AMLR working group has made the following recommendations to improve and optimise the water surveillance within the AMLR region. Subject to the implementation of these recommendations the optimised groundwater and surface water surveillance networks and the associated site classifications for the NR AMLR region are demonstrated in Figures 5.10 and 5.11.

Figures 5.10 and 5.11 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for* closure). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented. Dotted red arrows indicate that further review is necessary to establish if the sites are required, or can be made historic and closed.

In some circumstances the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'Unknown'.

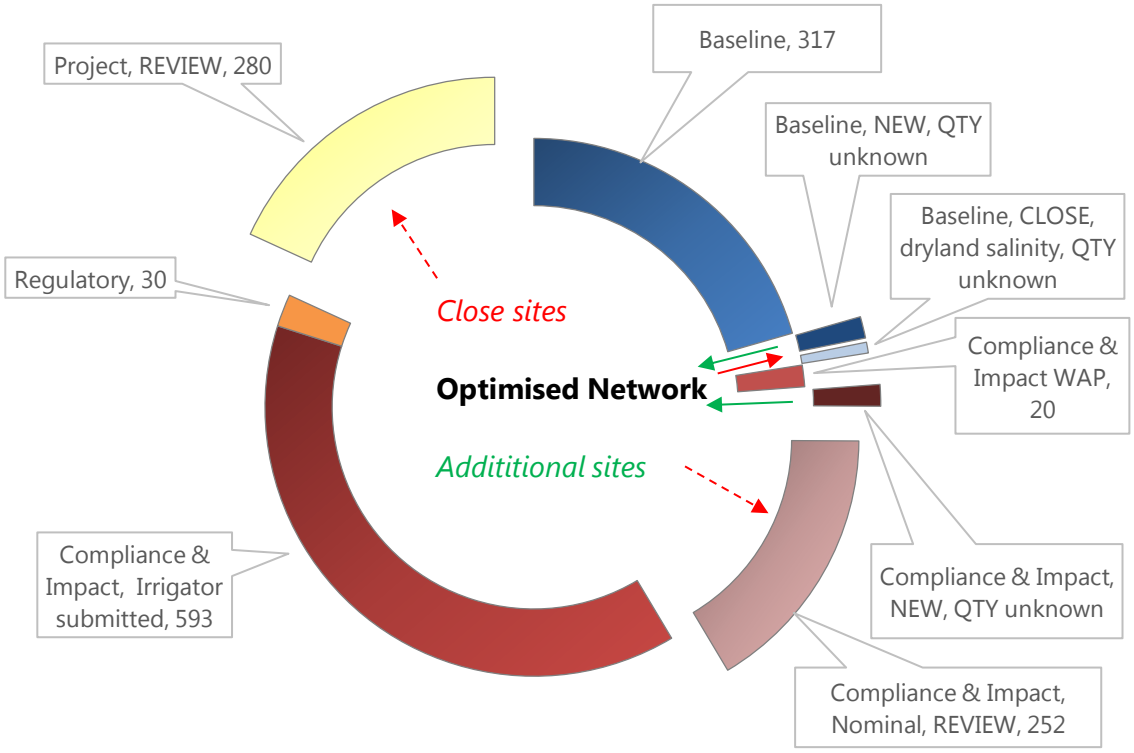


Figure 5.10 AMLR groundwater classifications: proposed optimised network

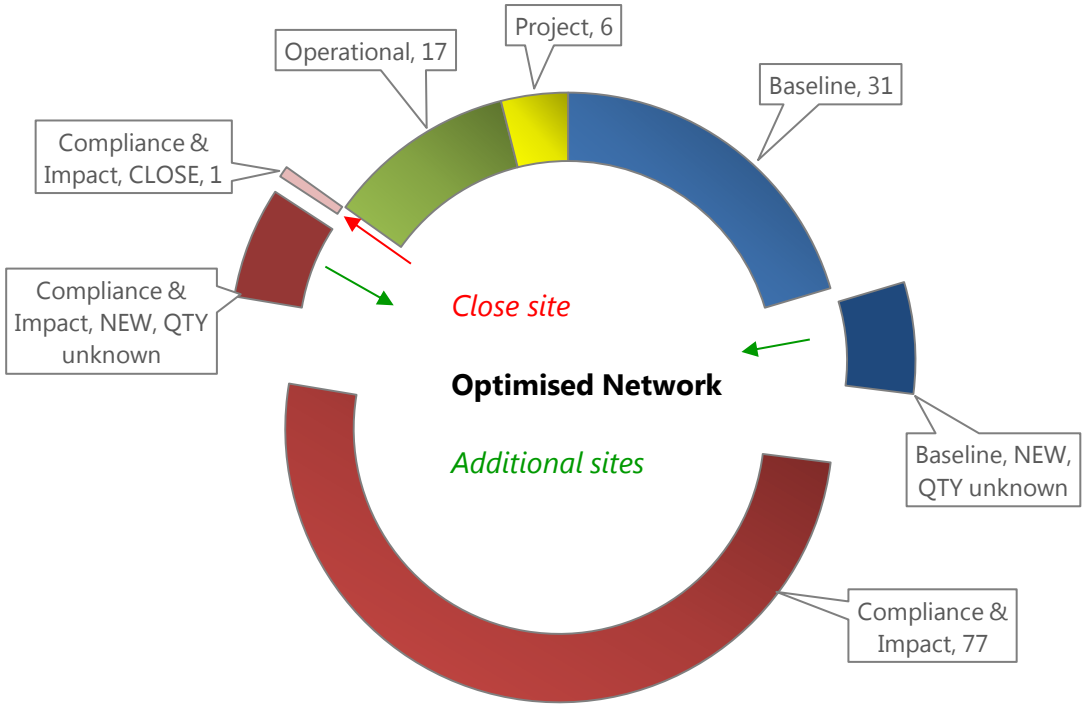


Figure 5.11 AMLR surface water classifications: proposed optimised network

General discussion points

- Groundwater and surface water resources in the prescribed areas of the NR AMLR region require ongoing surveillance to adequately support assessment of the state of the resources for the purposes of implementing and reviewing current and future WAPs and or water licensing activities. The surveillance network should provide both quantitative and qualitative data:
    - A particular focus is to be on zones of high demand or stress.
    - Ground and surface water surveillance networks should provide an adequate spatial coverage of the region's prescribed areas.
- The WMLR WAP specific water surveillance needs are being finalised through the development of a Monitoring Evaluation Reporting and Implementation (MERI) Plan which will identify data gaps and define any requirement for additional investment.
- The AMLR working group identified a lack of surveillance in regard to Fleurieu coastal catchments and Fleurieu Swamps.
- The AMLR working group identified a lack of surveillance in the Gawler River and Light River areas in the northern areas of the AMLR region. It is understood that there are potential issues in this region associated with shallow water tables, aquifer recharge activities and developments associated with effluent transfer.
- The AMLR working group identified development in the Kangaroo Flat region that requires further review of groundwater surveillance.
- The continued support for automated stations (logged and telemetered) at selected sites should be supported.

- It is understood that the DEWNR Groundwater team in SMK is reviewing current groundwater surveillance in the area surrounding the Penrice operations in the Barossa Valley. Outcomes of this review may create a need for additional investment.
- The Willunga Super Science project has effectively closed. The 156 Project sites associated with this project will need to be reviewed to establish the future classification of each site.

5.3.1 Proposed network modifications

A number of changes were recommended by the AMLR working group and an implementation process will be undertaken to ascertain what changes occur.

- It is recommended that the AMLR working group under the lead of NR AMLR initiate a review and assessment of the Fleurieu coastal catchments and Fleurieu Swamps to identify the surveillance priorities for ground and or surface water, should funding become available. Potential site locations may be researched and identified.
- It is recommended that NR AMLR monitors developments in:
    - The Gawler River and Light River areas and that any future surveillance requirements for groundwater and or surface water are identified by the AMLR working group. Additional investment to manage risks associated with this development may be required.
    - The Kangaroo Flat area and that any changes to surveillance requirements for groundwater and or surface water are identified by the AMLR working group. Additional investment to manage risks associated with these developments may be required.
- Additional surveillance sites required to support the WMLR WAP implementation: e.g. high demand zones. These sites will be classified as Compliance and Impact. The Baseline network in the immediate area may also require expansion.
- It is recommended that the AMLR working group, under the lead of SMK, seek to clarify the outcomes of the Penrice review and initiate any actions required.
- 252 groundwater sites were 'nominally' classified as Compliance and Impact under advice provided by a SMK Principal Hydrogeologist. It is recommended that a further review process be initiated in the first half of 2016 to establish if these sites are required.
- Baseline dryland salinity sites will be reviewed through a process underway statewide. This process may result in decreases in sites monitored for this purpose, however at this stage it is too early to estimate site numbers.
- It is recommended that a risk based review of salinity monitoring requirements for the water allocation plans is undertaken to ascertain the most effective method of reporting on salinity changes.
- The 156 Project sites associated with the completed Willunga Super Science project are required to be reviewed to establish the future classification of each site. This review is to be conducted under the lead of SMK.
- The 9 Project sites associated with the NCGRT project on the Adelaide Plains are required to be reviewed to establish the future classification of these sites. This review is to be conducted under the lead of SMK.

- The AMLR working group recommends that 115 groundwater sites classified as 'Project' sites are to be further reviewed and considered for closure. These sites incorporate the following 'Group Descriptions':
    - MLR groundwater recharge investigation sites
    - NAP (Seasonal)*
    - Shallow piezometer network for NAPSWQ*
    - Virginia Pipeline Scheme wells.* *

The above Project sites marked with '*' may require further discussion to ascertain if these sites have any ongoing surveillance role from a strategic perspective.

Project sites marked with '**' (Virginia Pipeline Scheme) will be retained whilst current private funding remains.

- The AMLR working group has recommended that surface water site A5040556, '*Morphett Arms Hotel Pluviometer at Glengowrie*' can be closed. It is recommended the RMU confirm that this status is reflected in Hydstra.

5.3.2 Other recommendations

- Members of the NR AMLR working group have recommended that, subject to funding, other modes of data discovery could be developed to inform the public.

6 Alinytjara Wilurara

The Alinytjara Wilurara (AW) working group classified primary surveillance sites for groundwater and surface water within the region. The majority of sites were identified as Operational and Baseline (including flood monitoring) sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the NR AW region in Sections 6.1 and 6.2.

Section 6.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the AW region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

6.1 AW: Groundwater site classifications

The Alinytjara Wilurara (AW) working group considered 48 groundwater sites within the region. The site classifications identified for these groundwater sites are shown in Figure 6.1.

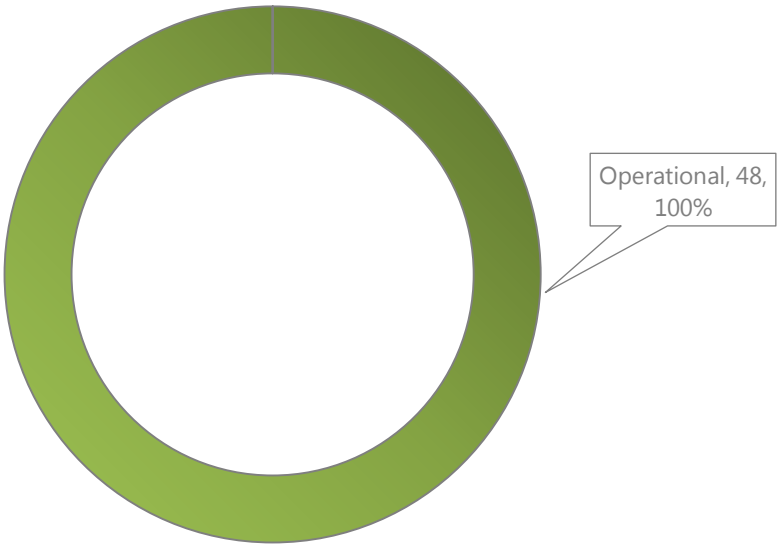


Figure 6.1 AW groundwater classifications at January 2016

Operational groundwater sites:

- SA Water: 48 sites. All sites considered were operational town water supply production wells. These sites are members of the Indigenous Community network, supplying water to aboriginal communities in the NR AW region.

6.2 AW: Surface water site classifications

The AW working group considered 15 surface water sites within the NR AW region. The site classifications identified for these surface water sites are shown in Figure 6.2.

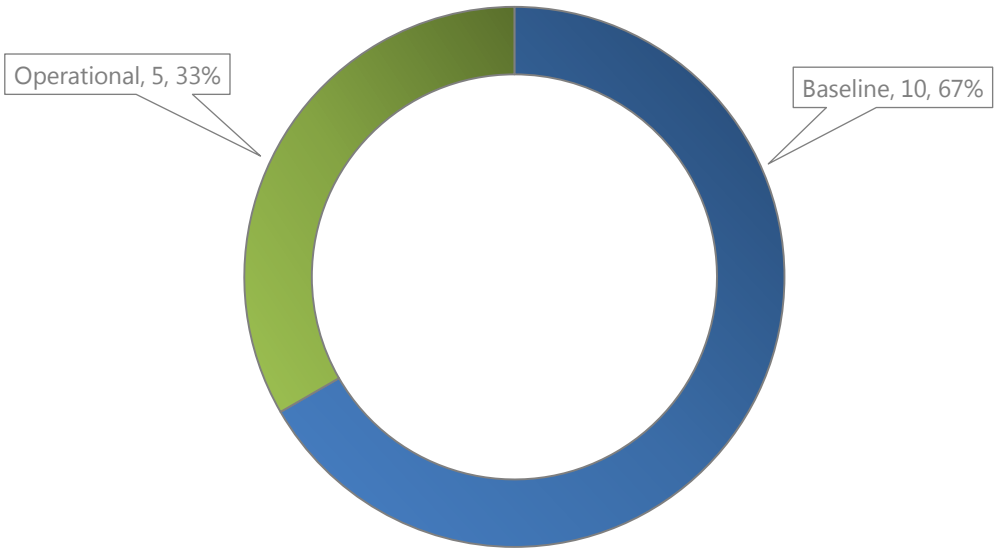


Figure 6.2 AW surface water classifications at January 2016

Baseline surface water sites:

- Baseline: 10 sites. These sites are pluviometers located throughout the AW region. These sites also provide SA Water operational information supporting town water supply (TWS) provision.

Operational surface water sites:

- Operational: 5 sites. The NR AW region has five automatic weather stations located at Oak Valley School, Rodinnia Oil Airport, Murputja-Kanpi/Nyapari, Watarru and Sandy Bore. These sites inform land management throughout the region.

6.3 AW: Optimised networks

The AW working group has made the following recommendations to improve and optimise water surveillance within the NR AW region. Subject to the implementation of the recommendations the optimised groundwater and surface water monitoring networks and the associated site classifications for the region are demonstrated in Figures 6.3 and 6.4.

Figures 6.3 and 6.4 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for* closure). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented.

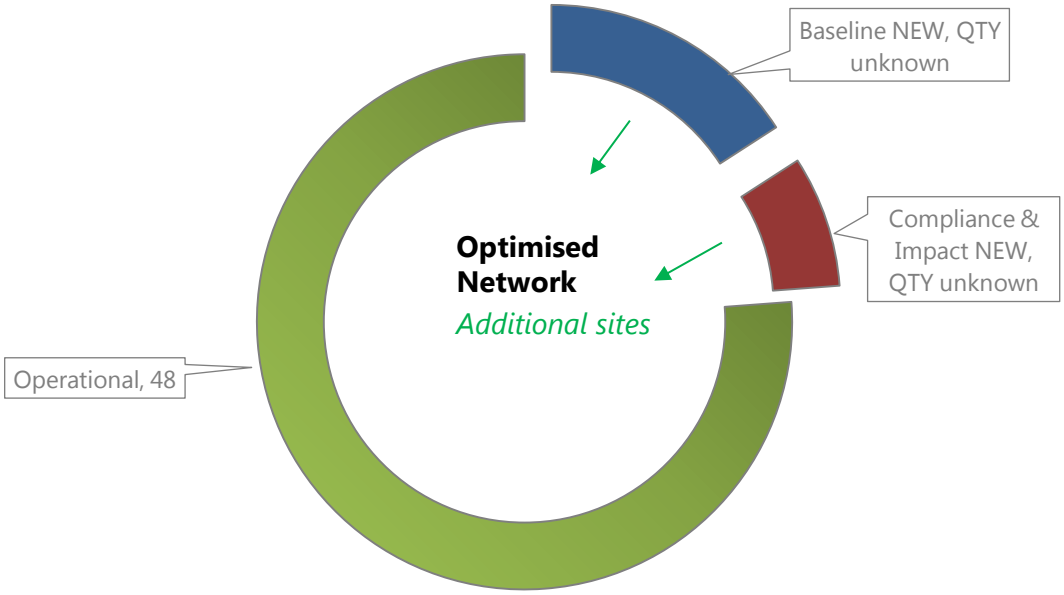


Figure 6.3 AW groundwater classifications: proposed optimised network.

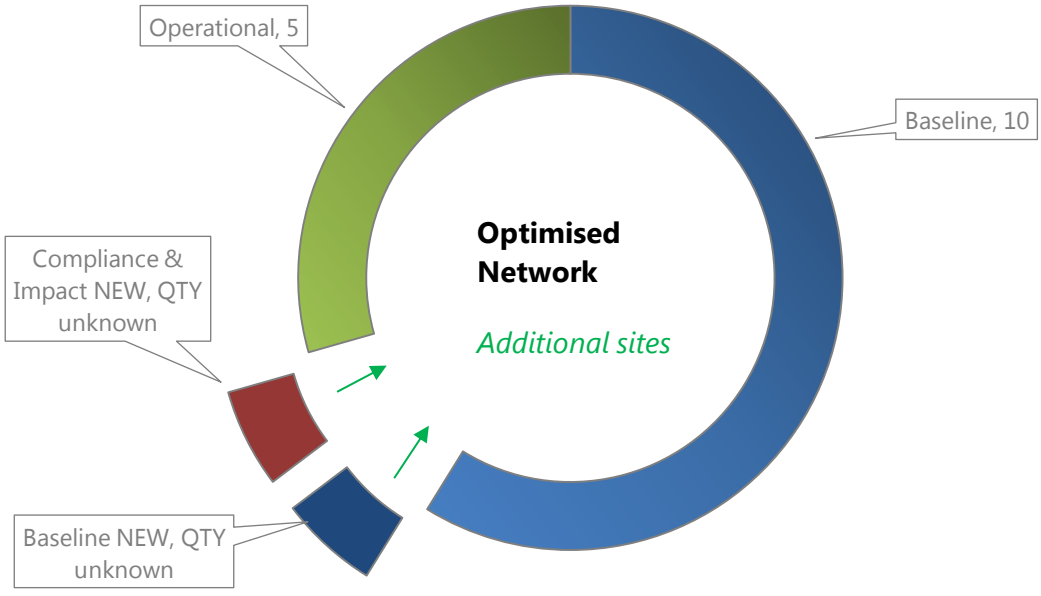


Figure 6.4 AW surface water classifications: proposed optimised network.

General discussion points

- There is no dedicated groundwater water monitoring network for the NR AW region. Preliminary work to identify a groundwater monitoring network has been put on hold until the current drilling program in the region is completed. Wells developed through the program may have a legacy as ongoing Baseline surveillance sites:
    - SA Water production wells require careful assessment for use as water level sites, as pumping will impact the data gathered. Non-production wells located in the vicinity of extraction points will also require careful assessment as local extraction may impact the data. Current non-production wells may also be required as production wells in the future, resulting in the potential loss of the site as a water level monitoring point.
- The Water Affecting Activity (WAA) section of the AW Regional NRM Plan has recently been updated and the revised principles will strengthen management of the water resources in the region. The implementation and the review of this updated WAA policy may require additional water surveillance investment.
- Additional groundwater and surface water surveillance is required to support increased research to improve the understanding of the capacity, extraction and re-charge of the groundwater resources in the region, and to address knowledge gaps in the region including the expected impacts of climate change.

6.3.1 Proposed network modifications

A number of changes were recommended by the AW working group and an implementation process will be undertaken to ascertain what changes occur.

- Work to define a water level monitoring network by the SMK groundwater team will be resumed once the drilling program is completed in late 2015. It is recommended that the AW working group, under the lead of SMK, reviews surveillance requirements in the region on completion of the groundwater network study in the first half of 2016.
- It is further recommended that the review of water surveillance requirements:
    - consider additional investment in groundwater and surface water Compliance and Impact sites to ensure the revised principles of the WAA section of the regional AW NRM Plan can be adequately implemented
    - identifies the knowledge gaps in the region and additional surveillance requirements to address knowledge gaps.
- Nil site reductions are recommended.

7 Eyre Peninsula

The Eyre Peninsula (EP) working group classified primary surveillance sites for groundwater and surface water within the NR EP region. The majority of sites were identified as Baseline (including flood monitoring sites) and Compliance and Impact sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the region in Sections 7.1 and 7.2.

Section 7.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

7.1 EP: Groundwater site classifications

The EP working group considered 491 groundwater sites within the NR EP region. All groundwater sites were classified through a review conducted by the EP working group and included guidance and input from a DEWNR hydrogeologist. This review incorporated the longevity of water level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 7.1.

