

NSW Water Quality Monitoring Framework

Schedule B: Data Standards and Protocols

June 2026

Acknowledgement of Country



Department of Climate Change, Energy, the Environment and Water acknowledges the traditional custodians of the land and pays respect to Elders past, present and future.

We recognise Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to place and their rich contribution to society.

Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

NSW Water Quality Monitoring Framework

Published by NSW Department of Climate Change, Energy, the Environment and Water

<https://www.water.dcceew.nsw.gov.au/>

First published: June 2026

ISBN/ISSN: 978-1-86516-023-8

Department or Agency reference number: DOC26/35578

More information

Email water.enquiries@dcceew.nsw.gov.au

Acknowledgements

The Water Quality Monitoring Framework has been informed by the valuable input and collaboration of the pilot agencies: WaterNSW, NSW EPA, Manly Hydraulics Laboratory (MHL), and key branches within NSW DCCEEW.

Copyright and disclaimer

© State of New South Wales through Department of Climate Change, Energy, the Environment and Water 2024. Information contained in this publication is based on knowledge and understanding at the time of writing, June 2026, and is subject to change. For more information, please visit the following websites:

For ECCS documents: <https://www.energy.nsw.gov.au/copyright>

For Water and Environment <https://www.environment.nsw.gov.au/about-us/copyright-and-disclaimer>

For General NSW Government <https://www.nsw.gov.au/nsw-government/copyright>

Contents

Acknowledgement of Country	ii
Glossary	4
1 Background	6
2 Introduction	6
3 Preliminary scope	7
4 Data collection	8
4.1 Surface water monitoring site selection	8
4.2 Sample and data collection	8
4.2.1 Manual sampling methods	9
4.2.2 Telemetered data	9
4.2.3 Quality controls and assurance for sample collection	10
4.2.4 Automated data entry	11
4.2.5 Laboratory analysis	11
4.3 Quality control and assurance reviews	11
5 Preparing metadata and data for sharing	13
5.1 Sharing metadata assets	13
5.2 Sharing data assets	14
6 Gaps and opportunities for improvement	14
7 References	15

Glossary

Term	Description
AGI	Australian Government Initiative
APHA	American Public Health Association
API	Application Programming Interface
BoM	Bureau of Meteorology
CPHR	Conservation Programs, Heritage and Regulation Group
Data Custodian	Organisations collecting water quality data and providing it to the Integrating Authority under the Framework.
EPA	NSW Environmental Protection Authority
FAIR	Findable, Accessible, Interoperable and Reusable
Framework	NSW Water Quality Monitoring Framework
Integrating Authority	The group or agency responsible for overseeing the Framework and the integration, sharing and publishing of data
ISO	International Organisation for Standardisation
NSW DCCEEW/ the department	NSW Department of Climate Change, Energy, the Environment and Water
MDBA	Murray-Darling Basin Authority
MHL	Manly Hydraulics Laboratory
NSS	National Statistical Service
OCSE	NSW Office of the Chief Scientist and Engineer
Pilot group/Pilot stakeholder agencies	The primary group of agencies involved in the development and implementation phases of the Framework
QA/QC	Quality Assurance/Quality Control
NSW SEED/SEED	NSW Sharing and Enabling Environmental Data (portal)
Statutory obligations	Legal duties that are required from the involved organisations/institutes or individuals

Term	Description
Technical solution	The combination of processes and digital platforms that will enable better data sharing under the Framework.
SPSE	Strategic Policy, Science and Engagement Group

1 Background

The Water Quality Monitoring Framework project (the Framework) aims to improve the collection, sharing, and publication of water quality data across NSW.

It is being developed as part of the NSW Government's broader response to the Office of the Chief Scientist and Engineer's review of the [Menindee fish death event](#). Delivery of full responses and commitments are progressing through the [Restoring the Darling–Baaka River program](#).

The Framework also aligns with the [NSW Water Strategy's](#) priority to improve the health of river, floodplain, and aquifer ecosystems.

The Framework is a central component of the [NSW Water Quality Governance Roadmap](#).

