Australian Government
Bureau of Meteorology

WATER MONITORING
STANDARDISATION
TECHNICAL COMMITTEE

National Industry Guidelines for hydrometric monitoring

PART 6: STREAM DISCHARGE RELATIONSHIP DEVELOPMENT AND MAINTENANCE

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In 2017 and 2018 the Water Monitoring Standardisation Technical Committee (WaMSTeC) led a periodic review of the National Industry Guidelines for hydrometric monitoring. WaMSTeC subcommittees conducted the review process and coordinated extensive industry consultation.

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(Note that at the time of contribution, individuals may have been employed with different organisations and some organisations were known by other names).

Foreword

This guideline is part of a series of eleven National Industry Guidelines for hydrometric monitoring. It has been developed in the context of the Bureau of Meteorology's role under the *Water Act 2007* (Cwlth) to enhance understanding of Australia's water resources.

The Bureau of Meteorology first published these guidelines in 2013 as part of a collaborative effort amongst hydrometric monitoring practitioners to establish standardised practice. They cover activities relating to surface water level, discharge and water quality monitoring, groundwater level and water quality monitoring and rainfall monitoring. They contain high level guidance and targets and present non-mandatory Australian industry recommended practice.

The initial versions of these guidelines were endorsed by the Water Information Standards Business Forum (the Forum), a nationally representative committee coordinating and fostering water information standardisation. In 2014, the functions and activities of the Forum transitioned to the Water Monitoring Standardisation Technical Committee (WaMSTeC).

In 2017, as part of the ongoing governance of the guidelines, WaMSTeC initiated a 5-yearly review process to ensure the guidelines remain fit-for-purpose.

These revised guidelines are the result of that review. They now include additional guidance for groundwater monitoring, and other updates which improve the guidelines' currency and relevance. WaMSTeC endorsed these revised guidelines in December 2018.

Industry consultation has been a strong theme throughout development and review of the eleven guidelines. The process has been sponsored by industry leaders and has featured active involvement and support from the Australian Hydrographers Association, which is considered the peak industry representative body in hydrometric monitoring.

These guidelines should be used by all organisations involved in the collection, analysis and reporting of hydrometric information. The application of these guidelines to the development and maintenance of hydrometric programs should help organisations mitigate program under-performance and reduce their exposure to risk.

Organisations that implement these guidelines will need to maintain work practices and procedures that align with guideline requirements. Within the guidelines, the term “shall” indicates a requirement that must be met, and the term “should” indicates a recommendation.

The National Industry Guidelines can be considered living documents. They will continue to be subject to periodic WaMSTeC review at intervals of no greater than five years. In the review phase, WaMSTeC will consider any issues or requests for changes raised by the industry. Ongoing reviews will ensure the guidelines remain technically sound and up to date with technological advancements.

National Industry Guidelines for hydrometric monitoring

This document is one part of the National Industry Guidelines for hydrometric monitoring series, which can be found at http://www.bom.gov.au/water/standards/niGuidelinesHyd.shtml.

The series contains the following parts:

Part 0: Glossary

Part 1: Primary Measured Data

Part 2: Site Establishment and Operations

Part 3: Instrument and Measurement Systems Management

Part 4: Gauging (stationary velocity-area method)

Part 5: Data Editing, Estimation and Management

Part 6: Stream Discharge Relationship Development and Maintenance *(this guideline)*

Part 7: Training

Part 8: Application of Acoustic Doppler Current Profilers to Measure Discharge in Open Channels

Part 9: Application of in-situ Point Acoustic Doppler Velocity Meters for Determining Velocity in Open Channels

Part 10: Application of Point Acoustic Doppler Velocity Meters for Determining Discharge in Open Channels

Part 11: Application of Surface Velocity Methods for Velocity and Open Channel Discharge Measurements

Table of Contents

National Industry Guidelines for hydrometric monitoring Part 6: Stream Discharge Relationship Development and Maintenance

1 Scope and general

1.1 Purpose

The purpose of this document is to provide guidelines for recommended practice for stream discharge relationship development and maintenance for hydrometric monitoring sites to achieve adequate accuracy for its intended application.