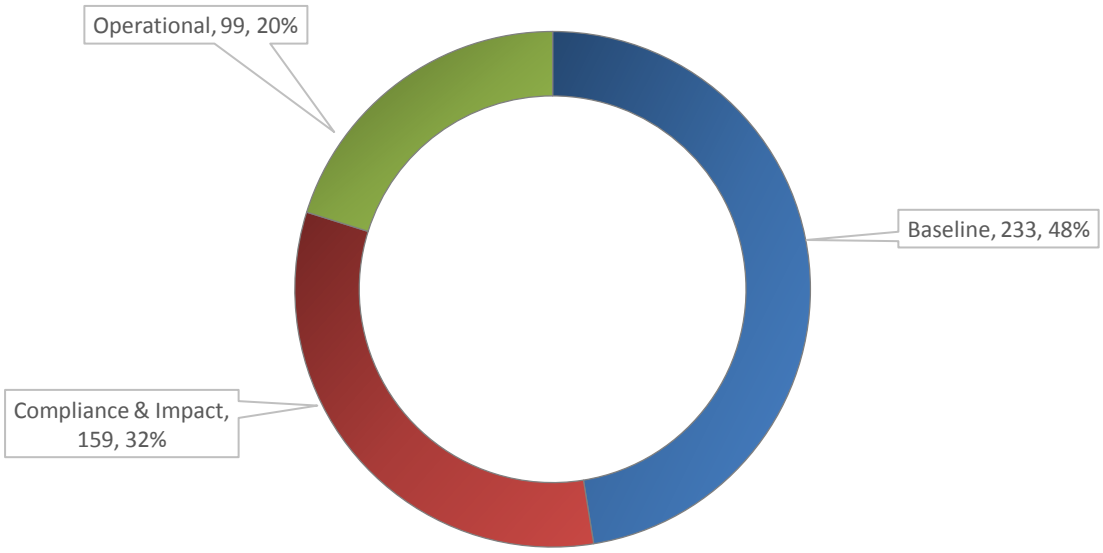


Figure 7.1 EP groundwater classifications at January 2016

A breakdown of the groundwater classifications for the Baseline, Compliance and Impact and Operational networks is provided in the text below and in Figures 7.2, 7.3 and 7.4.

Baseline groundwater sites:

- Musgrave PWA: 70 Baseline sites. These sites were identified by EP working group members; Principle Hydrogeologist (SMK), and groundwater monitoring staff (RMU):
    - 57 of the 70 sites are required for water quantity calculations to support WAP implementation. This indicates that a significant secondary classification of Compliance and Impact exists within the Musgrave PWA region. This is not readily visible in Figure 6.2.
    - 3 of the 70 sites are also required as part of the EPA statewide water quality network.
- Southern Basins PWA: 72 sites:
    - 60 of the 72 sites are required for water quantity calculations to support WAP implementation. This indicates that a significant secondary classification of Compliance and Impact exists within the Southern Basin PWA region. This is not readily visible in Figure 6.2.
    - 6 of the 72 sites are also required as part of the EPA statewide water quality network.
    - 1 site of the 72 sites is required for salt water interface monitoring.
- Dryland salinity: 91 sites. These sites are located at Cummins (50), Darke Peak (12) and Wanilla (29).
- No Baseline groundwater sites are identified outside of the prescribed areas with the exception of the dryland salinity sites. This reflects the predominantly low water quality and limited value of the water resource outside of the prescribed areas.

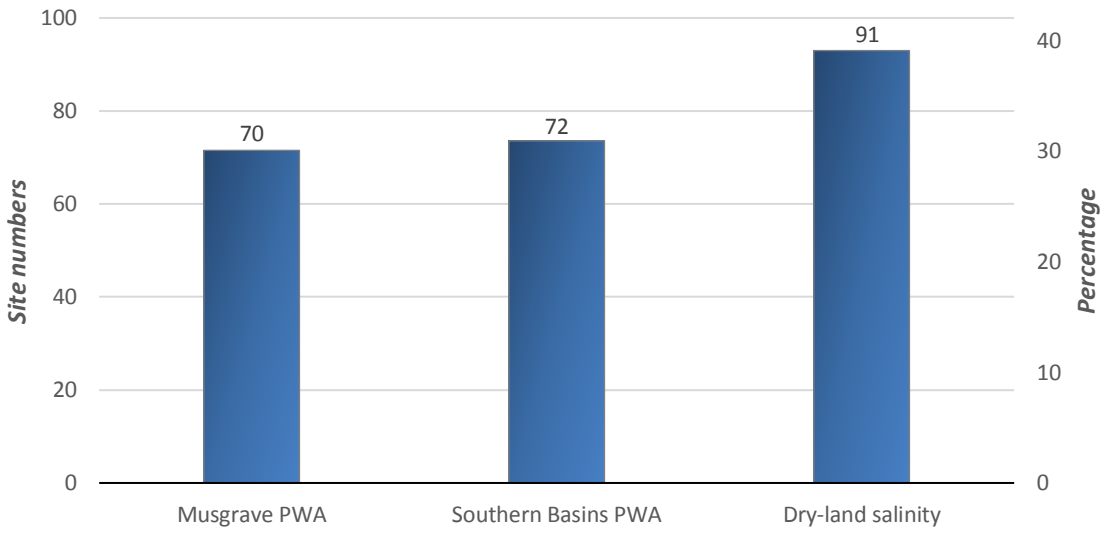


Figure 7.2 EP groundwater baseline sites

Compliance and Impact groundwater sites:

- Nominally Compliance and Impact: 145 sites. Although these sites are predominantly located in prescribed areas, they were not identified as specifically required for WAP implementation and review purposes and are therefore referred to as 'nominally Compliance and Impact sites. These sites are located in:
  - Musgrave PWA: 53 sites
  - Southern Basins PWA: 91 sites
  - Non-prescribed areas: 1 sites.
- Salt Water interface monitoring in Southern Basins PWA: 3 sites
- Required Compliance and Impact monitoring in Musgrave PWA: 4 sites
- Required Compliance and Impact monitoring in Southern Basins PWA: 7sites
- The Baseline networks within the Musgrave and Southern Basins PWAs overlap with 117 sites required for water quantity estimation associated with the WAPs. These sites are all classified as Baseline and are therefore not represented in Figure 7.3. This is in line with the classification priority approach when sites have multiple uses.

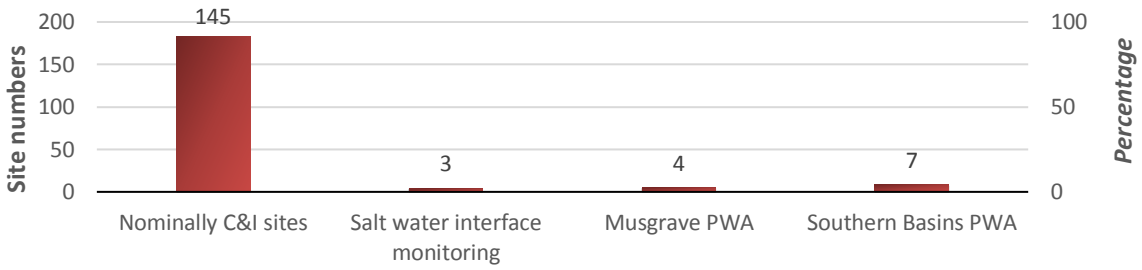


Figure 7.3 EP groundwater compliance and impact sites

Operational groundwater sites:

- Penong: 15 sites
- SA Water (Elliston Town Water Supply): 3 sites
- SA Water (Streaky Bay Town Water Supply): 61 sites
- Venus Bay-Port Kenny sites: 20 sites.

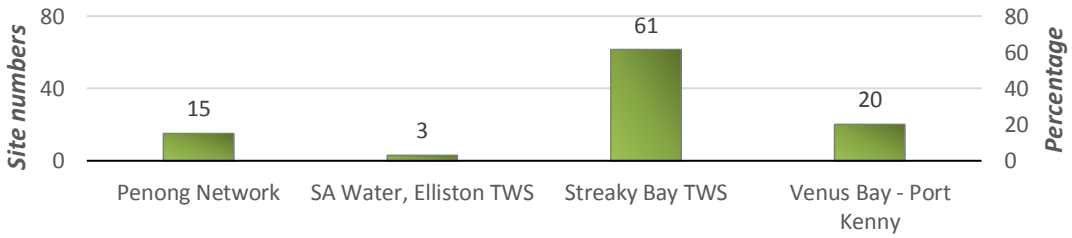


Figure 7.4 EP groundwater operational sites

7.2 EP: Surface water site classifications

The EP working group considered 13 surface water sites within the EP region. The site classifications identified for these surface water sites are shown in Figure 7.5.

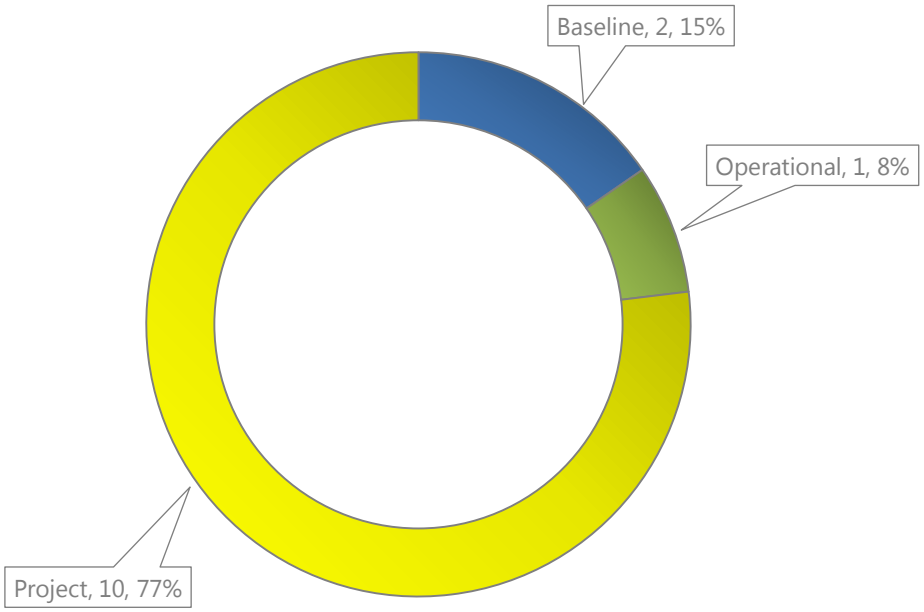


Figure 7.5 EP surface water classifications at January 2016

A breakdown of the surface water classifications for the Baseline, Operational and Project networks is provided below:

- Baseline surveillance: 2 sites. These sites are A5120500 *Tod River, 5 kms north-west of Poonindie*, and A5120508 *Toolillie catchment pluviometer at Toolillie*.
- Operational surveillance: 1 site. This site (A5120503, *Toolillie Gully upstream Tod Reservoir*) monitors flow into the Tod dam.
- Project surveillance: 10 sites:
    - Polda lens of Musgrave PWA: 5 sites. Of these 5 sites, 2 are closed. 3 surface water sites in Polda remain current (2 pluviometers and 1 Automatic Weather Station).
    - Southern Basins PWA: 4 sites. These sites are focused on groundwater and surface water relationship and recharge. These are pluviometer stations.
    - Little Swamp catchment: 1 site. This is a NR EP Project site.

7.3 EP: Optimised network

The Eyre Peninsula working group has identified the following recommendations to improve and optimise the water surveillance within the EP region. Subject to the implementation of the recommendations, the optimised groundwater and surface water surveillance networks and the associated site classifications for the EP region are demonstrated in Figures 7.6 and 7.7.

Figures 7.6 and 7.7 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for closure*). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented. Dotted red arrows indicate that further review is necessary to establish if the sites are required, or can be made historic and closed.

In some circumstances the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'unknown'.

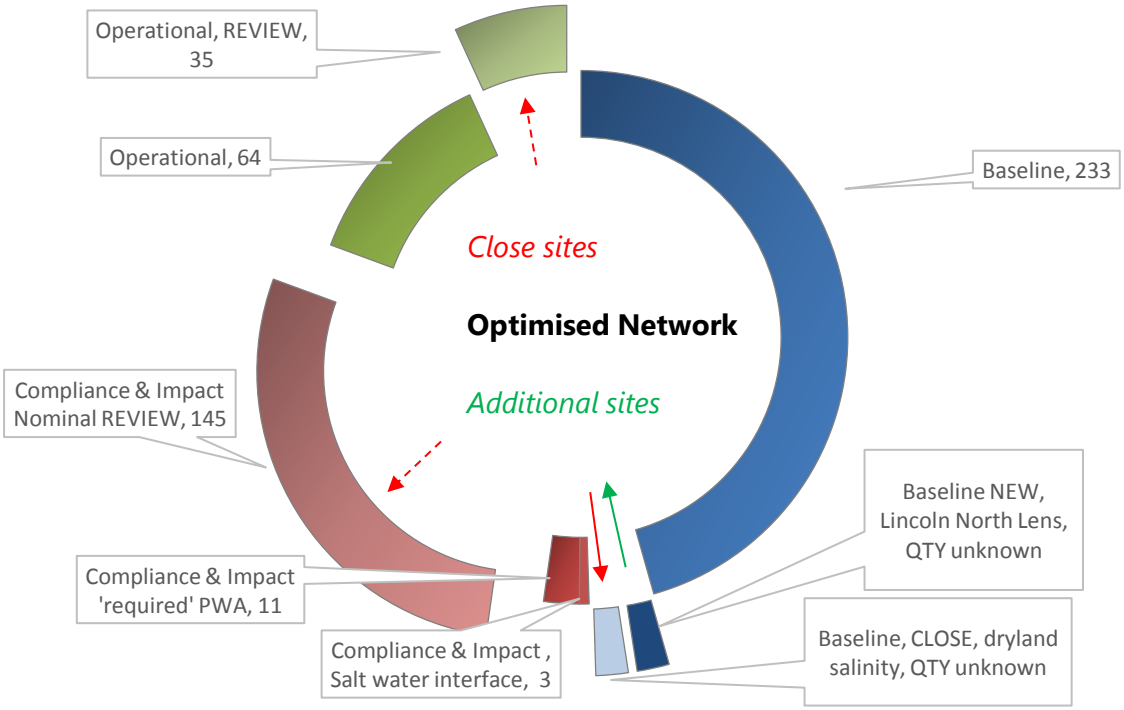


Figure 7.6 EP groundwater classifications: proposed optimised network.

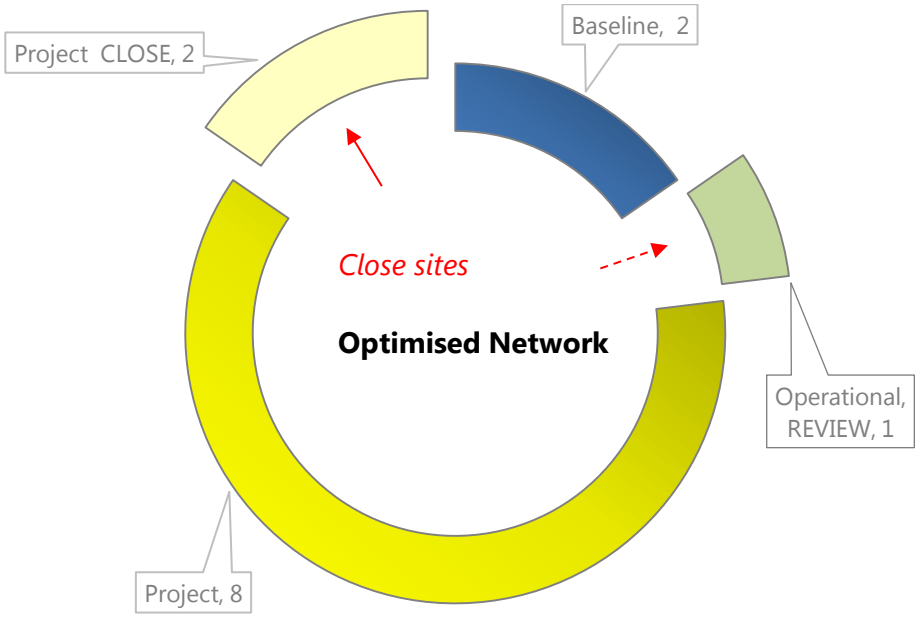


Figure 7.7 EP surface water classifications: proposed optimised network.

General discussion points

- There may be opportunity to supplement existing groundwater networks through the use of mining wells (and other private developer wells) once the assets are no longer required by the developer (refer to Section 13 Statewide recommendations).
- A review of water monitoring in the Polda Basin was conducted in 2014 and resulted in the report '*Polda Basin Monitoring Review*' (Branford & MacKenzie 2014). It is uncertain if the recommendations within this report have been implemented.
- The WAPs and the MERI Plan for the Southern Basins and Musgrave PWAs are currently under development. These plans may alter site classifications and the temporal and spatial locations of water surveillance sites located within the prescribed areas.
- Currently the Baseline groundwater network in the prescribed areas incorporates all of the sites nominated for water quantity calculation in the new water allocation plan. The MERI Plan for the new water allocation plan may alter the presently nominated Compliance and Impact component of the groundwater monitoring network.

7.3.1 Proposed network modifications

A number of changes were recommended by the EP working group and an implementation process will be undertaken to ascertain what changes occur.

- It is recommended that the EP working group, under the lead of NR EP, identify any additional surveillance investment or site re-classifications that result from the public consultation on the Southern Basins and Musgrave WAPs and the development of the NR EP MERI Plan.
- It is recommended that SMK consider additional groundwater surveillance for the Bramfield lens in Musgrave PWA.

- It has been previously recommended by SMK, and more recently by the EP working group, that additional investment in groundwater surveillance of the Lincoln North lenses is required. Five sites have been proposed and it is recommended that a survey be undertaken by SMK to establish whether any existing sites meet surveillance requirements, or whether new sites need to be constructed. Any new sites in the Lincoln North lenses area are recommended to be Baseline sites.
- It is recommended that recommendations from the '*Polda Basin Monitoring Review*' (Branford & McKenzie 2014) are implemented.
- It is recommended that SMK review the groundwater water level sites in the Polda, Kappawanta and Sharinga lenses of Musgrave PWA.
- 145 groundwater sites were 'nominally' classified as Compliance and Impact under advice provided by a SMK Principal Hydrogeologist. A process is underway to identify which of these sites are required. Some of these sites may be reclassified in the future on account of an Annual Water Use Report requirement as a condition on a Water Resource Works Approval in the revised Water Allocation Plan.
- The EP working group, under the lead of NR EP, is recommended to review the 35 Operational groundwater sites in the Venus Bay–Port Kenny and Penong networks for potential closure and report the outcome to the IRG.
- It is recommended that surface water site: A5120503, *Toolillie Gully upstream Tod Reservoir* be reviewed for ongoing data requirement. This site was initially constructed by SA Water to monitor flows into the water supply dam.
- Baseline dryland salinity sites will be reviewed through a process underway. This process may result in decreases in sites monitored for this purpose, however at this stage it is too early to estimate site numbers.

8 Kangaroo Island

The Kangaroo Island (KI) working group classified primary surveillance sites for groundwater and surface water within the NR KI region. The majority of sites were identified as Baseline (including flood monitoring sites) and project sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the region in Sections 8.1 and 8.2.

Section 8.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

8.1 KI: Groundwater site classifications

The KI working group considered 115 groundwater sites within the NR KI region. All groundwater sites were classified through a review conducted by the KI working group and included guidance and input from a DEWNR hydrogeologist. This review incorporated the longevity of water level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 8.1.

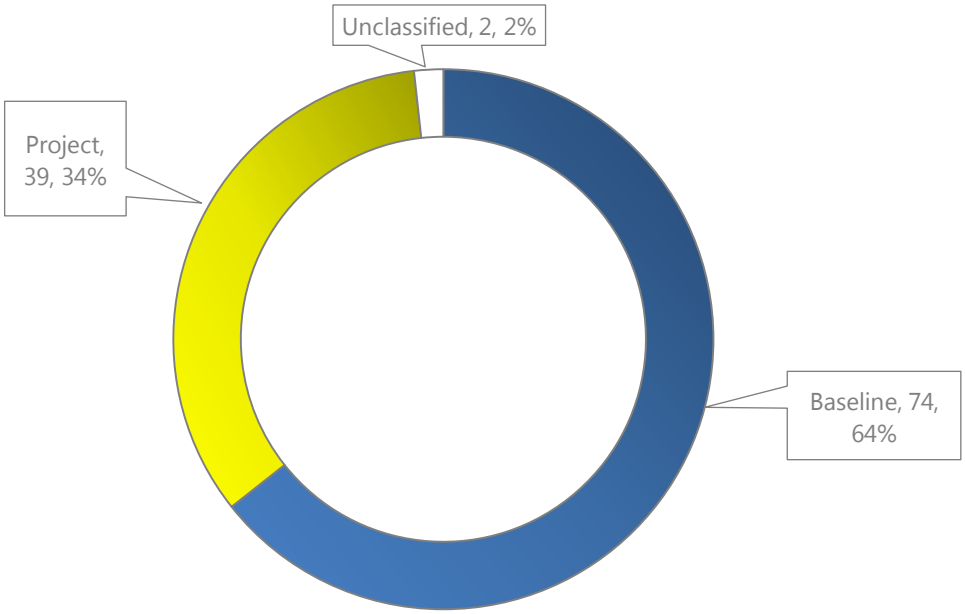


Figure 8.1 KI groundwater classifications at January 2016

A breakdown of the Baseline groundwater classifications is provided in text and in Figure 8.2. The breakdown for remaining classifications is discussed in text.

Baseline groundwater sites:

- Rocky River: 12 sites. These sites monitor the undeveloped catchment located in the south-west of Kangaroo Island.
- Dryland salinity: 62 sites. MacGillvray Plains region (9 sites) and Eleanor River region (53 sites related to PIRSA).

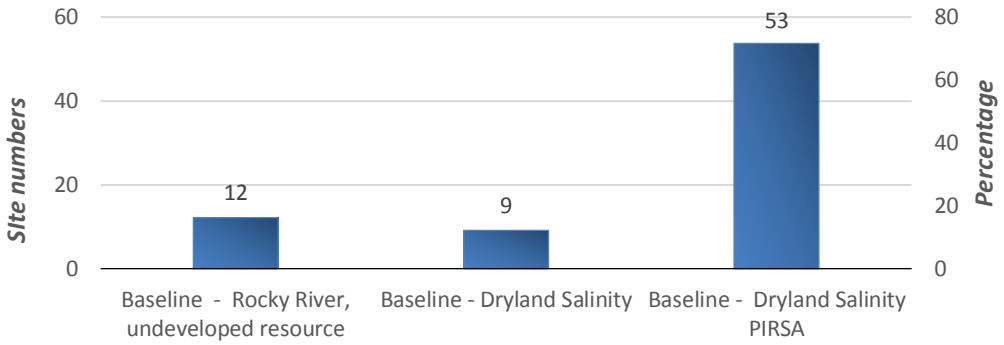


Figure 8.2 KI groundwater baseline sites

Project groundwater sites:

- Middle River catchment: 24 sites. These sites measure groundwater–surface water interaction.
- Rocky River: 15 sites. These sites are nested wells associated with the 12 Baseline sites.