Water quality data is currently collected, stored, and used by various government agencies and organisations for different purposes, in a variety of ways. To make this data more interpretable and informative when shared, standardised data collection, management, and sharing processes are needed. This will improve interagency data sharing processes and ensure they follow the FAIR data principles (Findable, Accessible, Interoperable and Reusable).

This schedule of the Framework provides guidance to water quality monitoring agencies and organisations on developing and improving their practices and processes for data collection, management and sharing.

2 Introduction

As part of the Framework, a collection of data standards and protocols is required to guide and support improvements to water quality data and metadata in NSW.

Water quality data is collected by numerous organisations in NSW for various purposes. As such, different instruments and processes are used to collect data on different water quality parameters. It is often difficult for data from these disparate programs to be used in conjunction with one another to answer water quality questions due to the lack of standardisation between monitoring programs.

Although metadata (information supporting the use of a dataset) exists for many water quality monitoring programs, the quality of this metadata varies greatly and limits their interoperability or re-use.

This issue is exacerbated by the variety of ways water quality data is stored and shared, along with monitoring programs that remain undiscovered or lack adequate metadata. As a result, water quality datasets in NSW are fragmented in availability, variable in quality and difficult to analyse together. This results in the exclusion of valuable information that could assist future water quality monitoring, modelling program design, incident response or inform policy decisions.

Given the bespoke design of many monitoring programs and projects used to address specific questions or objectives, providing a single set of standards for data collection, management and sharing of water quality monitoring data (a one-size-fits all approach) is not a realistic solution. However, providing best practice guidelines on establishing monitoring programs, sampling and

improving the metadata documentation quality can help reduce inconsistencies and support more effective data integration.

This is why this schedule, Schedule B, provides agencies and organisations with a suite of preferred data standards and protocols. These can be adopted or adapted to improve and align their water quality data collection, management and sharing processes. The aim is to improve the standard of water quality data collected, managed and shared by NSW organisations and agencies and align it with FAIR data principles.

The Framework provides standards and protocols to assist and guide agencies, rather than enforce change, recognising that a one-size-fits all approach to data standardisation is not realistic and would be costly and time-consuming.

Many agencies or organisations may already follow these standards or protocols, while others may find that they are not applicable to their circumstances, opting for alternate, but aligned, approaches.

This schedule may be updated in the future to:

- Accommodate alternate protocols and standards used by agencies and organisations (including internal documentation, should data custodians wish to share it) where they align with the Framework and FAIR data principles.
- Include standards and protocols necessary for the integration of new and emerging technologies and processes.

Importantly, **there is no legal obligation** for water quality monitoring agencies to follow the provided standards and protocols. However, the governance structure of the Framework will provide support to agencies working to align with these standards and protocols through the Integrating Authority (Schedule A, Roles and Responsibilities).

The Framework's data standards and protocols (this document) work in conjunction with other Framework documentation, notably:

- Schedule A, Roles and Responsibilities: Data sharing governance model
- Schedule C, Technical Solution: Data sharing process, to organise, improve and share water quality data.

Currently, the Framework is directing agencies to share data and metadata through the NSW SEED (Sharing and Enabling Environmental Data) Portal.

3 Preliminary scope

In alignment with the overarching Framework, this document prioritises water quality data to support better decision-making on the environmental health of rivers and streams.

This document provides an outline of data standards and procedures for water quality monitoring programs. It establishes technical requirements for collecting, managing and preparing water quality data for open data sharing (through the NSW SEED portal) to ensure consistency and reliability across programs.

The scope of Schedule B is deliberately limited to data standards and protocols. It does not address:

- roles and responsibilities
- governance arrangements of high-level Framework policy
- development of technical platforms, systems or databases
- broader strategic initiatives, such as integrated catchment management or early warning systems.

For more details on the broader scope, governance arrangements, and system-level initiatives refer to the Water Quality Management Framework Overview.

4 Data collection

4.1 Surface water monitoring site selection

Selecting appropriate monitoring sites is essential for collecting representative and reliable water quality data. The objectives of the monitoring program should guide site selection, the characteristics of the waterbody, and practical considerations such as access and safety.