Many of the concepts of this guideline can be generally managed through electronic database/software tools, but can equally be maintained through manual records.

1.2 Scope and application

This guideline applies to the following hydrometric monitoring site categories:

a) open flow channels with natural controls; and
b) open flow channels with artificial flow control structures.

The primary reference for this guideline is AS 3778.2.3—2001 *Measurement of water flow in open channels, Part 2.3: General—Determination of the stage-discharge relationship*.

This guideline outlines acceptable and common techniques that can be employed in the development and maintenance of stage−discharge relationships but does not restrict the practitioner from utilising other methodologies in accordance with organisational/customer requirements or quality assurance processes.

1.3 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this guideline:

1. Standards Australia, Measurement of water flow in open channels, General—Determination of the stage-discharge relationship, AS 3778.2.3—2001 (same as ISO 1100-2:1998).
2. Standards Australia, Measurement of water flow in open channels, General—Guidelines for the selection of flow gauging structures, AS 3778.2.5—2001 (same as ISO 8368:1999).

3. Standards Australia, Measurement of water flow in open channels, Velocity Area Methods, AS 3778.3 series.
4. Standards Australia, Measurement of water flow in open channels, Velocity−area methods—Measurement by slope−area method, AS 3778.3.3—2001 (same as ISO 1070:1992).

1.4 Definitions

For the purpose of this guideline, the definitions given in National Industry Guidelines for hydrometric monitoring, *Glossary*, NI GL 100.00–2019 apply.

2 Safety requirements

All work undertaken to acquire data and information to assist in the development of stage−discharge relationships for hydrometric monitoring sites shall be in accordance with the relevant government work health and safety legislation.

3 Data/Information requirements

The variety, quality and amount of data and information available relevant to the development and maintenance of the stage−discharge relationship for a hydrometric monitoring site can range from almost none to extensive history and data sets.

Data required for the development of the relationship shall conform with other relevant standards or organisational processes.

Records of data and information (metadata) utilised in the development of the relationship shall be maintained and shall be readily available in accordance with organisational or quality assurance processes.

3.1 General

The development, and subsequent maintenance, of a stage−discharge relationship for a gauging station requires:

a) quality data inputs and information (for example gaugings and survey information including flood slopes);
b) application of standardised and appropriate empirical and mathematical techniques;
c) appropriate competency of the practitioner in selecting suitable data and information for constructing and maintaining stream discharge relationships; and
d) gaugings obtained at sufficient frequency and flow range to be able to identify changes in the stage–discharge relationship.

The variability of raw data and application of appropriate techniques in stage–discharge relationship development determines the degree of confidence that will be imparted to the relationship and hence the confidence of subsequent datasets generated from the relationship.

3.2 Empirical method data requirements

For the initial development of a stage–discharge relationship, as a minimum, the following data/information requirements apply:

a) where possible, an identified Cease to Flow (CTF) stream level, i.e., the level or physical location at which the stream would stop flowing, referenced to a known datum (e.g. assumed reduced level, relative gauge height, or similar);
b) a set of gaugings that cover a range of stream levels and flows, sufficient to define the trend of the stage–discharge relationship—these gauging datasets should be applicable in terms of period of applicability and relevance of the data to the relationship being developed; and
c) surveyed cross-sections of stream control to top of bank.

Other data/information that would be of assistance in addition to the above minimum data requirements includes:

a) flood slope surveys;
b) historical gauging sets particularly for higher stages;
c) trends in impact of fluvial and seasonal impacts on reach conditions;
d) knowledge and reporting of the physical characteristics of the control that may influence the sensitivity of the stage–discharge relationship; and
e) knowledge of and management of the reliability and sensitivity of the stage recording.