Unclassified groundwater sites:

- Unit numbers: 622600153 and 622600154 remain unclassified in the Rocky River catchment. It is proposed to change these sites to SWL status 'Historical'.

8.2 KI: Surface water site classifications

The KI working group considered 15 surface water sites within the NR KI region. The site classifications identified for these surface water stations are shown in Figure 8.3.

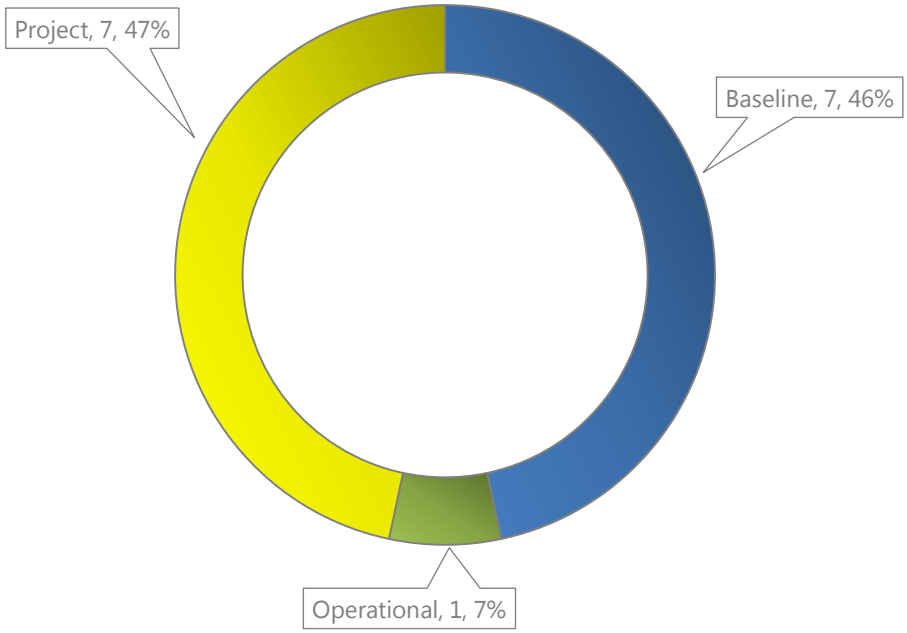


Figure 8.3 KI surface water classifications at January 2016

An outline of the Baseline and Project surface water classifications is provided in the text below and in Figures 8.4 and 8.5. Operational sites are discussed in text.

Baseline surface water sites:

- Rocky River catchment: 2 sites. These sites monitor the undeveloped catchment located in the south-west of Kangaroo Island.
- Middle River catchment: 2 sites. These sites are located upstream of the reservoir and at the ocean outlet point.
- Stunsail Boom River, Cygnet River and Timber Creek catchments each have 1 site.

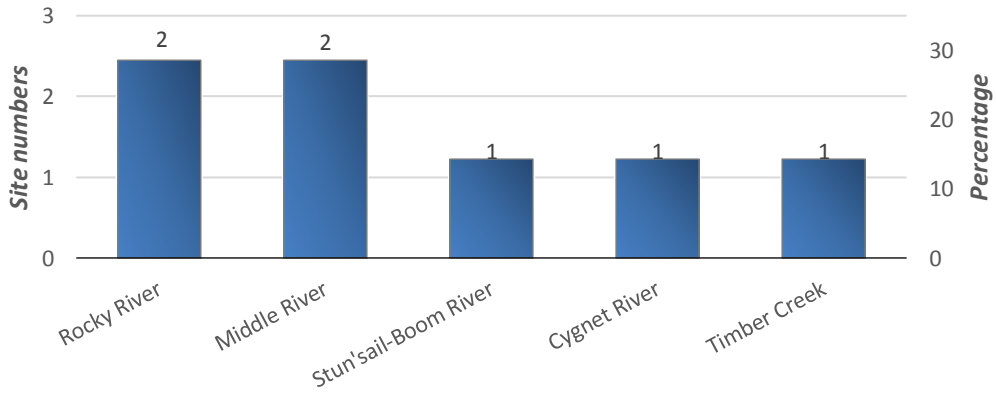


Figure 8.4 KI surface water baseline sites

Project surface water sites:

- Middle River catchment: 6 sites
- Cygnet River catchment: 1 sites. This site is located at Huxtable Forest.

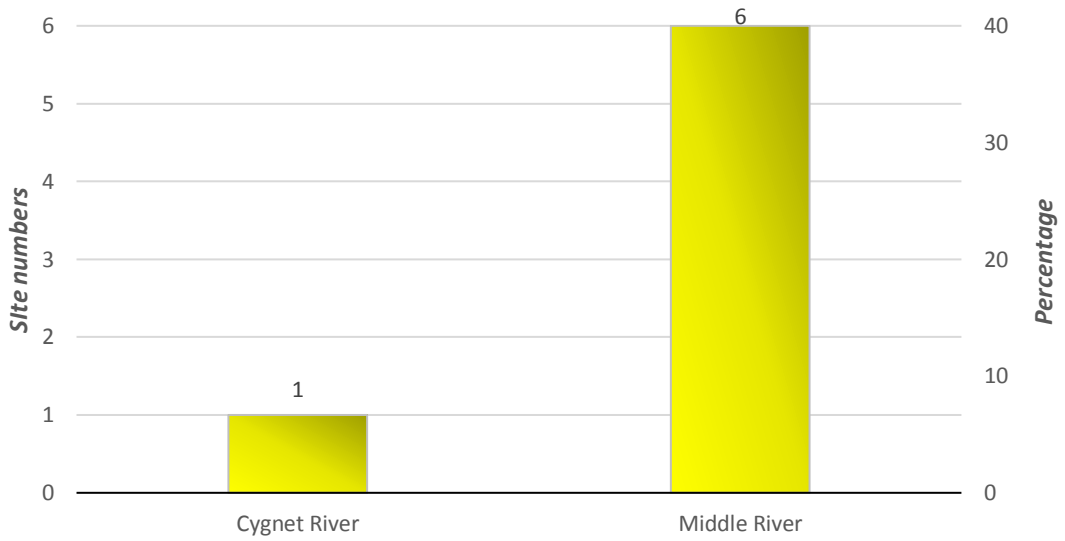


Figure 8.5 KI surface water project sites

Operational surface water sites:

- SA Water operates site A5131018 *Middle River Dam @ Kangaroo Island*, to support the operations of the reservoir located in Middle River Catchment.

8.3 KI: Optimised network

The KI working group has identified the following recommendations to improve and optimise the water surveillance within the NR KI region. Subject to the implementation of the recommendations, the optimised groundwater and surface water surveillance networks and the associated site classifications for the region are demonstrated in Figures 8.6 and 8.7.

Figures 8.6 and 8.7 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for closure*). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented.

In some circumstances the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'unknown'.

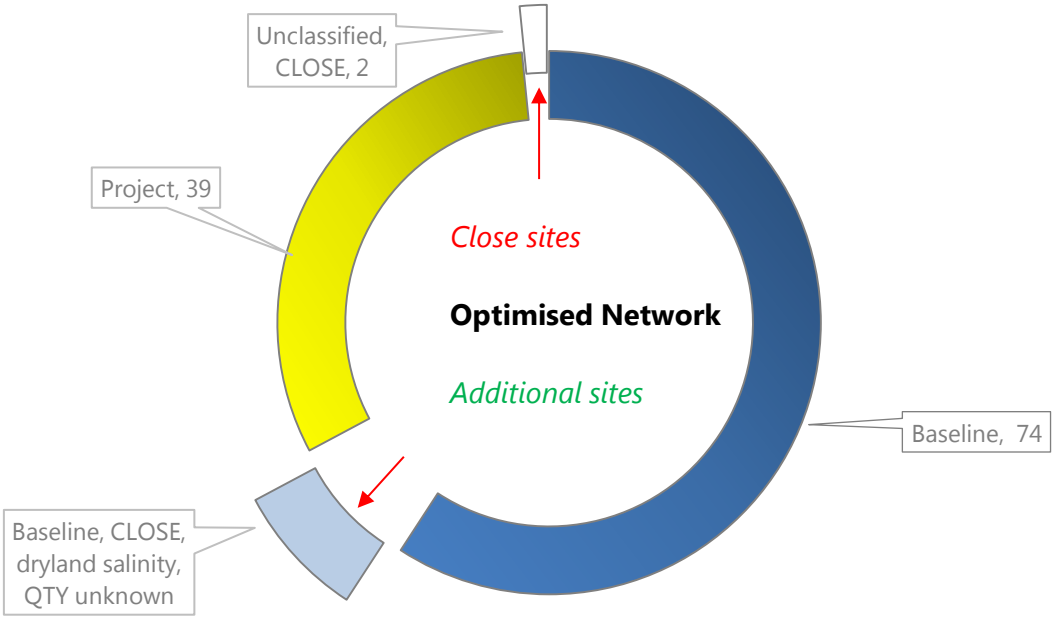


Figure 8.6 KI groundwater classifications: proposed optimised network.

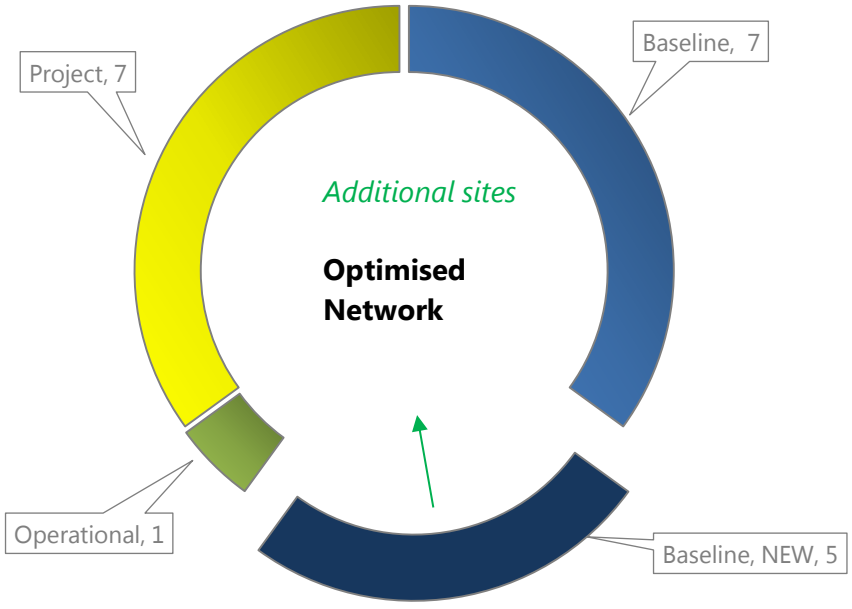


Figure 8.7 KI surface water classifications: proposed optimised network.

General discussion points

- There are no surface water or groundwater surveillance networks on the Dudley Peninsula. The peninsula has a number of water dependent ecosystems without knowledge on current and future risks.
- The working group identified knowledge gaps in understanding current and future risks of water resources on the Island, particularly on the Harriet River and Eleanor River catchments.

- Surface water site A5131023 Middle River downstream ETSA Track is incorrectly named, as 'Middle River downstream ETSA Track'. Working group members have agreed that this site was relocated 'upstream' to avoid the possibility of inundation resulting from the raising of Middle River dam wall. The site is now located 'upstream' of ETSA Track and as such the site record needs to be updated.
- There is also uncertainty regarding whether the location coordinates of site A5131023 Middle River downstream ETSA Track, have been updated or not, and therefore whether it's mapping in the correct location.

8.3.1 Proposed network modifications

A number of changes were recommended by the KI working group and an implementation process will be undertaken to ascertain what changes occur.

It is recommended:

- to expand the surface water surveillance to include sites at Harriet River and on Dudley Peninsula (Wilson or Chapman River). Associated groundwater surveillance requirements on Dudley Peninsula are to be identified by the KI working group under the lead of SMK.
- that additional surface water site/s be considered for the Eleanor River catchment on Kangaroo Island's south coast.

  Recommended additions to the surface water and groundwater networks will address existing knowledge gaps associated with these catchments, managing current or future risks to the resource, and to defining the environmental water requirements of water dependent ecosystems (Dudley Peninsula region).

  New sites would be classified as Baseline sites.
- that two SWL Status 'Current' groundwater sites in the Rocky River network are changed to SWL Status 'Historic' sites. These sites are OBSWELL Numbers MCD 19 (unit number 622600153) and MCD 20 (Unit number 622600154). It is recommended that this action be undertaken by the RMU.
- that Baseline groundwater dryland salinity sites will be reviewed through a process underway. This process may result in decreases in sites monitored for this purpose, however at this stage it is too early to estimate site numbers.

8.3.2 Other recommendations

- The KI working group recommends that RMU prioritises the validation of ratings curves for all surface water sites by undertaking flow gauging.
- It is recommended that RMU update the site name for A5131023 to Middle River upstream ETSA Track in Hydstra and record the site's coordinates at the next monitoring run, so they can be checked against the coordinates recorded in Hydstra.
- The addition of telemetry equipment is recommended for the surface water site A5131001 Cygnet River at Huxtable Forest and for the sites at Middle River, to allow faster identification of equipment malfunction. It is recommended that RMU and NR KI discuss resourcing requirements for this equipment.

9 Northern and Yorke

The Northern and Yorke (NY) working group classified primary surveillance sites for groundwater and surface water within the region. The majority of sites were identified as Baseline (including flood monitoring sites) and Compliance and Impact sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the NR NY region in Section 9.1 and 9.2.

Section 9.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the NY region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

9.1 NY: Groundwater site classifications

The Northern and Yorke (NY) working group considered 309 groundwater sites within the NR NY region. All groundwater sites were classified through a review conducted by the NY working group and included guidance and input from a DEWNR hydrogeologist. This review incorporated the longevity of water level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 9.1.

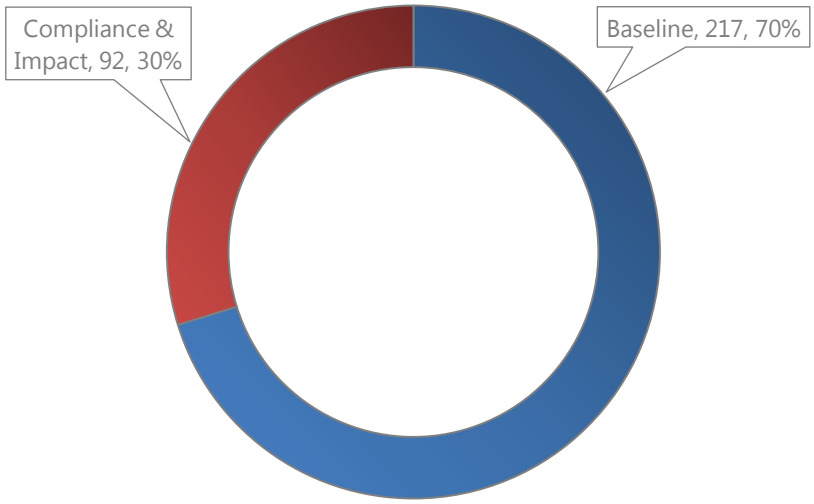


Figure 9.1 NY groundwater classifications as at January 2016

A breakdown of the Baseline and the Compliance and Impact groundwater classifications is provided in text and in Figures 9.2 and 9.3.

Baseline groundwater sites:

- Clare PWRA: 30 sites. Baseline sites identified by the NY working group.
- Baroota PWRA: 15 sites. Baseline sites identified by the NY working group.
- Non Prescribed areas: 56 sites. These sites were identified by the NY working group and are located in the Booborowie, Lochiel, Balaklava, Willochra and Walloway localities throughout the region.

- Dryland salinity: 116 sites. These sites are located in the localities of Jamestown, Wandearah Pirie Plains, Minlaton, Carribie and Upper Yorke:
    - Note: 15 dryland salinity sites have been classified as Baseline in addition to those identified as Baseline as part of the SMK's Principal Hydrogeologist's review. Six of these 15 sites are recorded as SWL status 'Historic' or 'Null' and are therefore unlikely to be required as part of the Baseline network.
    - These 15 dryland salinity sites have been added to the Baseline network to maintain consistency across the state in the initial treatment of dryland salinity sites. Associated Obswell no's are: *CRB5, CRB8, CUN3, MNL7, MNL19, MNL34, MNL32, MNL35, PWL10, PWL12, P1L13, PWL18, PWL20, PWL21, PWL3*.
    - A review of the dryland salinity sites across the state is underway and will clarify the final requirements for dryland salinity monitoring in the NY region.

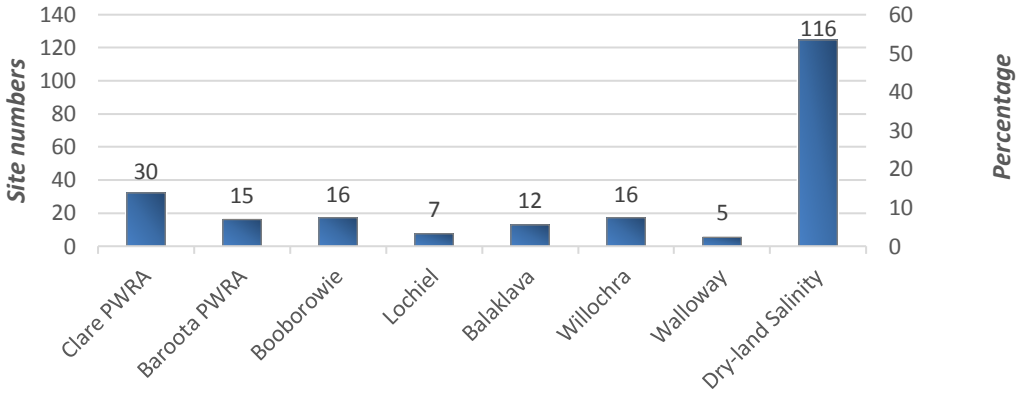


Figure 9.2 NY groundwater baseline sites

Compliance and Impact groundwater sites:

- Clare Prescribed Water Resources Area: 38 sites (*25 are TDS only*)
- Baroota Prescribed Water Resources Area: 6 sites (*4 are TDS only*)
- Non Prescribed areas: 48 sites. These sites are identified as 'nominally' Compliance and Impact as they are not located within prescribed regions. Further review may identify that these sites can be changed to SWL status 'Historic' (*13 of these sites are TDS only)*.
- Note: Further review of these TDS only sites is required to determine if they are required for Compliance and Impact salinity surveillance.

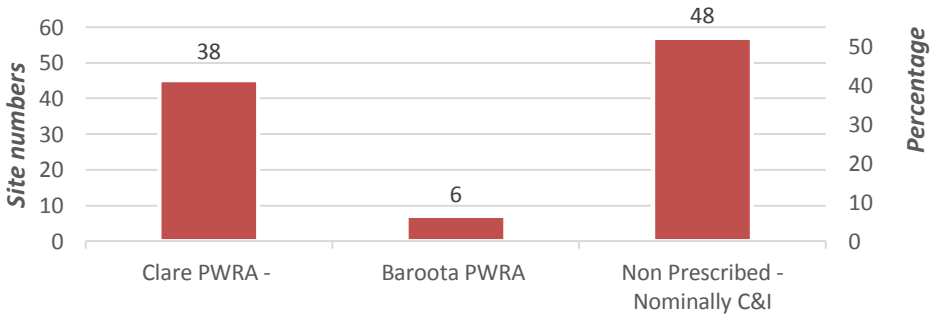


Figure 9.3 NY groundwater compliance and impact sites

9.2 NY: Surface water site classifications

The NY working group considered 29 surface water sites within the NR NY region. The site classifications identified for these surface water sites are shown in Figure 9.4.

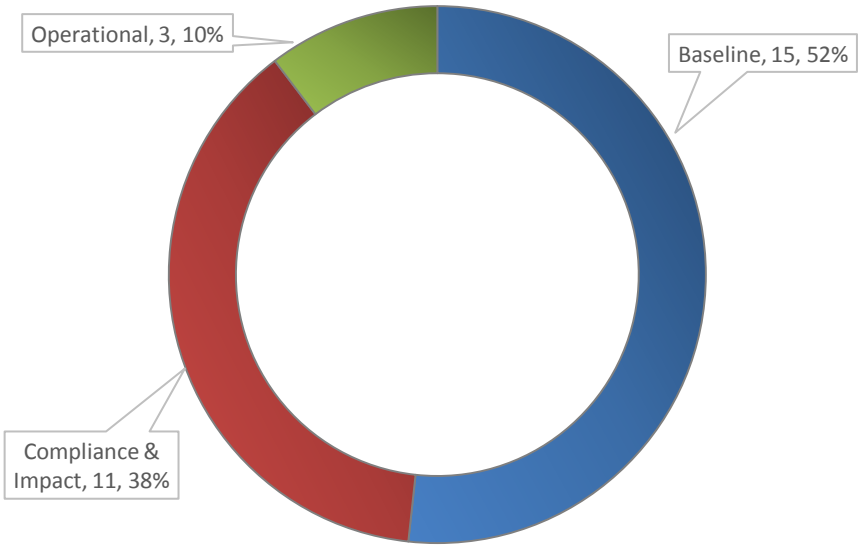


Figure 9.4 NY surface water classifications at January 2016

A breakdown of the Baseline surface water classification is provided in text and in Figure 9.5. The breakdown of the Operational classifications is discussed in text.

Baseline surface water sites:

- Status Reporting and NRM Regional Reporting: 12 sites. The secondary purpose of 3 of these 12 sites is flood monitoring.
- DEWNR Flood sites: 2 sites. Note that there are 5 Baseline DEWNR Flood sites in total.
- Site A5071005, *Hill River near Farrel Flat*, *Clare to Burra Road*, requires remediation work and is listed as 'Other'.