Agencies should refer to established standards and frameworks, examples include:

- [National Water Quality Management Strategy \(NWQMS\): Monitoring and Reporting Guidelines](#)
- [ISO 5667 series: Water Quality – Sampling](#)
- [National Industry Guidelines for Hydrometric Monitoring 2019, Part 2. Surface water sites.](#)

Organisations should record site purpose and other details in line with metadata standards in [Section 5.1](#) of this document.

4.2 Sample and data collection

To ensure high-quality, comparable water quality data across NSW, monitoring agencies should follow recognised standards and protocols. This section highlights key resources rather than duplicating detailed methods. These sampling methods have been developed and refined by experts over the course of decades.

Core references:

- [APHA \(2022\): Standard Methods for Examination of Water and Wastewater](#)
- [ANZG 2018: Australian and New Zealand Guidelines for Fresh and Marine Water Quality](#)
- [ISO Standards: Relevant international standards for sampling and analysis](#)
- [NWQMS: National Water Quality Management Strategy.](#)

4.2.1 Manual sampling methods

Water quality sampling methods vary by parameter, project objectives and environment. Agencies should adopt methods that:

- minimise contamination and preserve sample integrity
- use appropriate containers, preservatives, and holding times
- follow chain-of-custody and quality assurance/quality control (QA/QC) procedures.

For recognised approaches to calibration and sample collection, refer to Table 1: Example of international standards for sample collection. This is not an exhaustive list of standard methods.

Table 1. Example of international standards for sample collection

Parameter	Example methods documentation
pH	ISO 10523:2008, APHA 4500-H
Turbidity	ISO 7027-1:2016, APHA 2130B
Temperature	AS1006-1995
Dissolved oxygen	ISO 17289:2014, APHA 4500-O
Electrical conductivity	ISO 7888:1985, APHA 2510B
Phosphorus	ISO 2599:2003, APHA 4500-P
Nitrogen	ISO 13395:1996
Algal counts (incl. Blue green)	ISO 8692:2012, APHA 10200

4.2.2 Telemetered data

Telemetered water quality monitoring uses in-situ sensors and automated data transmission to provide continuous measurements. Agencies should consult the [NWQMS](#), particularly:

- Chapter 3 – Monitoring program design (including automated systems)
- Chapter 5 – Data handling, validation, and reporting.

Additional guidance is available on the ANZG (2018) guideline and relevant ISO standards such as ISO 15839 (Online sensors/analysing equipment for water – Specifications and performance tests).

These standards cover the standards and protocols in more detail:

- perform regular calibration, cleaning, and maintenance
- apply QA/QC procedures for automated data streams, including validation and flagging
 - document configuration, calibration, management of standard solutions and maintenance history (See Section 6.1 Metadata standards).

4.2.3 Quality controls and assurance for sample collection

Data custodians should implement robust calibration and maintenance procedures for all monitoring equipment in accordance with the instrument manufacturer's recommendations. This helps safeguard the reliability of water quality data. Calibration procedures include maintaining a comprehensive register of instrumentation specifications, calibration schedules, management of standard solutions and maintenance records.

National Association of Testing Authorities (NATA) accreditation provides formal recognition of a laboratory's technical competence and reliability by assessing staff, equipment, quality procedures, and operations against international standards. This accreditation demonstrates a laboratory's technical competence and reliability in accordance with international standards such as ISO/IEC 17025.

Calibration procedures

Calibration must be undertaken at scheduled intervals in accordance with manufacturer recommendations and relevant standards. For example, ISO/IEC 17025 describes good practice by requiring that measurement results are traceable to national or international measurement standards, with appropriate documentation retained to demonstrate consistency and repeatability.

Field sampling quality assurance

Field sampling quality assurance is essential for collecting representative and uncontaminated water quality samples. Before starting a program, agencies should review guidelines like the Field Sampling Programs guidance from ANZG (2018), while the [NWQMS](#) (especially Chapters 3 and 4) also covers field sampling procedures.