3.3 Theoretical method data requirements

Initial development of a theoretical stage–discharge relationship by this method may be required where there are no gauging datasets available and may be applied to the initial development of relationships for weirs and flumes.

For the initial development of a theoretical stage–discharge relationship, as a minimum, the following data shall be available:

a) identification of the stream control(s), whether natural or artificial; for the levels of flow being investigated;
b) for artificial controls, identification of any formulae and coefficients of discharge relevant to the structure;
c) identification of the Cease To Flow level for the site;
d) level information in the area sufficient to obtain a cross-section at the control; and
e) stream bed and/or water level information upstream of the control for a minimum distance of 200 m in streams with stable bed conditions, and greater for unstable bed conditions, sufficient to obtain estimates of the water slope or bed slopes for determining the energy gradient in theoretical formulas.

Other data/information that would be of assistance in addition to the above minimum data requirements includes:

a) level information, e.g. Lidar or survey information, sufficient to enable the extraction of cross section information from downstream of the control continuing

upstream of the planned gauging and/or measuring point (whichever is the most upstream);

b) photographs of the banks, channels and flood plains looking both upstream and downstream to assist with friction estimation; and

c) aerial and satellite imagery of the immediate vicinity of the site.

NOTE: Imagery of the site in different flow ranges is also an advantage to confirm flow patterns, control points and seasonal friction influences.

The organisation shall undertake actions to validate any theoretically derived stage-discharge relationship in accordance with customer requirements. Where appropriate this should involve undertaking a gauging program as a calibration of the theoretical relationship. The relationship shall be appropriately modified to improve confidence in the relationship.

3.4 Record keeping

The organisation shall define and maintain its data and record keeping processes, with regards to this guideline, as part of its overall quality assurance, procedural policy and or legislative requirements as applicable.

Records of data, information and processes employed in the development of the stage–discharge relationship shall be maintained by the organisation as per relevant organisational processes or quality assurance procedures.

As a minimum, the organisation shall maintain records of:

a) datasets (gauging, other hydraulic information and similar) used in the development of the stage–discharge relationship;

b) detailed surveys of stream controls or artificial control structures;

c) techniques and procedures used in the development of the relationship; and

d) known and perceived variability in the condition of the stream reach.

4 Stage–discharge relationship development

AS 3778.2.3—2001 provides information about various techniques that can be used for developing stage–discharge relationships.

Where possible, development shall employ empirical and theoretical techniques.

4.1 Natural stream controls

The stage–discharge relationship should be developed from a relevant gauging data set and known Cease to Flow information. See AS 3778.2.3—2001, Clause 6.2.3.

Where insufficient data are available for this method, initial relationship development may be undertaken by logarithmic equation and other mathematical applications that require a reasonable amount of survey information to undertake.

AS 3778.2.3—2001, Clause 6.3.1 states that:

> Hydraulic analysis and mathematical fitting can be used to aid in the curve fitting process, the stage–discharge relationship must conform to the calibration measurements.[1]

Gauging datasets shall always be utilised to validate the relationship.

AS 3778.2.3—2001, Clause 6.3.1 also states:

> The curve fitting process should result in curve shapes that conform to control changes.[2]

Transition areas in the relationship should align with changes in stream control cross-section profiles.

4.2 Artificial stream controls

A theoretical stage–discharge relationship may initially be applied in instances where artificial controls have been constructed at a hydrometric site.

Theoretical relationships in these instances are based on assumed free flow conditions and standard formulae have been developed for different structures and applications. AS 3778.2.5—2001 *General – Guidelines for the selection of flow gauging structures* outlines structures that can be utilised for stage–discharge relationship applications.

The organisation shall adopt the most appropriate relationship for the installed structure taking into account the customer requirements, installation conditions, tailwater effects, approach velocities and the like as discussed in AS 3778.2.5—2001.