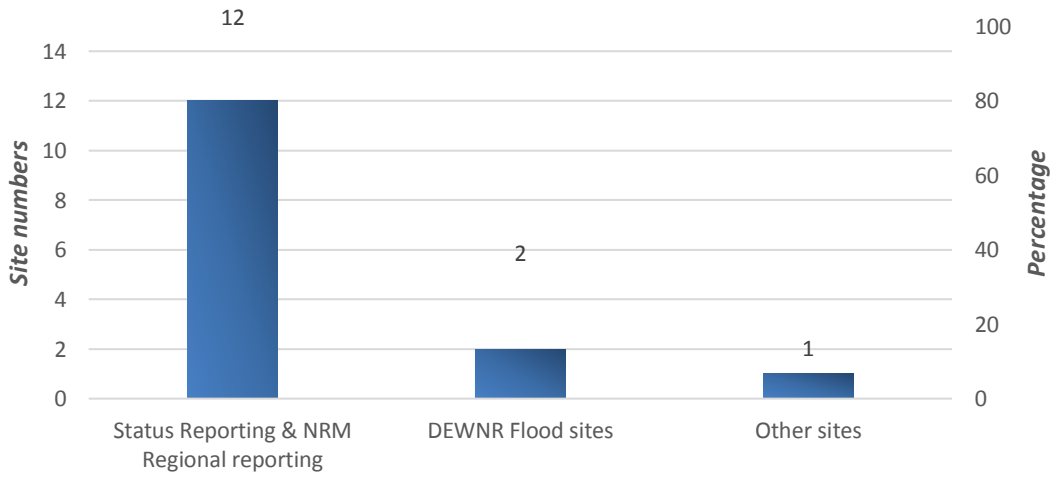


Figure 9.5 NY surface water baseline sites

Compliance and Impact surface water sites:

- Flood Other: 11 sites. These sites were nominated through working group discussions as having flood related function. 10 of these sites are BOM rainfall sites. The remaining site A5071002 *Rocky River downstream Threadgold's Crossing*, is a DEWNR automated flow station (logged and telemetered).

Operational surface water sites:

- Forestry SA rain gauges: 2 sites. These sites are: A5071007, Bundaleer Forest Depot, and A5071008, Wirrabara Forest Head Quarters.
- Clare Water Supply Scheme: 1 site. Site A5061010, Wakefield River at Taylors Vineyard is recommended to be decommissioned. See additional details below.

9.3 NY: Optimised network

The NY working group has identified the following recommendations to improve and optimise water surveillance within the NR NY region. Subject to the implementation of the recommendations the optimised groundwater and surface water surveillance networks and the associated site classifications for the region are demonstrated in Figures 9.6 and 9.7.

Figures 9.6 and 9.7 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for* closure). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented. Dotted red arrows indicate that further review is necessary to establish if the sites are required, or can be made historic and closed.

In some circumstances the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'unknown'.

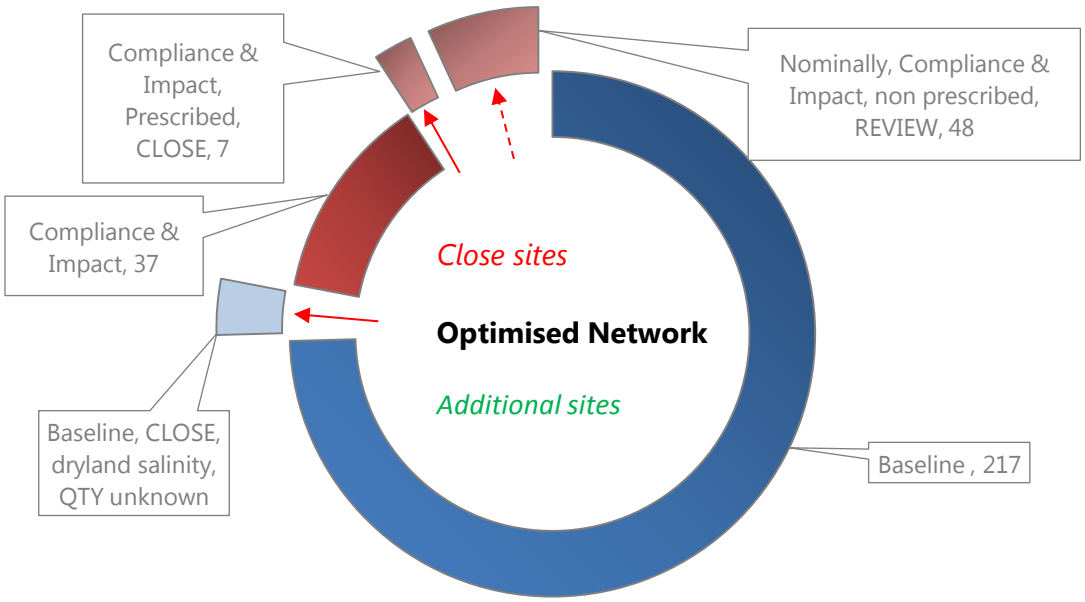


Figure 9.6 NY groundwater classifications: proposed optimised network.

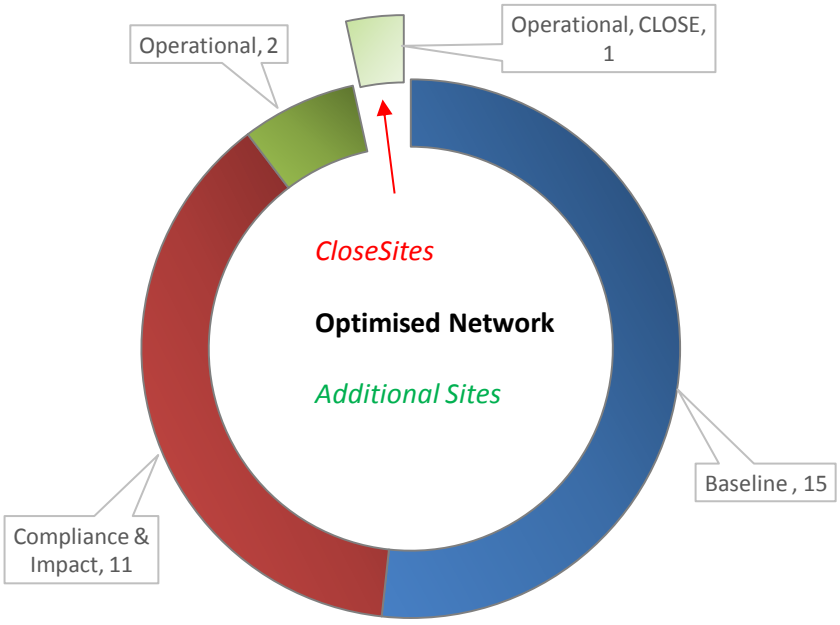


Figure 9.7 NY surface water classifications: proposed optimised network.

General discussion points

- The Clare WAP (NY NRM 2009, p. 86) advises that further investigations are required to better understand the underground water systems, including the relationship between rainfall, aquifer discharge and base-flow levels and to determine the impact of underground water extraction on surface water flows in the Prescribed Area.
- The NY Water Conservation Action Plan (CAP) is under development and may impact on the future requirement for water surveillance in the NY region, including water quality.
- A monitoring evaluation, reporting and improvement framework has been developed as a companion document to the NR NY Regional NRM Plan. This framework may impact on the level of water surveillance investment required in the NY region, including water quality.

9.3.1 Proposed network modifications

A number of changes were recommended by the NY working group and an implementation process will be undertaken to ascertain what changes occur.

- Surface water site A5071005 *Hill River near Farrel Flat - Clare to Burra Rd* requires rehabilitation as data is not currently fit for purpose. It is recommended that the RMU and NR NY initiate steps to cost and discuss resourcing for this work to be undertaken.
- Clare PWRA groundwater Compliance and Impact sites: 7 sites. It is recommended to change the status of Obswell No's: UPW35, UPW75, CLR58, CLR15, MLN4, CLR131 and CLR147 to SWL Status 'Historic' as they provide limited value to the assessment of water level within the network. It is recommended that this be actioned by the RMU.
- 48 non-prescribed groundwater sites were 'nominally' classified as Compliance and Impact under advice provided by a SMK Principal Hydrogeologist. It is recommended that a further review process be initiated in the first half of 2016 to establish if these sites are required.

- It is recommended that the NY working group, under the lead of NR NY, conducts a review of the 42 Compliance and Impact groundwater sites throughout the prescribed and non-prescribed areas of the NY region that are TDS only. This review should assess whether these sites are required for either water quantity or water quality surveillance throughout the region. (*Note that some sites overlap with this point from the above 2 points):*
    - If a site is not required, it is recommended to change the site's TDS status to TDS status equals Historic.
- The NY Baseline groundwater network currently incorporates 116 dryland salinity sites. All Baseline dryland salinity sites will be reviewed through a statewide process currently underway. This process may result in decreases in sites monitored for this purpose, however at this stage it is too early to estimate site numbers.
- Surface water site A5061010 *Wakefield River at Taylors Vineyard* is recommended to be closed:
    - Data from this site is of very poor quality. The site is described as having very low sensitivity and the ford is understood to leak on the right hand bank. Earlier attempts to repair the site to improve data quality have failed. Adequate repairs are understood to be very costly. There are also concerns regarding the site's location, being close to an extraction point at Taylor's Vineyard.
    - It is recommended that this be actioned by the RMU.

10 South Australian Arid Lands

The South Australian Arid Lands (SAAL) working group classified primary surveillance sites for groundwater and surface water within the NR SAAL region. The majority of sites were identified as Baseline (including flood monitoring sites) and Operational sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the region in Sections 10.1 and 10.2.

Section 10.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

10.1 SAAL: Groundwater site classifications

The South Australian Arid Lands (SAAL) working group considered 95 groundwater sites within the NR SAAL region. All groundwater sites were classified through a review conducted by the SAAL working group and included guidance and input from a DEWNR hydrogeologist. This review incorporated the longevity of water level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 10.1.

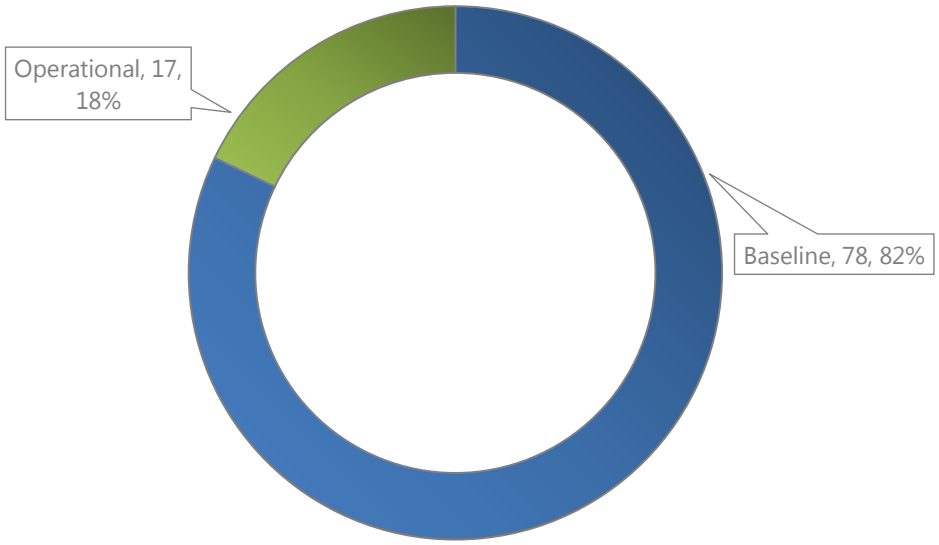


Figure 10.1 SAAL groundwater classifications at January 2016

A breakdown of the Baseline and Operational groundwater classifications is provided in text and in Figures 10.2 and 10.3.

Baseline groundwater sites:

- GAB artesian and non-flowing sites: 76 sites. These sites are predominantly located within the Far North PWA in the SAAL region.
- 2 sites need to be confirmed. These sites are unit numbers 674400001 and 664300010. These sites are currently listed as Baseline.

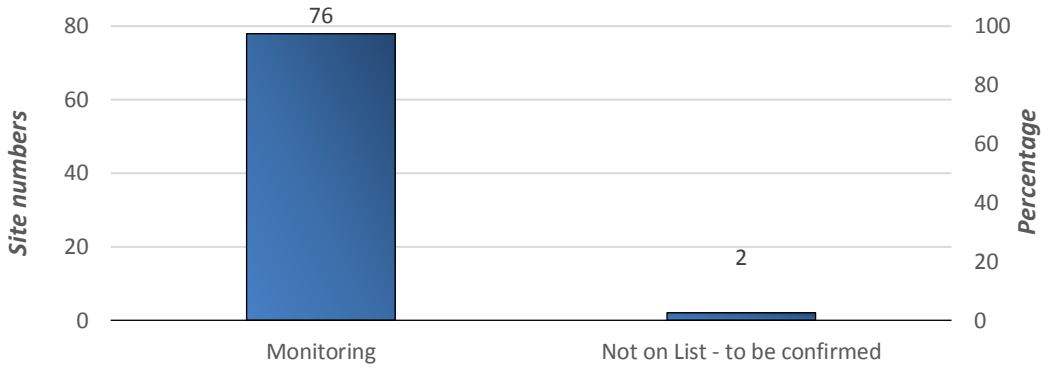


Figure 10.2 SAAL groundwater baseline sites

Operational groundwater sites:

- Marla sites (Town Water Supply): 15 sites. It is proposed to review these sites to identify any sites that may supplement and expand the Baseline network. The remainder may not be required as part of the state's groundwater surveillance network.
- Indigenous Communities (Town Water Supply): 2 sites.

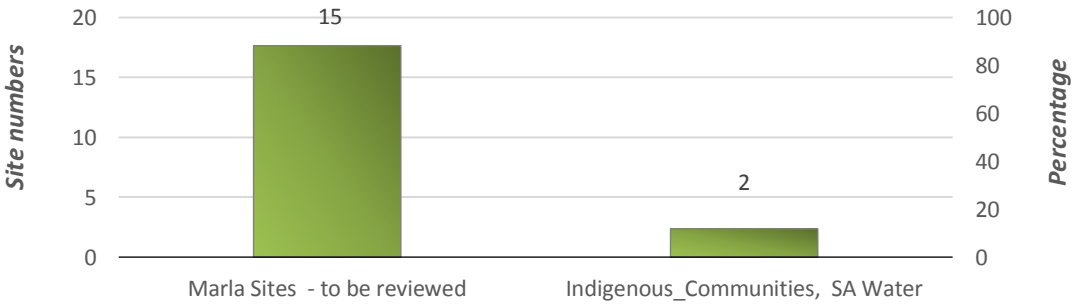


Figure 10.3 SAAL groundwater operational sites

10.2 SAAL: Surface water site classifications

The SAAL working group considered 26 surface water sites within the NR SAAL region. The site classifications identified for these surface water sites are shown in Figure 10.4.

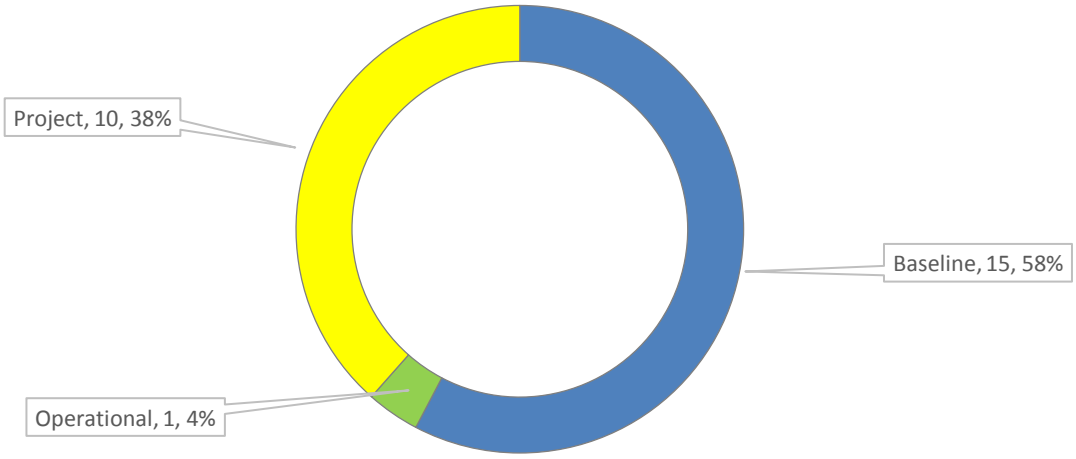


Figure 10.4 SAAL surface water classifications at January 2016

A breakdown of the surface water classifications is provided in text below.

Baseline surface water sites:

- Various rivers, creeks and water holes throughout the region: 8 sites. These sites include:
  - 6 DEWNR flood sites located on the Diamantina River, Warburton River, Cooper Creek and Neale's River
  - 1 Far North Ecology site (A0051003 Mucumba Creek at Alguchina Water Hole).
  - The sites located at Cooper Creek and at Birdsville are flow monitoring sites.
- Pluviometer; 1 site. A5100516 *Aroona Dam Pluviometer at Aroona Dam*.
- AWS: 1 site. Dalhousie AWS at Dalhousie Springs.
- BOM sites: 5 sites located at Pfitzners Well, North Mooloolo, Maynard's Well, Arcoona Bluff and the Plateau.

Operational surface water sites:

- 1 site. SA Water operate a rain gauge at Nepabunna Aboriginal Community.
- SANTOS have several flow monitoring sites throughout the Moomba area. These are not included in the project dataset.

Project surface water sites:

- 1 Scientific Expedition Group (SEG) site monitors flow. This site is A0040520 *Arcoona Creek at Gammon Ranges NP*.
- SEG: 9 rainfall sites are located in the Northern Flinders Ranges between Leigh Creek and Balconoona. These sites operate as an ongoing citizen science project, with data collected stored in South Australia's repository for water monitoring data.

10.3 SAAL: Optimised network

The SAAL working group has identified the following recommendations to improve and optimise the water surveillance within the NR SAAL region. Subject to the implementation of the recommendations the optimised groundwater and surface water surveillance networks and the associated site classifications for the region are demonstrated in Figures 10.5 and 10.6.

Figures 10.5 and 10.6 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for* closure). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented. Dotted red arrows indicate that further review is necessary to establish if the sites are required, or can be made historic and closed.

In some circumstances the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'Unknown'.

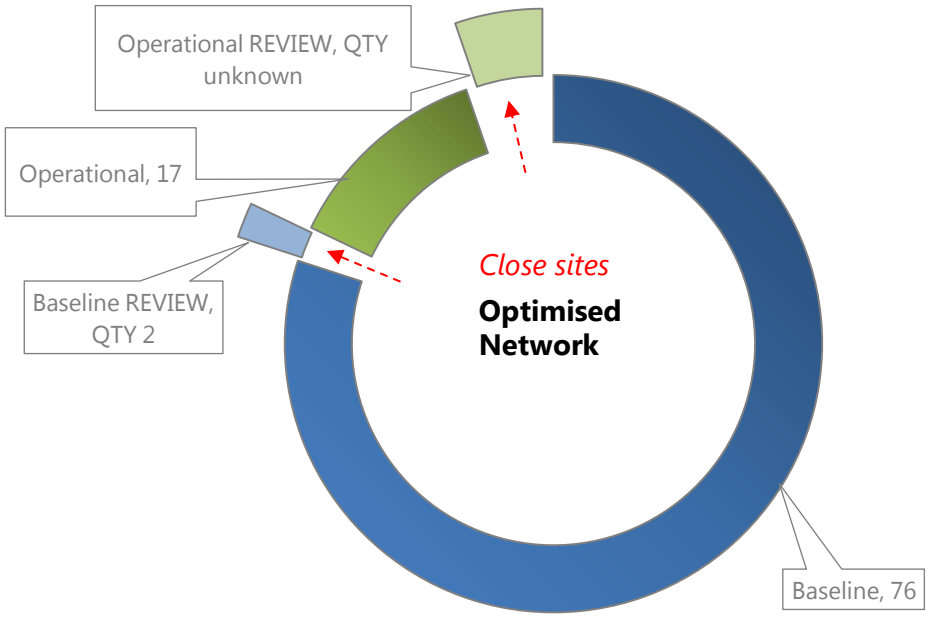


Figure 10.5 SAAL groundwater classifications: proposed optimised network.

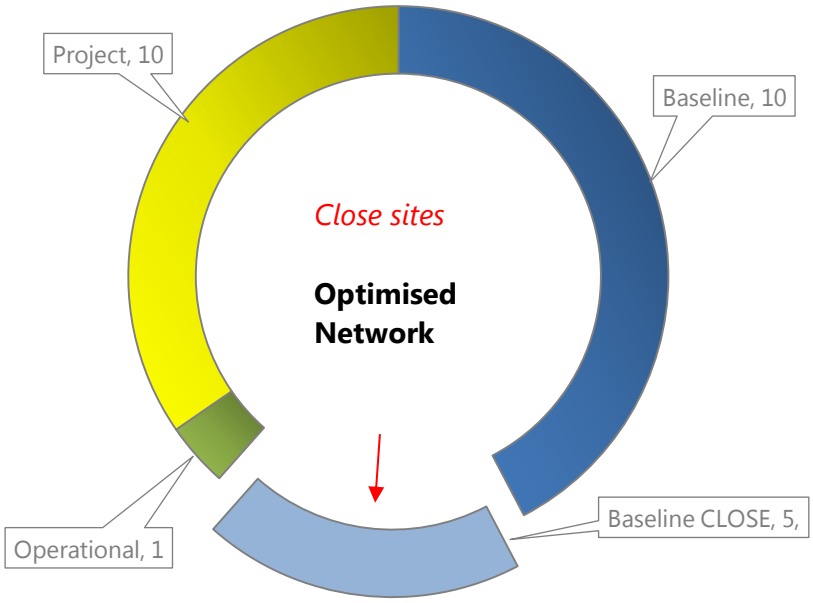


Figure 10.6 SAAL surface water classifications: proposed optimised network.

General discussion points

- The NR SAAL Regional NRM Plan and the Far North PWA WAP should provide guidance for water surveillance requirements.
- The SAAL Regional NRM Plan and MERI Plan are currently under review. In addition, a review of the Far North WAP is scheduled to begin in 2016 leading to adoption of a revised Far North WAP in 2019. The revision of these plans may result in additional investment being required in the NR SAAL region.
- All current surface water surveillance is required to be continued, with the exception of duplicate sites.
- Surface water surveillance priorities for future investment are:
  - additional flow data
  - water level data
  - increased surveillance of the 'water take' from the system.
- Specific areas of focus are recommended to be:
  - Recognised SAAL areas that are of significance – National Parks, wetlands of significance
  - SAAL areas where development currently exists
  - SAAL areas where development is likely to exist in the future
  - SAAL areas impacted by developments from outside the SAAL region.
- The Scientific Expedition Group (SEG) surface water sites are conducted primarily by volunteers. The SAAL working group discussed which of these sites may become Baseline sites if the volunteers are unable to continue conducting this surveillance.
- Additional surveillance of groundwater and surface water is required to support increased research to address knowledge and information gaps, including the study of the expected impacts of climate change on the SAAL region.