These existing standards cover QA/QC for field sampling including:

- field blanks – detect contamination from the field environment
- filter blanks – check for contamination from filtration equipment
- container and equipment blanks – identify contamination from containers or rinsing
- trip blanks – detect cross-contamination during transport
- sample replicates – test the reproducibility of the field sampling procedure and laboratory analysis.

Maintenance procedures

Routine and preventive maintenance must be documented and scheduled to minimise equipment failure and data degradation, consistent with the requirements for equipment management outlined in AS ISO/IEC 17025:2017. Maintenance activities should include:

- cleaning and inspection of sensors and probes, as guided by manufacturer specifications
- replacement of consumables and worn components.
- Verification of instrument performance prior to deployment, in line with calibration principles such as ISO/IEC 17025.

4.2.4 Automated data entry

The Framework supports and encourages the use of automated data collection methods wherever feasible. Automated data entry can help enhance data integrity and increase efficiency of collection and transfer to data management systems, aligning with the Framework's broader goals of improving water quality monitoring data management.

Many water quality monitoring organisations in NSW already use automated procedures and platforms to streamline data collection and reporting. While each organisation may employ different technologies and workflows, a common goal is to minimise manual data entry and reduce the risk of human error.

Automated data entry systems can also include built-in QA/QC mechanisms to enhance data integrity. The Framework suggests using quality assurance and control procedures systems such as:

- real-time validation rules (e.g., range checks, missing values)
- automated flagging of anomalies
- instrument calibration tracking
- audit trails for data edits and uploads
- version control and timestamping.

4.2.5 Laboratory analysis

Laboratory analysis must follow recognised standards, agencies should refer to the [ANZECC & ARMCANZ \(2000\)](#) laboratory analysis, particularly Box 1: Checklist for undertaking laboratory analysis. Laboratories selected should be accredited to ISO 17025 by the National Association of Testing Authorities (NATA).

These resources cover critical considerations such as:

- confirming analytes and selecting appropriate analytical methods
- ensuring methods meet detection limits, accuracy, and precision requirements
- verifying laboratory capability, equipment, and staff competence
- maintaining a robust data management system (chain of custody, validation, storage)
- implementing laboratory QA/QC plan, including control charts and corrective action plans
- using standard methods or documenting any justified variations.

4.3 Quality control and assurance reviews

Data custodians should conduct quality assurance and quality control checks on their data prior to open data sharing. While the Integrating Authority may provide a secondary check, it is the responsibility of data custodians to review and ensure the quality of their data.

All water quality data — whether from field sampling, laboratories, sensors, or external sources — should be stored in an analysable and manipulable format (e.g., CSV, SQL database) and remain traceable to raw data and metadata. This applies both within agencies and when shared openly.

Consistency in units, naming conventions, and significant figures within individual monitoring programs is essential when integrating multiple datasets.

Agencies should follow the [ANZG \(2018\)](#) Guidelines for Fresh and Marine Water Quality for QA/QC principles and ensure that only data meeting these standards are used in analysis.

QA/QC reviews should focus on:

- Source verification: confirm origin, QA/QC status, and metadata completeness.
- Data screening: apply statistical and graphical checks for anomalies, outliers, and range validity.
- Format checks: ensure compatibility with analysis tools and standardise units.
- Documentation: record all cleaning and transformation steps for reproducibility.

Table 2 outlines simple data quality control measures recommended for implementation by agencies. These measures cover aspects such as sampling accuracy, data validation, metadata completeness, and routine review processes.

Table 2. Recommended control measures for water quality data

Control	Description
Unit consistency	Ensure all parameters use correct and consistent units across the dataset
Range validation	Check values fall within realistic environmental ranges and the realistic ranges for the monitoring site; flag outliers
Calibration and maintenance	Confirm instruments are calibrated using certified standards and maintained according to manufacturer standards.
Detection limits (LOD)	Verify that reported values meet or exceed limit of detection. For results below LOD, apply consistent handling.
Data conversion	Apply necessary conversions ensuring data units are consistent (e.g., mg/L, % saturation)
Metadata completeness	Ensure project objectives, sampling methods, analytical techniques, and QA/QC notes are documented
Duplicate and outlier review	Identify and resolve duplicates; investigate and validate outliers.
Lab vs field comparison	Cross-check laboratory and field measurements for consistency.