- Selected mining sites and town water supply sites (e.g. Marla) could supplement the Baseline network throughout the SAAL region when no longer required by the developer:
    - Ongoing use of sites in this manner will ensure efficiency and effective use of existing assets.
    - The identification of potential sites and preliminary discussions could be held with relevant mining organisations.
- The imminent closure of Leigh Creek Coal mine should be considered and planned for in regard to water surveillance requirements associated with the rehabilitation of the site.
- SANTOS and other mining and development companies may be able to provide DEWNR surface water and groundwater data from privately owned monitoring stations. These private monitoring sites are managed to inform the business operations of the company, but if approved, the data may be useful for DEWNR to access:
    - The NR SAAL have a role titled 'Community Engagement and Partnerships Manager'. This staff member may be a useful contact for negotiations regarding accessing private company's data. It is likely that private monitoring activities have captured extensive data on flora and fauna in addition to water data. Any discussions regarding DEWNR accessing private monitoring data may include discussing access to this data as well, not only water related data.
- There are approximately 15 historical surface water surveillance sites throughout the NR SAAL region that are located at critical points in the system, and have established historical datasets. These sites were stage loggers installed as part of the ARIDFLO, Cooper and Critical Refugia projects and were associated with the University of Melbourne. These sites may be considered for re-opening if funding allows.

10.3.1 Proposed network modifications

A number of changes were recommended by the SAAL working group and an implementation process will be undertaken to ascertain what changes occur.

- The SAAL working group recommends that groundwater site Unit No. 5945-181 would be an ideal well to immediately add into the Baseline network for the non-artesian GAB monitoring program. The proximity of this site to the Dalhousie Springs complex and the NT border makes it worth consideration for inclusion. It is recommended that the IRG initiate steps to check the integrity of this site and evaluate its potential inclusion in the network.
- It is recommended that a review of water surveillance requirements be undertaken by the SAAL working group under the lead of SMK to:
    - consider the SAAL Regional NRM Plan and MERI Plan currently under review
    - identify the knowledge gaps in the region and additional surveillance requirements to address knowledge gaps.

    Based on identified knowledge gaps:

    - identify which of the SEG sites would be of value to add to the Baseline network should the SEG volunteers cease to maintain these sites
    - identify which of the Marla groundwater sites (Town Water Supply, 15 sites) may supplement and expand the Baseline network
    - review other selected mining sites and town water supply sites to supplement the Baseline network throughout the NR SAAL region, when no longer required by the developer
    - consider historical sites that may be re-activated.

It is recommended that the review be tabled to the IRG for discussion on the strategic importance of water surveillance in the region and to make recommendations for future surveillance requirements.

Refer to Section 13 for statewide recommendations on resourcing the optimised network and using wells no longer required by mines and other developments to supplement the groundwater network.

- It is recommended that discussions regarding data access, from privately owned monitoring stations operated by private entities, be undertaken at a higher level as it has statewide applicability.
    - It was agreed by the SAAL working group that DEWNR should initially seek to understand what surveillance data (both water and ecological) is held by private organisations, and rather than seek immediate access to the full extent of the data, request access on an 'as needs basis'.
    - The SAAL working group noted that some data may already be supplied to Department of State Development through regulatory approval channels and that this data may potentially be already passed through to DEWNR. This should be investigated prior to data access discussions with private site owners proceeding.
- Groundwater unit numbers 674400001 and 664300010 are identified as Baseline sites. This classification is recommended to be reviewed by SMK to establish if these sites are correctly classified. If these sites are not required it is recommended they be made Historical.
- It is recommended that sites in the Marla network not required as members of the Baseline network, may be changed to SWL status 'Historic'.
- Surface water Baseline closures: 5 sites. These sites are the BOM surface water sites that are duplicate records of 5 SEG sites. The BOM records can be deleted from the project dataset. The corresponding SEG sites should remain in the project dataset.
- In regard to the overlapping datasets related to the SEG (DEWNR) sites and BOM sites, it is recommended that the DEWNR data is considered the point of truth and the associated BOM records be deleted from the project dataset.

10.3.2 Other recommendations

- The following Baseline groundwater sites may be mapping incorrectly. This issue may be associated with the 'zone' field in the project dataset being incorrect and should initially be investigated as a desktop activity. Field checking of site coordinates during the next monitoring trip should be undertaken, if required. This should be actioned by RMU. Relevant drillhole numbers are:
    - 684500008, 704500022, 703600216, 664300011, 674100001, 654000014, 704100100
- DEWNR seek clarity on its responsibility for identifying water monitoring requirements associated with the rehabilitation of the closed mines site and other developments and seek adequate resourcing.

11 South Australian Murray-Darling Basin

The South Australian Murray-Darling Basin (SAMDB) working group classified primary surveillance sites for groundwater and surface water within the region. The majority of sites were identified as Baseline (including flood monitoring sites), Operational and Compliance and Impact sites.

Information and analysis of the primary groundwater and surface water site classifications and the breakdown of sites within each classification is provided for the NR SAMDB region in Sections 11.1 and 11.2.

Section 11.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the SAMDB region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

11.1 SAMDB: Groundwater site classifications

The SAMDB working group considered 1632 groundwater sites within the SAMDB Natural Resources region. All groundwater sites were classified through a review conducted by the SAMDB working group and included guidance and input from a DEWNR hydrogeologist. This review incorporated the longevity of water level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 11.1

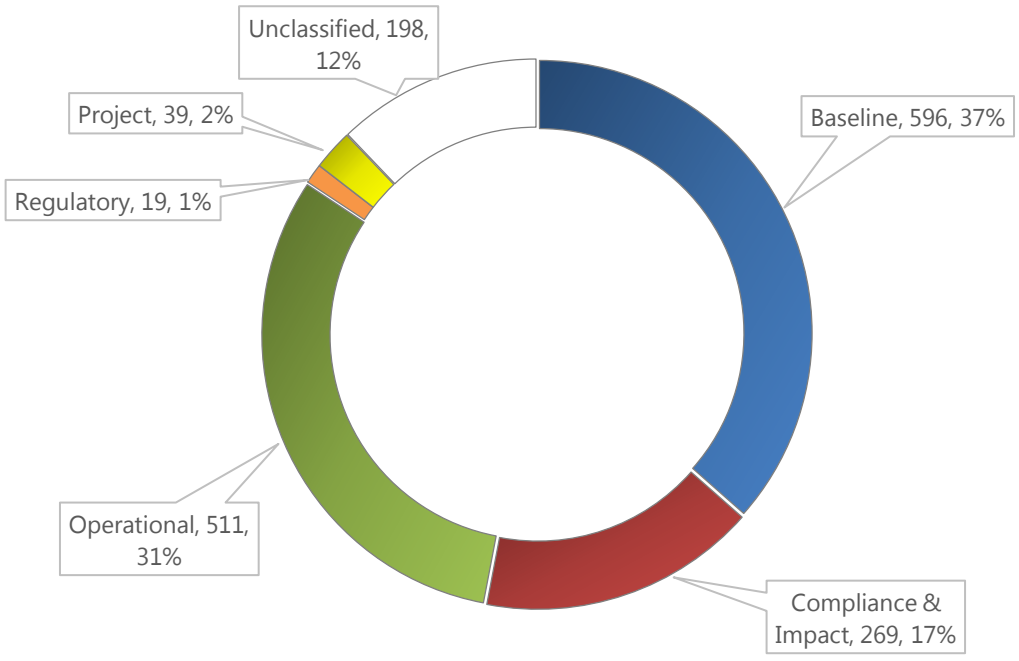


Figure 11.1 SAMDB groundwater classifications at January 2016

A breakdown of the Baseline and the Compliance and Impact groundwater classifications is provided in text and in Figures 11.2 and 11.3. The breakdowns for remaining classifications are discussed in text.

Baseline groundwater sites:

- 'Prescribed Area' surveillance: 131 sites. These sites are located within the Angas Bremer, EMLR, Marne Saunders and Peake, Roby and Sherlock and Mallee PWAs. Thirteen of these sites located in the Mallee PWA (Mindarie region) are recommended to be made historical.
- Riverland irrigation: 359 sites. These sites monitor the effect of irrigation in the Riverland and are located throughout Waikerie, Loxton, Berri-Barmera, Cadell, Moorook, Pike Murtho, Renmark Cooltong, Sunlands Qualco, Taylorville, Waikerie Holder and Woolpunda regions.
- Dryland salinity: 41 sites. These sites are located in the Angas Bremer, Coastal Plain, Keyneton, and Tungkillo regions.
- South Australia–Victoria Border zone: 28 sites. These sites are monitored for standing water level on behalf of the NR SAMDB Board and are conducted by a contractor.
- Mallee PWA: 37 sites. This surveillance is undertaken on behalf of the NR SAMDB Board by a contractor.

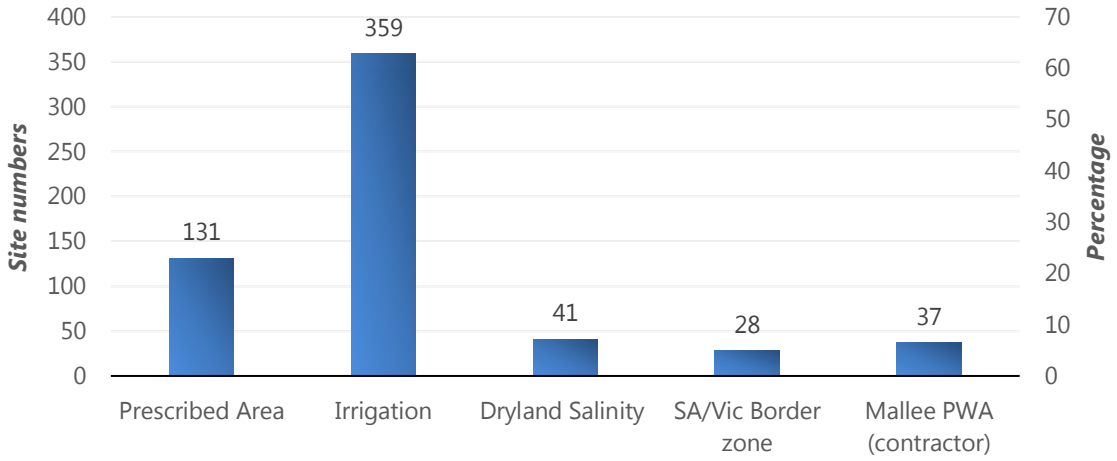


Figure 11.2 SAMDB groundwater baseline sites

Compliance and Impact groundwater sites:

- 'Prescribed Area' surveillance: 101 sites. These sites are associated with WAP implementation and review. These sites are located in Angas Bremer PWA, Marne Saunders PWRA, and Peake, Roby and Sherlock PWA.
- Nominally Compliance and Impact: 168 sites within various PWAs. These sites are NOT identified as being specifically required for implementation and review of WAPs. Further review of these sites by the working group may achieve further optimisation from these areas:
    - EMLR PWRA (60 sites)
    - Mallee PWA regions (53 sites)
    - Marne Saunders PWRA (33 sites)
    - Peake, Roby and Sherlock PWA (20 sites)
    - Other (2 sites)

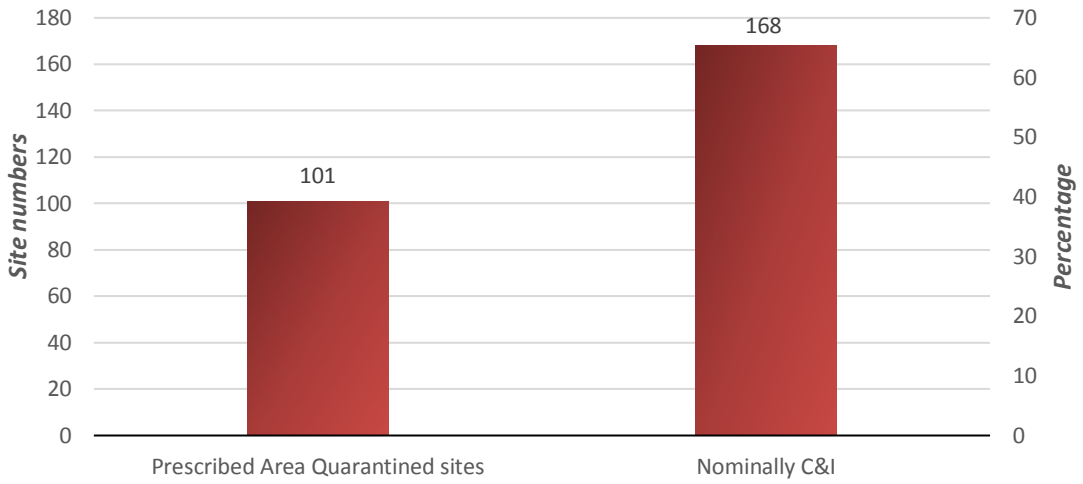


Figure 11.3 SAMDB groundwater compliance and impact sites

Operational groundwater sites:

- Salt Interception Scheme monitoring: 419 sites. These sites are monitored by SA Water inform the operation of Salt Interception Schemes (SIS) throughout the Riverland. Specific locations include the Waikerie Lock 2, Woolpunda, Stockyard Plains, Noora, Bookpurnong, Waikerie Phase 2, Waikerie Waikerie, Sunlands, and Loxton SIS.
- Chowilla Regulator: 92 sites. These sites inform the operation of the regulator. Some of these are sites are located in NSW.
- Many of these sites are funded through the Murray–Darling Basin Authority.

Regulatory groundwater sites:

- Murray Zircon mine at Mindarie. 19 sites

Project groundwater sites:

- 'Murray Futures Program' CLLMM: 20 sites. Data for these sites is collected by the EPA.
- Reclaimed Swamps at Mobilong: 17 sites. These sites are associated with SA Water and the EPA.
- NR SAMDB Rangelands Project: 2 sites. NR SAMDB are maintaining these two sites as part of the Rangelands Project that is currently underway.

Unclassified groundwater sites:

- 198 groundwater sites remain unclassified throughout the SAMDB region. The majority of these sites are located in the Chowilla region.

11.2 SAMDB: Surface water site classifications

The SAMDB working group considered 249 surface water sites within the NR SAMDB region. The site classifications identified for these surface water sites are shown in Figure 11.4.

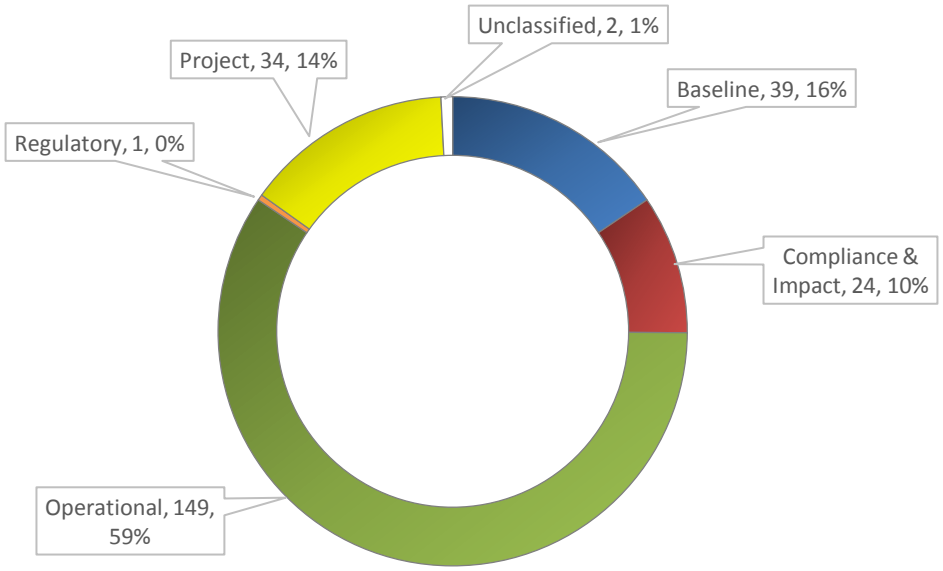


Figure 11.4 SAMDB surface water classifications at January 2016

A breakdown of the Baseline and Operational surface water classifications is provided in text and in Figures 11.5 and 11.6. The breakdown for remaining classifications are discussed in text.

Baseline surface water sites:

- Surface Water Status Reporting: 29 sites. 7 of these sites are also DEWNR Flood sites.
- DEWNR Flood sites: 8 sites. These 8 sites are located in tributaries of the River Murray in the Eastern Mount Lofty Ranges and provide surveillance of flash flooding. Note that a total of 15 DEWNR Flood sites are identified within the Baseline classification.

  There is uncertainty regarding sites A4261102 and A4261173 as to whether they are DEWNR Flood sites or SAMDB Flood sites. Refer to the Statewide Recommendations section for further information on flood monitoring sites.

  Other: 2 sites. A4261020 *Tookayerta Creek downstream Nangkita Creek* and A4261099 *Currency Creek near Peel Road Cemetery* are important surface water sites in the EMLR.

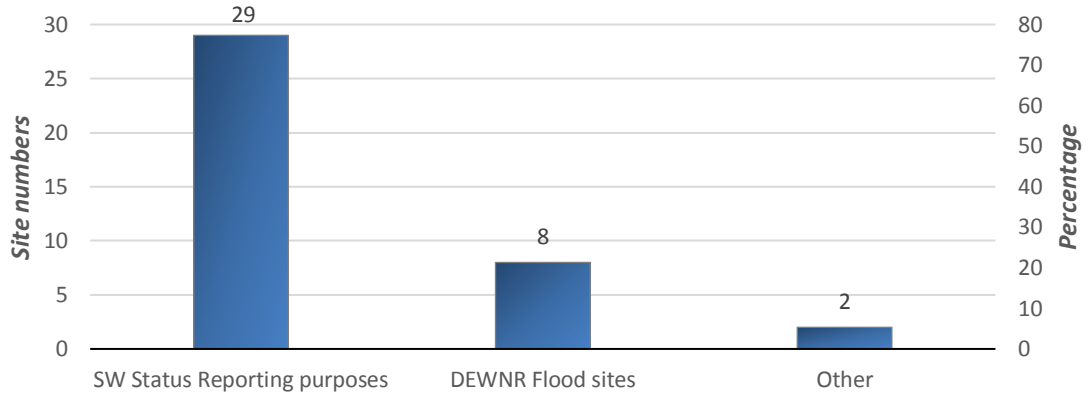


Figure 11.5 SAMDB surface water baseline sites

Operational surface water sites:

- MDBA Monitoring sites: 64 sites. These sites are funded by the MDBA to support River Murray operations. The data from these sites is used for multiple reporting purposes.
- Automatic Weather Station sites and rain gauges: 45 sites. These sites support land management and agricultural practice across the region.
- SA Water monitoring to support River Murray operations: 10 sites
    - Site A4261033 *Lake Alexandrina at Clayton Jetty* is not operating currently, and is only used for opportunistic readings. The site is an SA Water site and is recommended for closure, subject to approval by SA Water.
- Forestry SA: 1 site. This is a logger equipped rain gauge which informs Forestry SA's land use and management.
- Salt Interception Scheme (SIS) monitoring: 13 sites. These sites inform management and operations of the SIS schemes.
- Chowilla Operations: 16 sites. These sites inform the operations of the Chowilla regulator.
- Additional Operational surface water sites have multiple classifications and are represented in other classification categories.

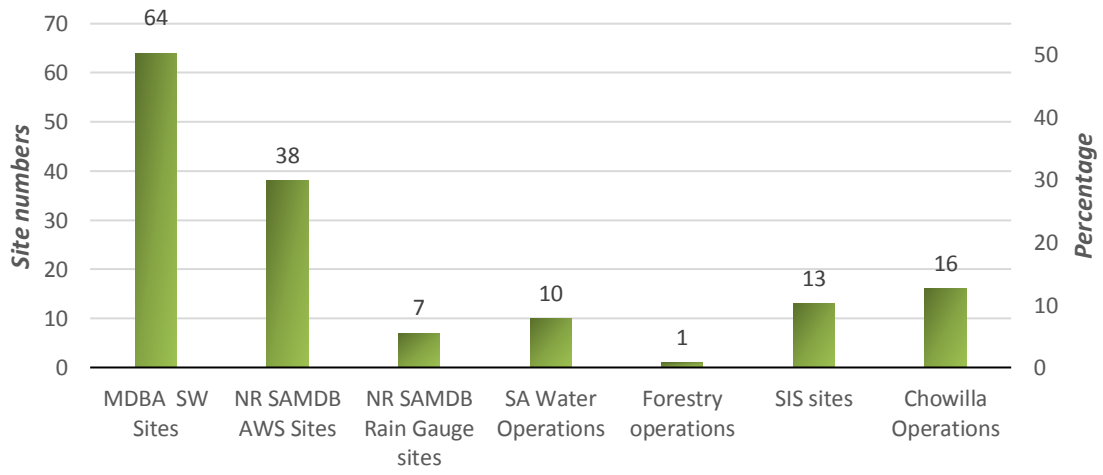


Figure 11.6 SAMDB surface water operational sites

Compliance and Impact surface water sites:

- Goyder Institute/SARDI EMLR WAP: 12 sites. These sites are focused on providing data to support water allocation planning.
- Compliance and Impact sites include those focused on ecological monitoring and include V-WASP monitoring, and NR SAMDB sites.
- Other Flood sites: 6 of the Compliance and Impact sites were identified as 'Other Flood sites'.
- Site A4261073*, Angas River at Ballandown Road*, is decommissioned and should be recorded as closed in Hydstra.
- A number of surface water sites classified as Baseline, have secondary Compliance and Impact purposes recorded in the project dataset. Site A4261103 *Giles Creek downstream Signal Flat* was not identified as Baseline and therefore classified as Compliance and Impact.
- Several of the Compliance and Impact sites have secondary classifications recorded in the project dataset.