These control measures are based on best practice guidance for water quality data management, including QA/QC principles outlined in the ANZG (2018) WQ Guidelines and recommendations.

5 Preparing metadata and data for sharing

Before sharing water quality data and metadata in accordance with the processes outlined in Schedule C, data custodians should be aware of the formats in which data can be shared under the current Framework arrangement.

Currently, data and metadata from water quality programs should be shared on the NSW SEED portal by data custodians, with assistance from the Integrating Authority.

Where possible, sharing metadata and datasets is preferred, however, sharing of metadata to describe a water quality monitoring program, at a minimum, is also acceptable. This allows the documentation and cataloguing of water quality monitoring programs and projects in NSW for reference and sharing by the NSW SEED portal.

5.1 Sharing metadata assets

In the context of the Framework, metadata provides information about water quality monitoring programs and their associated data. It explains when, where, how and why the data was collected so that datasets can be understood, shared, and reused effectively.

At a minimum, the Framework promotes the sharing of metadata that identifies and describes a water quality monitoring program and:

- who conducts the program and the organisational contact details
- how long it has been active
- the spatial extent of the program (and how many sites it includes)
- the frequency of sampling and parameters measured
- descriptions of the program and objectives.

For a full list of metadata fields for uploading data to SEED, please refer to Schedule C, Appendix A.

Additionally, materials related to the monitoring program can be shared with the metadata statement in SEED to further describe the work being undertaken including:

- monitoring program descriptions and manuals
- URLs and weblinks,
- published reports
- geospatial files.

Metadata should be treated importantly by data custodians and be afforded its own internal QA/QC process, supported by the Integrating Authority. Data custodians should check the completeness of mandatory fields, validate the accuracy of the information provided (e.g., confirming correct coordinates and methods) and ensure consistency across internal datasets, including naming conventions and units.

5.2 Sharing data assets

Where possible, the Framework supports data custodians in sharing data collected by their monitoring programs as raw or curated datasets.

Data from water quality monitoring programs can be shared in SEED as:

- standard tabular formats: csv, xlsx
- machine-readable formats: JSON, XML
- geospatial formats: GeoJSON, ESRI Shapefile
- webservices or API endpoints
- URL links directing to external websites hosting data or dashboards.

It is recommended that shared datasets be accompanied by or include minimum required metadata as specified in the *National Industry Guideline for Water Quality Metadata (NI GL 101.00–2016)* to ensure traceability and interoperability. All datasets will also include a data quality statement as part of SEED's data sharing protocols. The Integrating Authority will assist data custodians in preparing the data quality statement.

6 Gaps and opportunities for improvement

While Schedule B establishes a strong foundation for water quality data management across NSW, several areas require further development or alignment. These gaps highlight opportunities for continuous improvement and collaboration across agencies and systems.

- **Inconsistent adoption of standards:** there is variability in how agencies apply sampling protocols, metadata structures, and data formatting. This inconsistency can hinder data integration and reduce comparability across regions and monitoring programs.
- **Metadata completeness:** metadata accompanying datasets is sometimes incomplete or inconsistently applied, particularly for legacy or manually submitted data. This affects traceability and limits the usability of datasets for broader analysis and reporting.
- **Parameter coverage:** not all water quality parameters are monitored consistently across sites and programs. This results in spatial and temporal gaps that can limit statewide assessments and trend analysis.
- **Custodian capacity and resources:** differences in technical capacity, staffing, and digital infrastructure across agencies can affect the consistency and quality of data submissions. Support and training may be needed to ensure all custodians can meet Framework standards.
- **Feedback mechanisms:** establishing a feedback loop could help inform future updates to standards and improve overall data quality.
- **Data quality tools:** utilise AI-powered tools to automate data validation, error detection, and correction, improving data accuracy and efficiency with minimal manual effort.