Project surface water sites:

- Katfish 2 sites and Pike 7 sites.
- CLLMM region: 21 sites. The CLLMM data is currently collected by the EPA.
- NR SAMDB: 3 sites. These sites are A4261148 *Burra Creek at Worlds End (Low Flow)*, A4261149 *Burra Creek at St Just Street Ford,* and A4261147 *Burra Creek upstream Logan Creek*.
- State Water Resource Monitoring: 1 site. This site is A4261021*, Marne Catchment Pluviometer at Moss Smith Road*.

Regulatory surface water sites:

- Brukunga Mine: 1 site. This site is located downstream of the mine site in the EMLR.

11.3 SAMDB: Optimised network

The SAMDB working group has identified the following recommendations to improve and optimise the water surveillance within the NR SAMDB region. Subject to the implementation of the recommendations, the optimised groundwater and surface water monitoring networks and the associated site classifications for the region, are demonstrated in Figures 11.7 and 11.8.

Figures 11.7 and 11.8 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for* closure). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented. Dotted red arrows indicate that further review is necessary to establish if the sites are required, or can be made historic and closed.

In some circumstances, the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'unknown'.

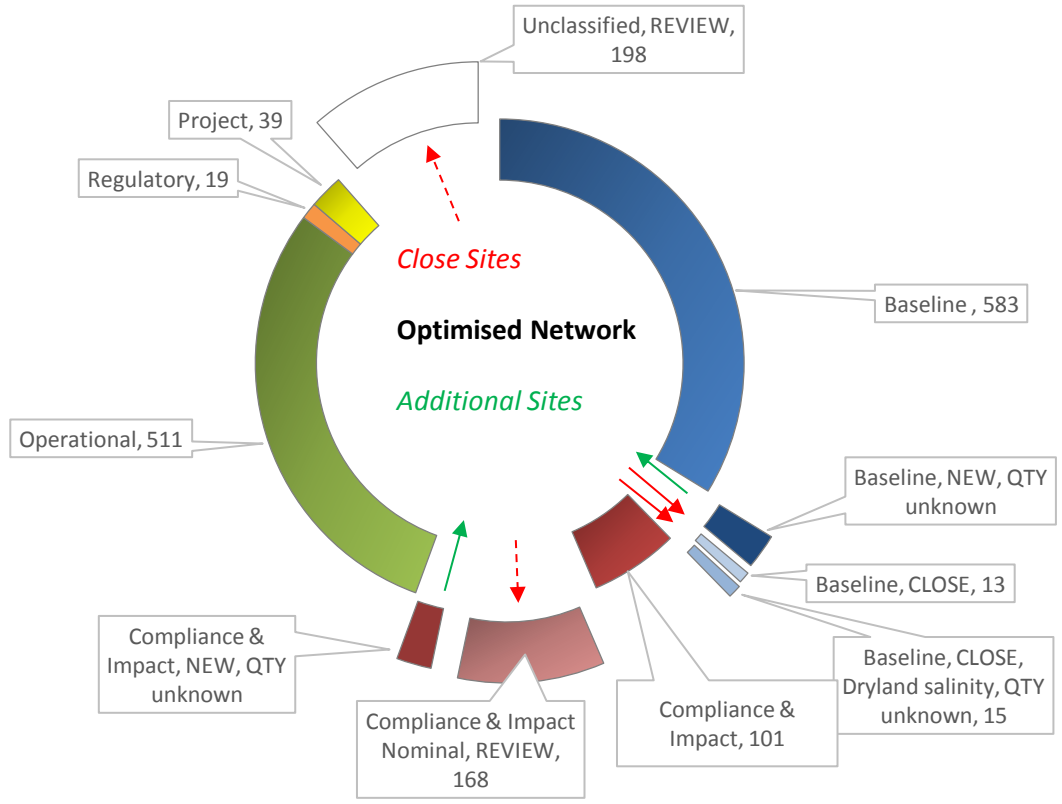


Figure 11.7 SAMDB groundwater classifications: proposed optimised network.

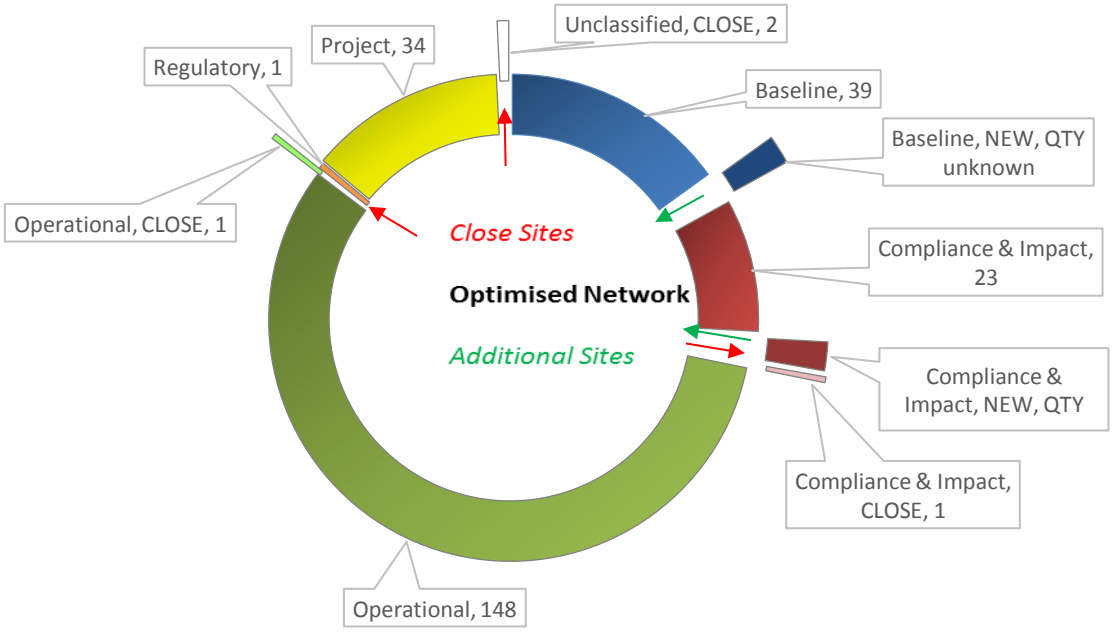


Figure 11.8 SAMDB surface water classifications: proposed optimised network.

General discussion points

- A review of the post project completion surface and groundwater surveillance requirements, will be required for the following projects:
    - Coorong, Lower Lakes and Murray Mouth (CLLMM)
    - Riverine Recovery projects and The Living Murray projects: Chowilla, Pike and Katfish.
- It is envisaged that at the conclusion of projects, that project planning recommendations will advise a series of recommendations that either transfer monitoring sites to the state network, or decommission monitoring sites.
- Groundwater and surface water resources in the prescribed areas of the SAMDB, require ongoing surveillance to adequately support assessment of the state of the resources for the purposes of implementing and reviewing current and future WAPs and or water licensing activities. The surveillance network should provide both quantitative and qualitative data.
- Goyder funding of 12 surface water sites, set up to determine the effectiveness of the Eastern (and Western) Mount Lofty Ranges WAPs, will soon cease. These sites are currently classified as Compliance and Impact sites and are all equipped with data loggers and telemetry. The future status and requirement for these sites to remain current will need to be considered. This has been actioned by NR SAMDB.
- The Hydstra status of the Baseline classified surface water site A4261020, '*Tookayerta Creek downstream Nangkita Creek* will need to be changed to 'current'. This has been actioned and confirmed by the RMU:
    - Confirmation is required by the appropriate group, that this site fulfils the requirement for a new Baseline stream-flow monitoring station in Tookayerta Creek catchment. This is to be actioned by NR SAMDB via the EMLR WAP MERI committee.
- There is uncertainty regarding surface water sites A4261102 and A4261173 as to whether they are DEWNR flood monitoring sites or SAMDB flood monitoring sites. In this report, these sites are treated as Baseline DEWNR flood monitoring sites. Refer to Section 13 Statewide Recommendations.
- The SAMDB working group has identified that groundwater site numbers 6630-3340 (KRG001) and 6630-3324 (KRG002) are Project sites with loggers contributing to the NR SAMDB Rangelands Project:
    - Note: Although sites KRG001 and KRG002 are located in the SAMDB, they are also members of the NR Northern and York based Booborowie network. Both sites have been confirmed as NOT being required as part of NR NYs monitoring network.
    - Therefore, it is recommended that the SWL status of both sites should be changed to 'Historic'. Access to these wells should be maintained supporting the SAMDB Project usage. This is to be actioned by the RMU.

11.3.1 Proposed network modifications

A number of changes were recommended by the SAMDB working group and an implementation process will be undertaken to ascertain what changes occur.

- It is recommended that ongoing surveillance requirements of completed projects be identified by project planning recommendations that either transfer monitoring sites to the state network, or decommission monitoring sites. Refer to Section 13 Statewide Recommendations.
- Additional groundwater and surface water surveillance sites will be required to support implementation of the EMLR WAP particularly within the high demand zones (Tookayerta Permian HDZ, Angas Kanmantoo HDZ & Bremer Adelaidean HDZ) and three groundwater Management Areas (Finniss Adelaidean, Angas Adelaidean & Bremer Kanmantoo). WAP specific water monitoring needs are being finalised through the development of a MERI Plan which will define any requirement for additional surveillance investment. This is being be actioned by NR SAMDB via the EMLR WAP MERI committee.

- The majority of additional surveillance sites required in the EMLR to support WAP implementation will be classified as Compliance and Impact, with some expansion to the Baseline network also likely.
- Surface water site A4261018 Western Flat Creek, Mt Barker, was closed by DEWNR in 2011 and is therefore not included in this project's dataset. This site is however identified as a key flow gauging station in Appendix E of the EMLR WAP. Any requirement to re-open this site, should be considered as part of the development of the MERI Plan associated with the EMLR WAP, and if re-opened be classified as Compliance and Impact.

The following groundwater sites are recommended for review:

- 168 groundwater sites that were 'nominally' classified as Compliance and Impact under advice provided by a SMK Principal Hydrogeologist. It is recommended that the review process be initiated in the first half of 2016 to establish if these sites are required.
- Baseline dryland salinity sites (process currently underway). This process may result in decreases in sites numbers monitored.
- 198 groundwater sites which remain unclassified. These sites are mostly located in the Chowilla region. It is recommended that the review process be initiated in the first half of 2016 to establish which of these sites are required and their classification.

The following groundwater sites are recommended to be closed:

- 13 groundwater sites in the Mindarie region (OBSWELL no's: *ALN5, AUD3, CHS10, CHS11, CHS12, CHS13, CHS5, MCP1, MND19, MND24, MND29, MND30, MND31)* have been identified as not required. It is recommended to change these sites to SWL status 'Historic'. These sites are currently classified as Baseline.
- 2 non-operational groundwater sites, BKP30 in Noora and WAK40 in Stockyard Plain. It is recommended to change these sites to SWL status 'Historic'.
- 6 groundwater sites located north of the Marne River (unit numbers 672800004, 672802359, 672802365, 672802490, 672802639 and 682800730) which have been identified as not required. It is recommended to change these sites to SWL status 'Historic'.
- The following groundwater sites remain unclassified. It is recommended to change these sites to SWL status 'Historic'. Access to these wells will be maintained as they are used by NR SAMDB and community groups for monitoring training purposes. Unit numbers are as follows:
  - 672702971
  - 672702972
  - 672702973
  - 672702974
- The status of surface water site A4261033 *Lake Alexandrina at Clayton Jetty*, is recommended to be changed to Historic. Although this site is currently classified as Operational, it is not operating, and exists for opportunistic readings only.
  - It was discussed in the working group that site A4261033 Lake Alexandrina at Clayton Jetty is an SA Water site, and that SA Water should be consulted in regard to any changes made to the site's status. The IRG is recommended to initiate steps to implement these changes to the site.

11.3.2 Other recommendations

- Hydstra records for surface water site A4261220 will need to be checked to confirm that the correct name (*'Angas River at'…'Ballandown Rd')* is recorded. This has been actioned and confirmed by RMU.
- Surface water Compliance and Impact site *A4261073, Angas River at Ballandown Road*, is decommissioned and should be recorded as closed. This has been actioned and confirmed by RMU.

12 South East

The South East (SE) working group classified primary surveillance sites for groundwater and surface water within the NR SE region. The majority of sites were identified as Baseline (including flood monitoring sites), Operational, Compliance and Impact and Project sites.

Information and analysis of the primary groundwater and surface-water site classifications and the breakdown of sites within each classification is provided for the NR SE region in Sections 12.1 and 12.2.

Section 12.3 outlines the proposed optimised surveillance networks for groundwater and surface water in the SE region and lists specific regional recommendations. Section 13 of the report provides recommendations applicable statewide.

12.1 SE: Groundwater site classifications

The SE working group considered 1539 groundwater sites within the NR SE region. All groundwater sites were classified through a review conducted by the SE working group and included guidance and input from a DEWNR hydrogeologist. This review incorporated the longevity of water level record, the well (and casing) construction quality and condition, and well accessibility issues.

The site classifications identified for these groundwater sites are shown in Figure 12.1.

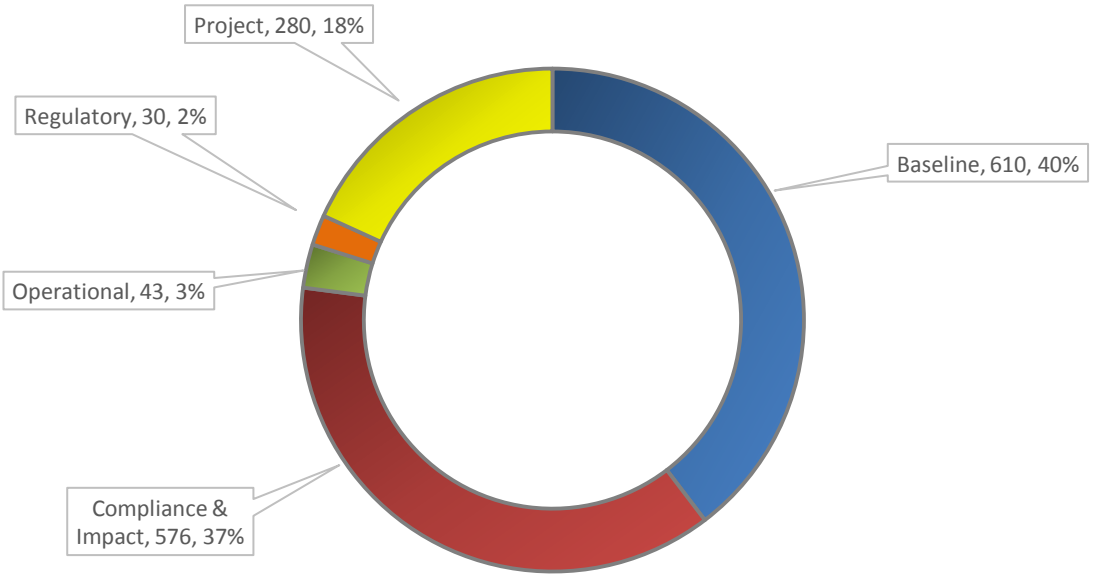


Figure 12.1 SE groundwater classifications at January 2016

A breakdown of the Baseline, Compliance and Impact, and Project groundwater classifications is provided in text and in Figures 12.2 to 12.4. The breakdowns for the remaining classifications are discussed in text.

Baseline groundwater sites:

Where practicable, baseline sites are presented separately for the various sub sections of the unconfined aquifer and for the South East Confined Aquifer in Figure 12.2.

- Upper South East: 18 sites. These sites were originally drilled in the early 1980s to obtain a background potentiometric surface and to compile water table cross-sections to measure the impact of drains. Prior to their introduction there was no groundwater surveillance in the Upper South East.
- Upper South East, Adaptive Flows Management, Decision Support System (USE AFM DSS): 49 sites. These are SEWCDB groundwater sites, required by the SEWCDB, that provide data on flow conditions and inform operations of the USE Drainage Network.
- 14 of the above Baseline sites are also monitored by the EPA as part of the statewide water quality monitoring network. This is not represented in Figure 12.2 as the EPA use is a secondary classification.

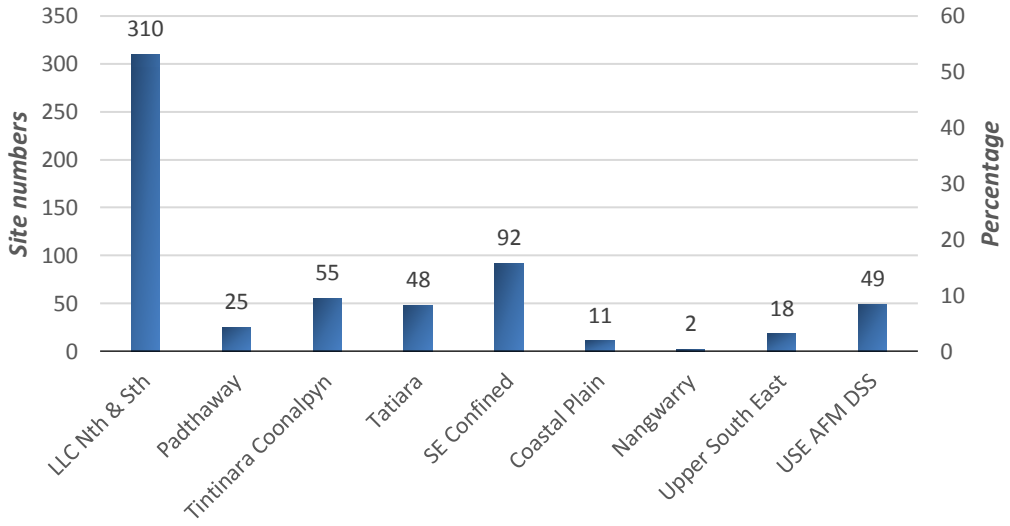


Figure 12.2 SE groundwater baseline sites

Compliance and Impact groundwater sites:

- Groundwater Dependent Ecosystems: 74 sites: These sites monitor GDE health and condition at numerous GDE assets throughout the NR SE region. Additional GDE related sites are incorporated in the LLC South Baseline network.
- LLC North and South: 91 sites. These sites are 'nominally' Compliance and Impact and assist in the management of the unconfined aquifer throughout the region.
- Padthaway: 21 sites. These sites are 'nominally' Compliance and Impact and assist in the management of the unconfined aquifer throughout the Padthaway region.
- SE Confined aquifer: 8 sites: These sites are 'nominally' Compliance and Impact and assist in the management of the confined aquifer.
- Licensed Irrigated Wells: 268 sites: Funding for these former pumped TDS sites ceased in July 2014. If these sites are required, an alternative funding source will be required.
- Tintinara–Coonalpyn: 40 sites: These sites are 'nominally' Compliance and Impact and assist in the management of the unconfined aquifer throughout the Tintinara–Coonalpyn region.
- Tatiara: 37 sites. These sites are 'nominally' Compliance and Impact and assist in the management of the unconfined aquifer throughout the Tatiara region.

- Upper South East: 11 sites. These sites are 'nominally' Compliance and Impact and assist in the management of the unconfined aquifer throughout the Upper South East region.
- NVC Plan: 20 sites. These Compliance and Impact sites are required as part of the approvals processes related to the development of the drainage network in the Upper South East.
- Other: 6 sites. These sites are 'nominally Compliance and Impact sites.

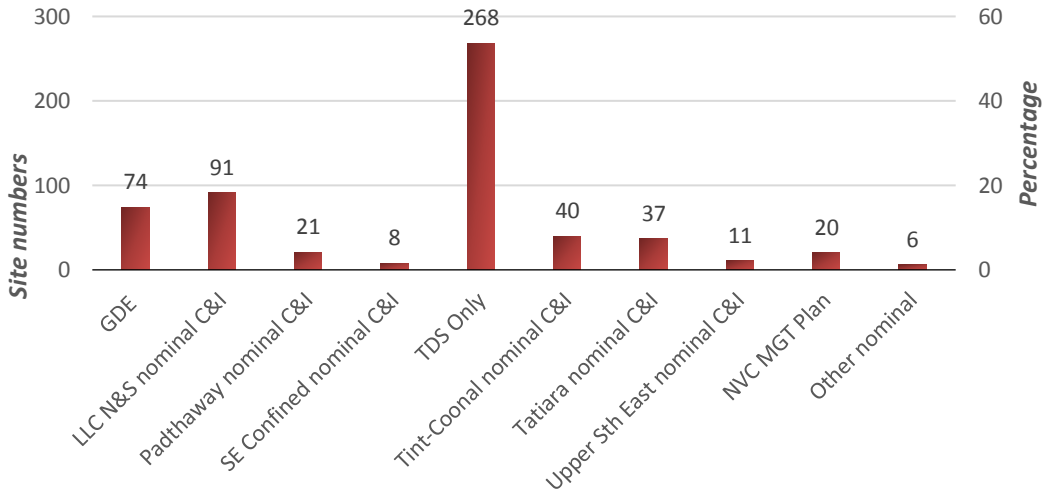


Figure 12.3 SE groundwater compliance and impact sites

Project groundwater sites:

- These Project sites represent a variety of projects throughout the NR SE region including sites at Blue Lake, Kimberley Clark, Nangwary, SA Fries and drainage related sites.
- Upper South East dryland salinity: 70 sites. These sites were drilled between approximately 1986–1992, by either Landcare or DEWNR. In conjunction with the 18 Baseline sites in the Upper South East, these sites were originally drilled to obtain a background potentiometric surface and to compile water table cross-sections to measure the impact of drains.

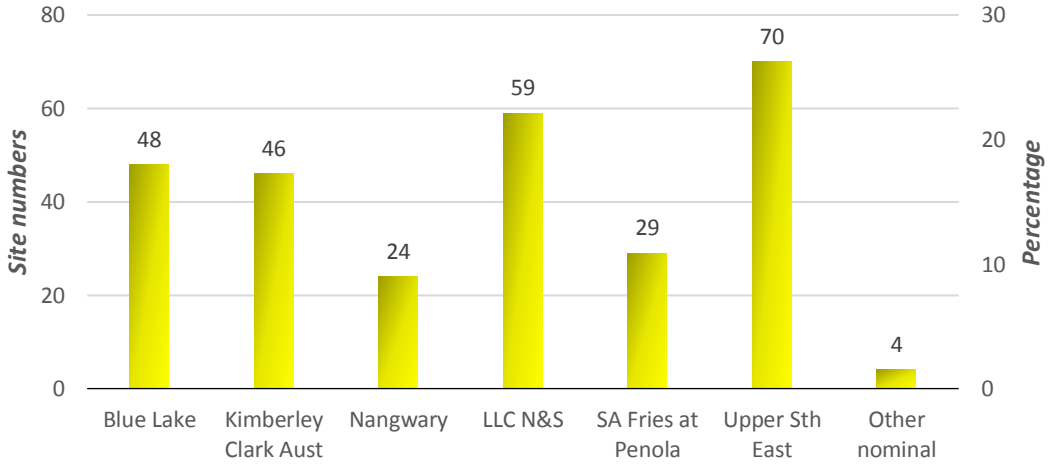


Figure 12.4 SE groundwater project sites

Operational groundwater sites:

- All Operational groundwater sites are related to SA Water town water supply operations. 43 sites are identified throughout the NR SE region.