7 References

Australian and New Zealand Environment and Conservation Council (ANZECC) (1992) *National Water Quality Management Strategy*, ANZECC, Australian Government.

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000a) *National Water Quality Management Strategy, Document 4 - Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, ANZECC and ARMCANZ, Australian Government.

Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (2000b) *National Water Quality Management Strategy, Document 7- Australian Guidelines for Water Quality Monitoring and Reporting*, ANZECC and ARMCANZ, Australian Government.

Australian and New Zealand Land Information Council (ANZLIC) (2015) AS/NZS ISO 19115.1:2015 Metadata | ANZLIC

Australian Government, National Statistical Service (NSS). (2017). *A guide for data integration projects involving Commonwealth data for statistical and research purposes*

Australian Government Initiative (AGI) (2023) *Water Quality Management Framework*, AGI Website, accessed 21 March 2025.

Australian Government Initiative (AGI) (n.d.) *Field sampling program*, AGI Website, accessed 21 March 2025.

ANZLIC (2007) *ANZLIC Metadata Profile- Version 1.1*.

Bureau of Meteorology (BoM) (2012), *Water Data Transfer Format, version 1.0.2*, accessed 21 July 2025

Bureau of Meteorology. (2016). *National Industry Guideline for water quality metadata*.

Department of Planning and Environment (DPE) (2023) *Extreme Events Policy*, DPE, NSW Government.

Department of Planning, Industry and Environment (DPIE) (2021) *Roles and Responsibilities Agreement: DPIE Water, NRAR and WaterNSW*, DPIE, NSW Government.

Department of Planning, Industry and Environment (DPIE) (n.d.) *Review and Update of NSW Water Quality Objectives*, DPIE, NSW Government.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2024) *NSW Water Quality Governance Roadmap*, DCCEEW, NSW Government.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Unpublished) *Water Quality Incident Management Plan-Hypoxic events*, DCCEEW, NSW Government.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Unpublished) *Updated Draft National Water Agreement*, DCCEEW, Australian Government.

Department of Planning, Industry and Environment (DPIE)- Water (n.d.) *Water resource plans*, accessed 30 January 2025.

International Organisation for Standardisation (ISO) (2006) *Water quality - Sampling - Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems* (ISO 5667-5), ISO.

International Organisation for Standardisation (ISO) (2009) *Water Quality - Sampling - Part 11: Guidance on sampling of groundwaters* (ISO 5667-11), ISO.

International Organisation for Standardisation (ISO) (2014a) *Water quality - Sampling - Part 6: Guidance on sampling of rivers and streams* (ISO 5667-6), ISO.
<https://www.iso.org/standard/55451.html>

International Organisation for Standardisation (ISO) (2014b) *Water quality - Sampling - Part 14: Guidance on quality assurance and quality control of environmental water sampling and handling* (ISO 5667-14), ISO.

International Organisation for Standardisation (ISO) (2016) *Water quality - Sampling - Part 4: Guidance on sampling from lakes, natural and man-made* (ISO 5667-4), ISO.

International Organisation for Standardisation (ISO) (2018) *Water quality - Sampling - Part 3: Preservation and handling of water samples* (ISO 5667-3), ISO.

International Organisation for Standardisation (ISO) (2020) *Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques* (ISO 5667-1), ISO.

Manly Hydraulics Laboratory (MHL) (2019) *NSW Modelling and Monitoring Hub Special Project- NSW Water Monitoring Information and Collaboration Tools- Final report*, MHL, NSW Government.

NSW Government (2024) *NSW Water Sector Shared Technology Ecosystem Roadmap- Strategic Business Plan- Final version*, Adapted from WNSW Board Approved, NSW Government.

Office of the NSW Chief Scientist and Engineer (OCSE) (2023) *Independent review into the 2023 fish deaths in the Darling-Baaka River at Menindee- Final report*, OCSE, NSW Government.

Patni S., 2017. *Pro PRESTful APIs*. Apress

WaterNSW (2025) *Water Quality API*.

Australian Government, National Statistical Service (NSS). (2017). *A guide for data integration projects involving Commonwealth data for statistical and research purposes*.