Regulatory groundwater sites:

- EPA: 30 sites. These sites are related to the EPA's statewide water quality network. Additional EPA sites are represented in other classifications where multiple site purposes exist.

12.2 SE: Surface water site classifications

The SE working group considered 238 surface water sites within the NR SE region. The site classifications identified for these surface water sites are shown in Figure 12.5.

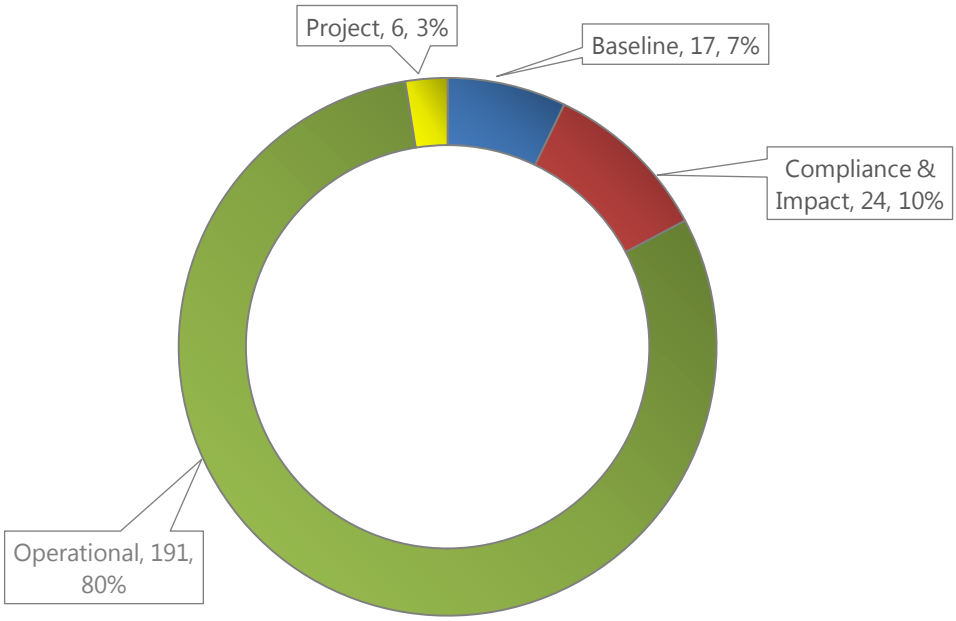


Figure 12.5 SE surface water classifications at January 2016

A breakdown of the Compliance and Impact, and Operational surface water classifications is provided in text and in Figures 12.6 and 12.7. Baseline and Project classification breakdowns are provided in text.

Baseline surface water sites:

- Outlet points and key drainage points: 17 sites. These sites monitor surface water and flow parameters and are located throughout the region. All except one of these sites are automated platforms (equipped with loggers and telemetry).
- Several of these have an Operational aspect related to the operation of the SE drainage network.
- The assessment identified 29 Historical surface water Baseline sites that are currently closed. Fourteen of these would be re-opened if future funding could be secured.

Compliance and Impact surface water sites:

- Morambro Creek WAP: 2 sites
- Ramsar agreement implementation requirements: 1 site
- Marcollat Watercourse: 1 site
- Groundwater dependent ecosystems: 20 sites. These sites are all located within the Lower Limestone Coast PWA area.

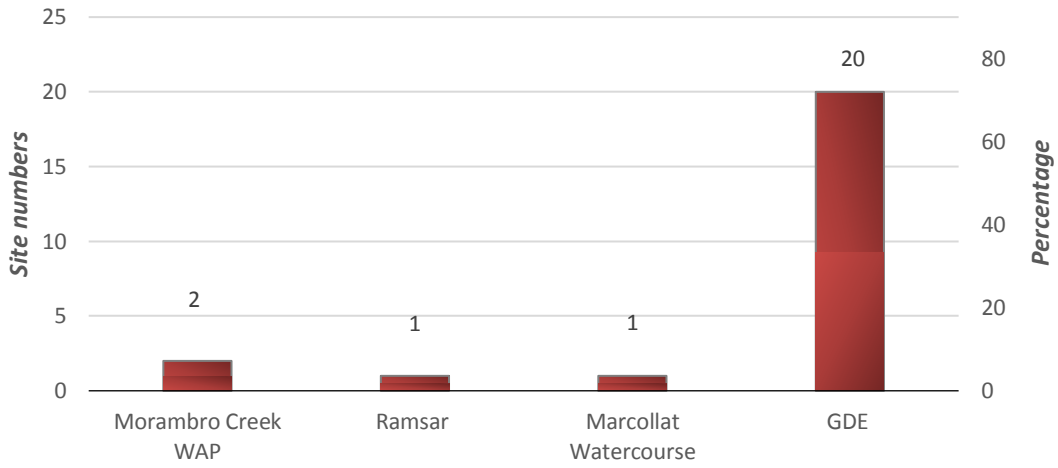


Figure 12.6 SE surface water compliance and impact sites

Operational Surface water sites**:**

- Forestry operations: 11 sites. These are rain gauges equipped with loggers.
- SEWCDB Catchment surveillance sites: 137 sites. These sites are unequipped, manually read sites, regularly used by Drainage Operations Staff for operational purposes. Some of these sites may have a gauge board. As these sites are not equipped they have no future investment requirements or asset management considerations.
- Natural Resources South East Automatic Weather Stations: 19 sites. These sites inform land management across the region
- SEWCDB Equipped sites: 22 sites. These sites are all data logger and telemetry equipped (except A2391026 *Marcollat Watercourse at South Reedy Swamp*) and are used for operational management of the SE drainage network.

  Of these 22 sites, the following parameters are monitored:

  - Water depth: 17 sites
  - Flow: 8 sites
  - EC: 15 sites
  - Rainfall: 6 sites
  - Meteorological parameters: 6 sites
  - Water quality parameters: 4 sites.

- Other: 2 sites. DEWNR sites A2391184, *Blue lake pluviometer*, and A2391137, *8 mile creek 1km down-stream of Ewen Ponds*.
- 17 Operational sites were identified as 'Closed' as part of working group processes and are not represented in Figure 11.7. Of these sites, 10 are identified as '*to be re-opened subject to funding*'. These sites are 5 Pluvio sites and several drain and watercourse sites across the region. Refer to the NR SE region Optimised Networks section of the report for further information.

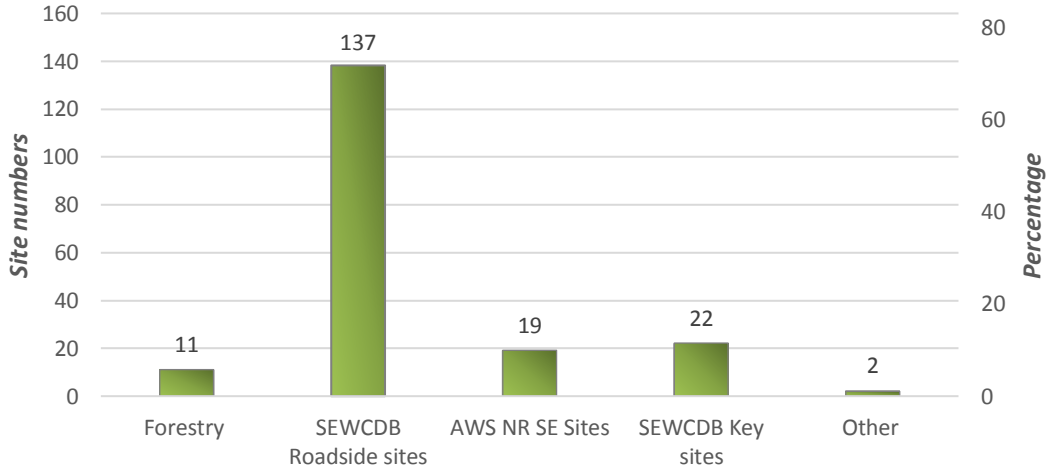


Figure 12.7 SE surface water operational sites

Project surface water sites:

- Groundwater dependent ecosystem: 6 sites. These are equipped with loggers and located at Lake Frome (3 sites), Freshwater Lake (1 site), Butchers Gap (1 site) and Bevilaqua Ford Drain (1 site).

12.3 SE: Optimised networks

The SE working group has identified the following recommendations to improve and optimise water surveillance within the NR SE region. Subject to the implementation of the recommendations the optimised groundwater and surface water monitoring networks and the associated site classifications for the region are demonstrated in Figures 12.8 and 12.9.

Figures 12.8 and 12.9 incorporate the classifications for current ongoing sites, proposed new sites (if any), and proposed site closures (if any).

Proposed new sites or proposed site closures are represented by the '*exploded*' sections and correspond with green arrows (*additional sites*) and red arrows (*sites recommended for* closure). Note that green and red arrows correspond with recommendations that are yet to be approved or implemented. Dotted red arrows indicate that further review is necessary to establish if the sites are required, or can be made historic and closed.

In some circumstances the number of new sites or site closures recommended is yet to be determined and will be finalised through further review. In this case the data label reflects the quantity as 'unknown'.

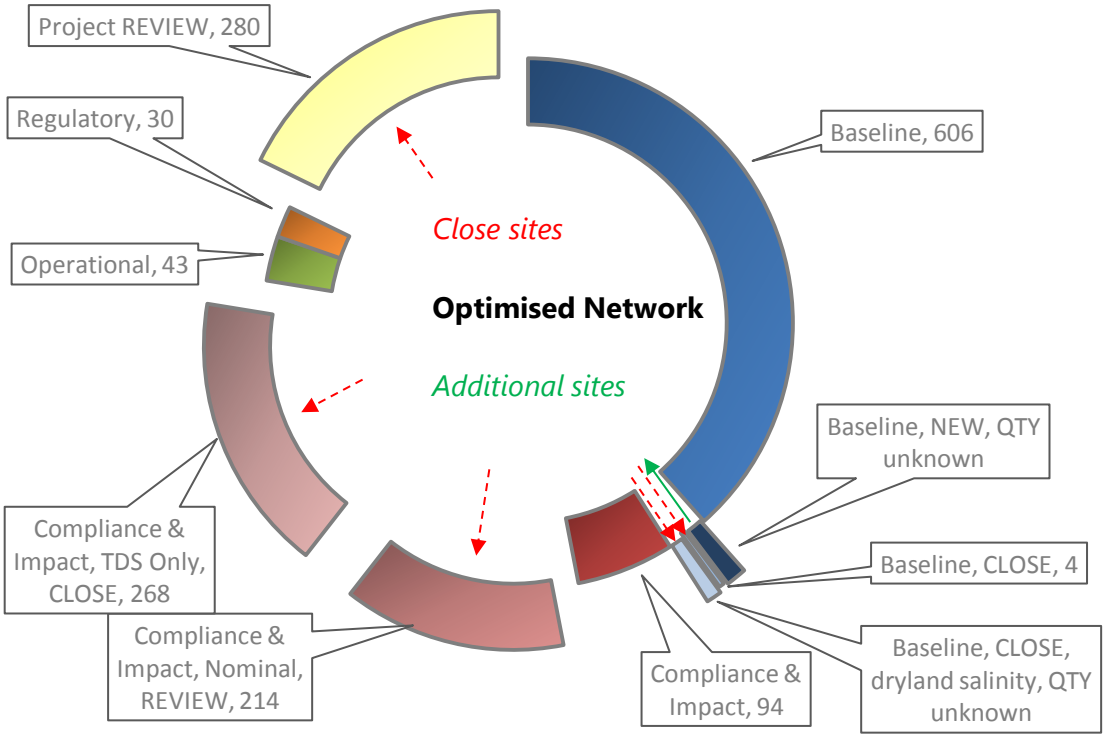


Figure 12.8 SE groundwater classifications: proposed optimised network.

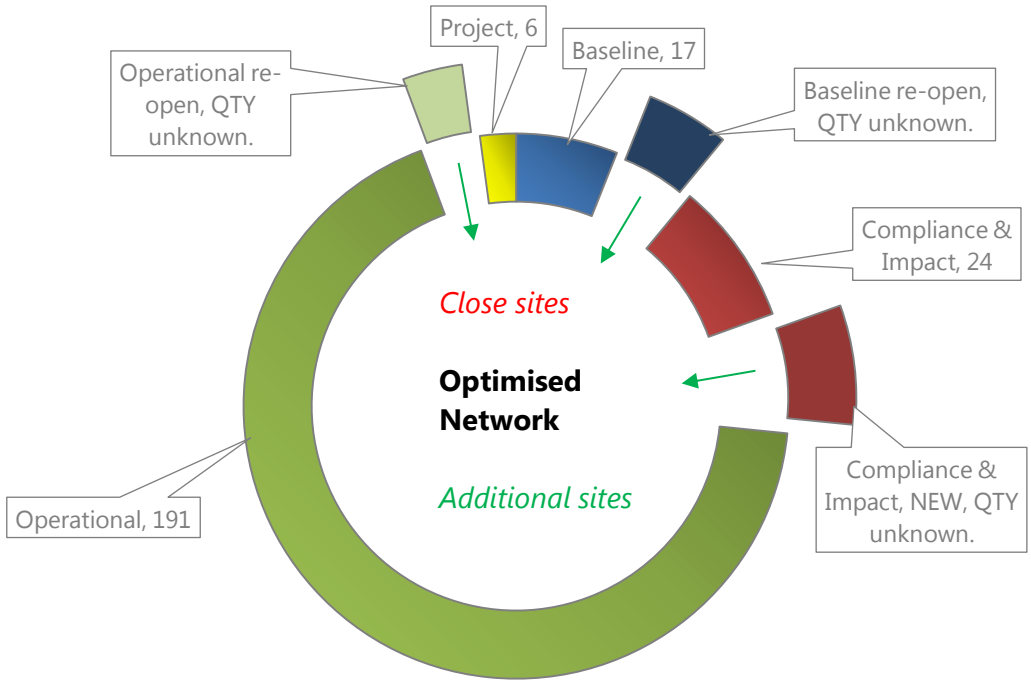


Figure 12.9 SE surface water classifications: proposed optimised network.

General discussion points

- Groundwater and surface water resources in the prescribed areas of the NR SE, require ongoing surveillance to adequately implement the Lower Limestone Coast, Tatiara, Tintinara Coonalpyn, Padthaway, Morambro Creek WAPs and the WAA permit policies in the NR Regional NRM Plan and the SE Drainage and Wetland Strategy.
- 14 Baseline SEWCDB and 10 Operational SEWCDB surface water sites currently closed, were identified as being 'of value' to re-open subject to funding availability.
- Discussion by the SE working group on the surveillance requirements of groundwater dependent ecosystems and groundwater–surface water relationships, identified the need for additional surveillance for this purpose throughout the SE region. Currently 26 surface water sites A2391158 to A2391183 classified as Project (6 sites) or Compliance and Impact (20 sites) were identified as monitoring GDE health and condition. Records indicate that all are equipped with loggers.
- The SE working group identified the need for additional flood monitoring in the NR SE region, in particular Bordertown and Naracoorte.
- Groundwater networks for Tintinara and Coonalpyn surveillance networks are both located in the one Prescribed Wells area. Combining the separate networks into one network is expected to deliver administrative and reporting efficiencies. Further discussion resulted in a number of actions for the Tintinara network (refer to 'Other Recommendations' below).
- Numerous groundwater sites throughout the SE are referred to as being linked to other nearby groundwater sites. This linkage enables the linked site to be used to extend the continuous time series data available for the location if the original site becomes unavailable for ongoing monitoring:
    - As a result of this, consideration from a knowledge management perspective, is required to identify how sites that are SWL status 'Current', can be recorded as being linked to other sites that are SWL status 'Historical'. While only one of the sites is recorded as 'Current', the combined data of these two sites may contribute to the Baseline (or other classification) network.
- A number of groundwater monitoring sites in the Wattle Range region, particularly in the Hundreds of Coles and Short, are located near to the surface drains, Drain M and Bakers Range Drain. While there appears to be general decline in the water in the Wattle Range area associated with the expansion and development of the blue gum plantations, it appears as if water in the drains can provide some recharge to the adjacent local groundwater:
    - It is recommended that a further review of groundwater site classifications and network design across the Wattle Range region is undertaken with a focus on the influence of drains on Obswells in the region. This review may re-classify sites, reduce the number of sites under the influence of drains, and may introduce a monitoring signal that indicates the presence of water in an adjacent drain, therefore identifying the nearby groundwater level as potentially non-representative of the regional trend.
    - It is recommended that this review be initiated by the IRG in conjunction with the SE working group.
- Lower Limestone Coast Forestry Forest Water Accounting project. The SE NRM Board has partly funded a project to study groundwater level impacts of plantation forestry. This project will result in additional investment in groundwater surveillance.
    - This project will incorporate 4 new groundwater sites equipped with loggers, monitored quarterly over a 3 year period. Funding for the first year (15-16) is confirmed, funding the second and third year is anticipated to be confirmed through the 16-17 budget process.

12.3.1 Proposed network modifications

A number of changes were recommended by the SE working group and an implementation process will be undertaken to ascertain what changes occur.

- The 'Border Groundwater Agreement' ongoing monitoring requirements will be reviewed in the light of the decision by the SE working group to reduce the monitoring network. The Border Groundwater Agreement Operational Guidelines (BGA Operational Guidelines 2015) detail the Agreement's monitoring requirements.
- It is recommended that the SE working group, under the lead of the SEWCDB, conduct an immediate review of the 14 Baseline SEWCDB and 10 Operational SEWCDB surface water sites that are currently 'closed' that are identified as being 'of value' to re-open if funding becomes available.
    - The review should consider costs to re-open and prioritisation of these sites.
- It is recommended that the SE working group initiate a process, under the lead of NR SE, to identify and prioritise potential locations for additional surveillance of groundwater dependent ecosystems and explore funding options.
- It is recommended NR SE monitors developments in the Forestry project and reports any potential impact it may have on surveillance investment in the NR SE region to the SE working group.
- DEWNR secured funding from the Commonwealth through the Natural Disaster Resilience Program, with additional support from the Tatiara District Council and the State, to fund installation of flood monitoring sites for Bordertown (Tatiara Creek). The funding will allow the installation of 3 pluviometers east and south east of Bordertown and 2 surface water flow sites in Tatiara Creek in 2015-16. The Tatiara District Council will also contribute to the ongoing monitoring of these sites. Once installed these sites will be classified as Baseline sites.
- It is recommended that the SE working group under the lead of SMK develop the costing of a Flood monitoring system for Naracoorte Creek and seek sponsorship for funding. A proposal would be submitted to SAFECOM if another funding round is announced:
    - Preliminary work has been conducted in early 2015 to discuss requirements and locate potential sites.

    Refer to Section 12 for statewide recommendations for flood warning.

The following sites are recommended to be closed:

- 4 Baseline groundwater sites, Obswells STB3, JEF6 and JEF7 in the Coastal Plain network, and ROS5 in LLC Nth network, which have been identified as not required. It is recommended to change these sites to SWL status 'Historic'.
- McCains/SAFRIES at Penola has been sold to another business and the 29 Project groundwater sites are no longer monitored. It is recommended to change these sites to SWL status 'Historic'.
- 268 Compliance and Impact sites throughout the SE region are identified as 'TDS only'. Funding for these sites ceased on 1 July 2014. It is recommended to change these sites to SWL status 'Historic'.

The following sites are recommended for review:

- 214 groundwater sites 'nominally' classified as Compliance and Impact under advice provided by a SMK Principal Hydrogeologist. It is recommended that the review process be initiated in the first half of 2016 to establish if these sites are required.

    These sites are located within the following networks:

    - Lower Limestone Coast (North and South)
    - Padthaway

- Tintinara - Coonalpyn
- Tatiara
- Upper South East
- SE Confined

- The review of 'nominally' Compliance and Impact sites may also consider the current and future water monitoring requirements associated with the forestry industry i.e. the monitoring of forest water extraction and information requirement for annual fee calculation.
- The 280 groundwater Project sites, including the 29 SAFRIES sites, are recommended for closure. A preliminary assessment of these sites has been undertaken through the working group classification processes and it is possible that the nominated Baseline networks will be sufficient for surveillance requirements in these regions.
- 70 dryland salinity Project sites in the Upper South East (process underway). This process may result in decreases in sites numbers.

12.3.2 Other recommendations

- It is recommended that the condition of 26 logged sites (A2391158 to A2391183) is evaluated and data downloaded. This should be led by NR SE with the support of the SE working group:
  - Data accessed from each logger should be provided to the Hydstra administrator to ensure it is recorded as part of the state's surface water archive.
- It is recommended to implement the following actions relating to the Tintinara groundwater network:
  - There is uncertainty regarding whether Obswell ARC020 corresponds to unit number 6926-37 as records currently indicate. There is also concern regarding the accuracy of this site's location in SA Geodata. It is recommended that RMU assess these site issues and report back to the SE working group.
  - The SE Working group discussed a number of minor changes to the wells in the current classification list for the Tintinara network, which is under review.

    The outcome of this process may result in minor changes to the number of Baseline and Compliance and Impact wells in the classification list.
- The SE Working group also noted the possible inclusion of a small number of additional Compliance and Impact sites (but could not elaborate further), which is currently under review.
- It is recommended that the SE working group under the lead of SMK develops an internal procedure to activate linked groundwater sites in the South East in the event of current sites becoming not available for data collection in the future.
- Several Obswell numbers are potentially incorrectly allocated. It is recommended that Obswells CMM103, CMM104, CMM105 and CMM106 are checked to confirm if they should correctly be numbered KLN019, KLN020, KLN021 and KLN022 respectively. It is recommended that the RMU groundwater team clarify this situation and report results to the IRG.

13 Statewide recommendations

This section outlines recommendations that were applicable to two or more regions and or were of strategic importance from a statewide perspective.

The recommendations are listed by topic.

13.1 Flood warning monitoring

Discussions with the Regional working groups noted that there was a need for better coordination of flood monitoring given that DEWNR as flood hazard leader has a requirement to ensure that suitable flood monitoring is in place and that the resultant information systems support the BOM and other state agencies to predict and model the potential effects of flood occurrences.

Discussion with the Leader Flood Management, DEWNR, additionally raised issues related to accessing data in a timely manner for flood warning, especially where data does not automatically transmit to State Government data archives.

In late 2015 BOM released a paper titled 'Introduction to Bureau's efforts in standardising its hazard related services and implications for monitoring networks' (BOM 2015). This paper details recent efforts to standardise BOM hazard related services and outlines the implications that these initiatives will have on monitoring networks.

BOM forecast the formation of a group within each State and Territory to review flood monitoring requirements, and that a National Flood Warning Infrastructure Working Group will develop the standards for flood monitoring infrastructure. The BOM envisaged that these activities will lead to improvement and consistency in flood monitoring, which are in-line with discussion points made by the Regional working groups and the Leader Flood Management, DEWNR.

It is recommended:

- that the SMCG forms a Flood Hazard management working group to:
    - consider the overall requirements for a South Australian Flood Warning system, incorporating monitoring, data communication and emergency management system requirements
    - engage in the national parallel processes to standardise flood hazard related services and consider the implications that standardisation will have for the flood monitoring network
    - review current issues related to data transfer and data compatibility and identify actions to ensure that appropriate stakeholders can access the data to make well informed and timely decisions
    - evaluate the adequacy of the existing statewide flood monitoring sites and, whether the 34 sites identified as 'Other Flood sites' add value to the combined DEWNR flood monitoring network and therefore should be resourced or alternatively closed
    - identify options for resourcing the flood monitoring network.

13.2 Site purpose categories

The site purpose categories outlined in Section 4 were an outcome of discussions across all eight Regional working groups to identify the use of data from monitoring sites under the principal '*measure once, use many times'*. The inclusion of purpose categories was initially recommended by the SE working group. They reflect that water surveillance is conducted throughout the state for diverse purposes.

It is recommended:

- to include a 'Site Purpose' attribute in the primary state water databases, Hydstra & SA Geodata
    - Information on the specific purpose(s) a site serves (when identified by the Regional working groups) was added to the project dataset attribute 'Classification Comment'.
    - It is envisaged that the information system for groundwater and surface water will support the recording of multiple classifications at single sites (e.g., Baseline sites that also serve as Compliance and Impact sites over a nominal period), as well as multiple site purpose categories (up to 3 per site).
    - Modifications will be required to enable site classifications, site purposes, monitoring history and metadata to be recorded (i.e., start & end dates, parameters monitored).
- the abovementioned modifications recommended to Hydstra and SA Geodata be given highest priority to ensure that the full value of the optimisation project in identifying site classifications and site purpose categories can be realised as this information is currently stored in separate data sets that cannot be readily updated.

13.3 Ongoing resourcing

The contents of this report emphasise the importance and significance of a quarantined Baseline groundwater and surface water surveillance network as the foundation for the statewide network. These sites provide a long term continuous dataset, to support the assessment of the resource.

The importance of the Baseline network is further reinforced given the use of many Baseline sites to inform on the effects of climate change and drought, and for flood monitoring.

It is recommended:

- that the resourcing of the Baseline network has highest priority from state funding to enable Baseline sites to be quarantined.

Compliance and Impact, Project, Operational and Regulatory sites can supplement the Baseline network, however the longevity and spatial distribution of sites with these primary classifications will always be subject to change as the information needs change. Therefore sites with Compliance and Impact, Project, Operational and Regulatory primary classifications cannot be always relied upon to supplement the Baseline network.

Discussions with the Regional working groups, particularly SAMDB, highlighted the need to consider the potential ongoing requirement of surveillance sites established under projects at an earlier stage of the project life-cycle.

It is recommended:

- that consideration of the potential for transition of any Project, Compliance and Impact, Regulatory or Operational monitoring site to the Baseline network be made at the planning stage and ongoing resourcing requirements identified.

It is envisaged that SMK will facilitate the implementation of the regional and statewide recommendations in this report in consultation with all affected parties. Part of the implementation will include an analysis of the resourcing implications of the optimised networks for groundwater and surface water. This analysis will incorporate operational and asset management aspects of the surveillance networks.

The eight Regional working groups will be engaged in implementing the recommendations of this report, and it is envisaged that they will continue to meet on at least a biannual basis thereafter to consider regional water surveillance requirements.

It is recommended:

- that the resourcing requirements to maintain overarching support and operation of the IRG and Regional working groups be considered by the SMCG, and where possible be met by the core capacity of partaking DEWNR regions and branches, and other agencies, as was used for this optimisation project.

13.4 Equitable support of water surveillance across all regions

Discussions with the Regional working groups revealed under representation of water resource surveillance in the Far North and APY Lands both in terms of sites and visitation frequency.

It is recommended:

- that a more equitable water monitoring surveillance program be implemented to address the under representation of water resource surveillance in the Far North and APY Lands.

13.5 Site visitation frequency

Strategically located automated surveillance platforms (loggers/telemetry) are used to supplement the data collected manually and to also provide an indication of the optimal timing for collecting the field data. (The field trips are also used to ensure the automated sites are calibrated and functional.)

Discussions with the eight Regional working groups raised the question of introducing a standard frequency of groundwater surveillance. The general consensus from these discussions was that 2 visits per annum would be adequate given the support provided by the automated surveillance platforms.

It is recommended:

- that the groundwater site visitation frequencies across the state to be standardised to a minimum of 2 visits per annum.
    - Not with-standing the recommended standardised surveillance frequency, the monitoring frequency can vary to ensure the outcomes are fit for purpose in reference to the objectives of the monitoring program.

In regard to surface water surveillance, sites require ongoing review of the currency of the ratings curves, which along with the resource management risk drives flow gauging prioritisation. Not with-standing this, opportunistic gauging will occur when environmental conditions are suitable (e.g. to gauge less common flow events when they occur).

The majority of surface water flow sites have some form of automation therefore the focus of site visits is to ensure the instruments are calibrated and functional (as probes can be susceptible to fouling in some conditions) and to download logged data. No change in visitation frequency is recommended.

13.6 Management zone network focus

Discussions with the Regional working groups indicated a general shift in focus of groundwater surveillance towards a management zone focus (i.e. PWRA region or Natural Resources region).

The combination of existing networks into larger groups representing prescribed regions or Natural Resources regions is expected to deliver administrative and reporting efficiencies and better align with the use of new technologies such as the groundwater data entry tablet recently developed for field staff undertaking the field collection of data. This will also reduce the duplication of records resulting from individual wells being used to assess overlapping networks.

Grouping networks based on the prescribed water resource area (where applicable) may be helpful in directing the public to monitoring networks and sourcing data.

It is recommended:

- that the shift towards a management zone focus for groundwater surveillance in all eight natural Resources regions be promoted.

13.7 Generation of approved DEWNR GIS layers from the project site classification datasets

Access to the monitoring network classifications in an ESRI®ArcGIS environment will require GIS layers to be developed. (Note: this may not be required if the modifications to the primary datasets Hydstra and SA Geodata are implemented quickly). It is recommended:

- that approved DEWNR GIS layers and procedures for maintaining them be developed from the site classification datasets for groundwater and surface water.

13.8 Supplementing water surveillance networks with private entity surveillance sites

Private entities that operate surveillance sites could make their datasets available to supplement the state surveillance data set.

It is recommended:

- that the use of private entity surveillance sites to supplement existing state surveillance networks be considered, and preliminary discussions with relevant organisations undertaken where required.

13.9 Consideration and analysis of salinity surveillance requirements

Salinity testing from irrigator submitted samples is no longer supported as a result of budget savings implemented by Customer and Commercial Services from July 2014.

It is recommended:

- testing of irrigator submitted samples continues under a cost recovery model.

Reduced surveillance for salinity from pumped aquifer samples has occurred since July 2014 as a result of budget savings implemented by SMK.

It is recommended:

- a working group be established to review the strategic requirement for salinity surveillance from a statewide perspective and provide direction on optimising the salinity monitoring network and identifying resourcing options (which may include irrigated submitted samples).

A parallel process has been initiated by SMK to clarify the ongoing status of dryland salinity sites in consultation with the Manager Sustainable Soils (DEWNR), to ensure the state dryland salinity network remains optimal.

13.10 Community Monitoring

Discussions with the Regional working groups indicated that Citizen Science is increasing in popularity and use.

It is recommended:

- that the SMCG consider the effects of community collected data and physical samples on information quality and water management decision defensibility. Consideration should incorporate how water monitoring standards and procedures be incorporated into Citizen Science.

13.11 Standards and procedures

SMK has an ongoing working group process to develop and update standards and procedures for water resource monitoring, in consultation with affected stakeholders.

Two procedures currently under development detail the procedures related to the opening, modifying and closing of water resource monitoring sites. As part of this project's implementation process any outcomes of recommendations to open and close monitoring sites will be managed through the processes outlined in these two draft procedures. These standards and procedures provide a final check and balance.

It is recommended:

- that a DEWNR policy be developed which outlines the methodology that enables modifications to the state water resource monitoring network to be undertaken in a consistent, defendable and repeatable manner. It is envisaged that this policy (and related procedures) would address the opening and closing of monitoring sites and the modification of the attributes SWL status, TDS status and visitation frequency. The policy would also define network change approval processes and record keeping protocols.
- that all monitoring standards and procedures are updated in-line with the policy.

Strict adherence to monitoring standards and procedures will ensure that archival and operational records of the monitoring network present a consistent picture of the state's monitoring networks.

13.12 Plain language report card

Discussions with the Regional working groups, particularly AMLR highlighted the benefit of multiple pathways to inform the public on water management (and generally).

It is recommended:

- that, subject to funding, other modes of data discovery could be developed to inform the public.

13.13 Legal status of water surveillance sites listed in WAPs

A number of sites listed in WAPs were identified as 'Historical' raising the question of DEWNR's legal responsibility to maintain and monitor these sites.

It is recommended:

- that Crown Solicitor advice is sought on this matter.

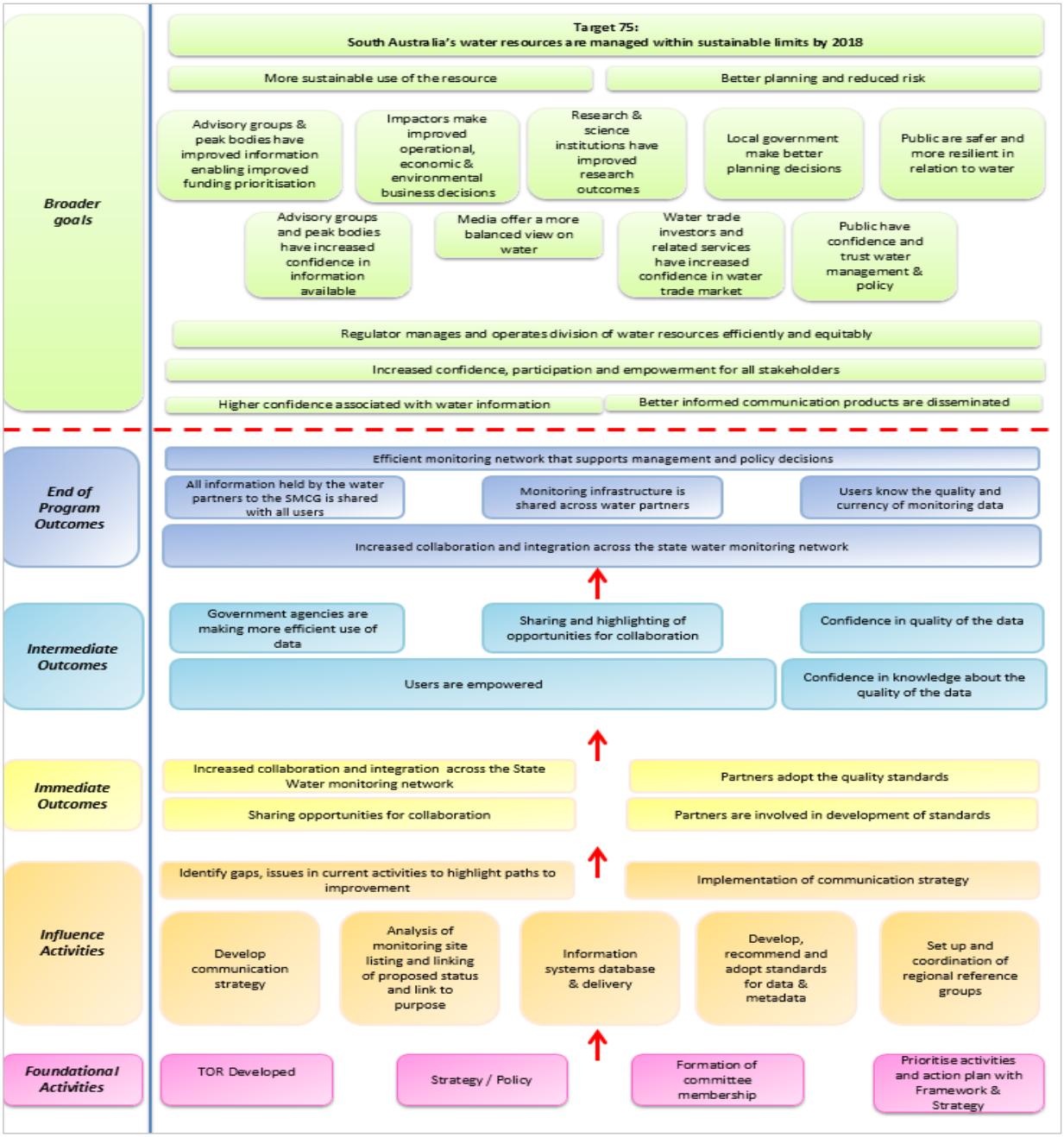
13.14 Next steps

Once this report is endorsed, a plan will be developed by SMK to oversee the prioritisation and implementation of the regional and statewide recommendations.

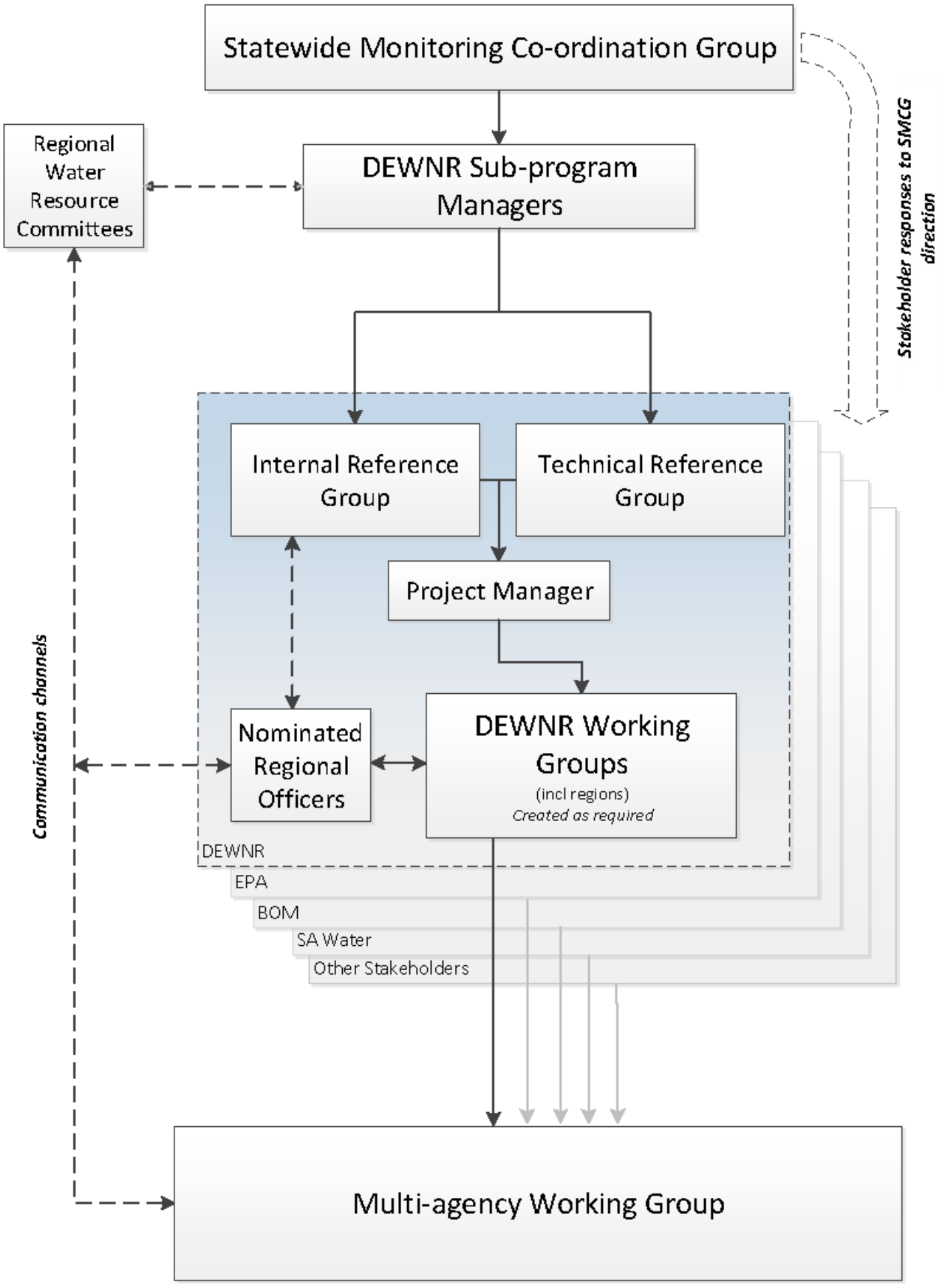
It is envisaged that the next five yearly iteration of the network optimisation (2020) will focus on cross agency and stakeholder involvement.

14 Appendices

Appendix 1. Program logic



Appendix 2: Project governance structure



15 Glossary

AMLR: Adelaide and Mount Lofty Ranges

AWS: Automatic weather station

AW: Alinytjara Wilurara

BOM: Bureau of Meteorology

CLLMM: Coorong Lower Lakes and Murray Mouth

DEWNR: Department of Environment, Water and Natural Resources

d/s: Downstream

EMLR: Eastern Mount Lofty Ranges

EP: Eyre Peninsula

EPA: Environment Protection Authority

GAB: Great Artesian Basin

GDE: Groundwater Dependant Ecosystem

Hydstra: South Australia's surface water database.

Internal Reference Group (IRG): A DEWNR group established to assist in the development of a sustainable and adaptable operational management plan for the state water surveillance network. The IRG membership is comprised of key DEWNR water data stakeholders with strong knowledge and expertise in water surveillance in South Australia.

KI: Kangaroo Island

LLC: Lower Limestone Coast

Logger: Device which records and stores water related parameter measurements at required frequencies for later downloading.

MERI: Monitoring Evaluation, Reporting and Implementation

Network: Groundwater monitoring sites in similar geographic area or serving similar purpose are grouped together to monitoring networks.

NR: Natural Resources

NY: Northern and Yorke

Obswell: An online facility that provides access to the state's observation bore monitoring data. The observation bores have been grouped together in 'Networks' which focus on a region in the state or an aquifer.

PIRSA: Primary Industries and Resources South Australia

Pluviometer: Rainfall recording device

Purposes: In the context of water resource monitoring, the term 'purpose' refers to the primary use that the water data from a specific site, or group of sites, is applied to. Understanding the various uses that water data is applied to, assists in understanding the statewide monitoring network.

Prescribed: Important water resources in South Australia are protected and managed by being 'prescribed' under the NRM Act. Prescription means that the water resource must be sustainably managed to provide security for all water users, now and into the future.

PWA: Prescribed Wells Area.

PWRA: Prescribed Water Resources Area

RMU: Resource Monitoring Unit

SAAL: South Australian Arid Lands

SA Geodata: South Australia's Groundwater database

SAMDB: South Australian Murray-Darling Basin

SARDI: South Australian Research and Development Institute

SE: South East

SEG: Scientific expedition group

SEWCDB: South East Water Conservation and Drainage Board

SIS: Salt interception Scheme

SMCG: The Statewide Monitoring Coordination Group, established in 2013 to oversee multi organisational progress towards achieving the eight guiding principles for water monitoring investment in South Australia as detailed in Geraghty and Barrett 2012.

SMK: Science, Monitoring and Knowledge branch of DEWNR

SWL: Standing water level. Depth to water in a monitoring well from the casing height to the surface water level. This data is used to calculate water quantity.

SWL status Current: Indicates that a groundwater monitoring site is a used as part of the current SWL monitoring network.

SWL status Historic: Indicates that a groundwater monitoring site was used as part of the previous SWL monitoring networks, but is not part of the current network.

TDS: Total dissolved solids: A measure of a water resource's salinity.

TDS Current: Indicates that a groundwater monitoring site is a used as part of the current TDS monitoring network.

TDS Historic: Indicates that a groundwater monitoring site was used as part of the previous TDS monitoring networks, but is not part of the current network.

Telemetry: Device which sends recorded data from a remote location to a central point.

TWS: Town water supply

Unit Number: Groundwater sites are individually identified using a 'unit numbering system'

u/s: Up stream

USE: Upper South East

V-WASP: The Verification of Water Allocation Science Program (V-WASP) is a monitoring program established to collect ecological, water quality and hydrological data to provide a basis for validating the science in existing water allocation plans**.**

Water Affecting Activity (WAA)**:** An activity as described in Section 127 of the NRM Act 2004, for which a permit may be required.

Water Allocation Plan (WAP)**:** A water allocation plan (WAP) is a legal document that sets out the rules for managing the take and use of prescribed water resources. It ensures these resources are allocated fairly and secures sustainable water supplies for the community, industry and the environment for future generations.

WMLR: Western Mount Lofty Ranges

16 References

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