As with natural stream controls, where appropriate the organisation should undertake calibration gaugings through the full range of flows and conditions. Periodically, the organisation shall validate and modify, if necessary, the developed relationship.

5 Periods of application

Stage–discharge relationships have the potential to change at the hydrometric site.

Potential changes in the relationship can occur:

a) gradually over time, due to factors such as scour or siltation of the control, vegetation growth or structural changes to the channel following dry periods;
b) suddenly, due to human activities (e.g. construction) or during extreme events such as floods or landslips; or
c) periodically, e.g., due to variable backwater influences including during high tides.

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1 Source: AS 3778.2.3—2001 Clause 6.3.1. © Standards Australia Limited. Copied by the Australian Government Bureau of Meteorology with the permission of Standards Australia and Standards New Zealand under Licence 1901-c052.

2 Source: AS 3778.2.3—2001 Clause 6.3.1. © Standards Australia Limited. Copied by the Australian Government Bureau of Meteorology with the permission of Standards Australia and Standards New Zealand under Licence 1901-c052.

When such change occurs, new stage–discharge relationships shall be developed as necessary to continue to adequately define the derived flows for the hydrometric site.

A “period of application” shall be specified and applied to the relationship to identify the appropriate periods where the relationship is valid.

It is also possible that a relationship may have more than one possible period of application during the history of the hydrometric monitoring site.

The organisation shall maintain records of periods of application as well as documenting any changes to these periods.

At transition from one rating to another, the resulting generated flows should be inspected to ensure continuity with no sudden step in produced flows at the transition unless this is specifically required by a customer. Depending on the circumstance of the transition it may be appropriate to implement a phased rating period in the record. A phased rating is a period of time where it is considered that the prior and following rating cannot be specifically applied, for example while a control is in a period of disturbance during an event. A phased rating will increment the rating change to the next rating over the interval between the period of application of the predecessor and successor ratings.

When applying a new period of application, be it a point in time or a phased change scenario, the dataset and any other available and relevant information shall be inspected with care to ascertain the most appropriate period of application dates and technique.

6 Units of measure and resolution

Units of the stage–discharge relationship shall be expressed in SI units except where regulations or reporting requirements require otherwise. The following requirements apply:

1. Stage shall be expressed in metres to three decimal places.
2. Discharge shall be expressed in either cumecs (m^3/s) or Megalitres per day (ML/d) to three significant figures. The chosen unit shall be defined by the organisation’s requirements of reporting protocols.

7 Quality assurance and validation

Quality assurance and validation processes shall be undertaken by an appropriately competent and experienced practitioner, with high level skills relevant to water data collection, analysis and reporting of water data in a State and National framework.

The organisation (practitioner) shall undertake applicable tests and checks of the stage–discharge relationship against the applicable gauging data set at each site to:

a) validate the derived relationship;
b) maintain confidence in the relationship through identification of stability, or not, of the relationship over time; and

c) identify any change, its magnitude and time of occurrence, in the stage−discharge relationship to permit the prompt development of a new relationship if required.

Care shall be taken in the application of appropriate statistical tests and interpretation of results.

AS 3778.2.3—2001, Section 7 states:

> When testing and checking stage–discharge relationships, it is very important that the analyst understands why the measurements plot as they do. Without this understanding, the analyst might incorrectly apply and interpret certain statistical tests. The analyst should always consider what has been happening to the controlling stream characteristics and make decisions on this basis rather than arbitrarily using statistical results.[3]

7.1 Relationship quality assessment

Quality assessment of the stage–discharge relationship should indicate the level of confidence in the relationship, that is, the representativeness of the relationship to condition reality.

AS 3778.2.3—2001 outlines methods for undertaking assessments of stage–discharge relationships. Other quality assessment processes may apply depending on the requirements of the site, customer requirements, criticality of the site operations and similar.

In all cases the organisation shall define and document the quality of the stage−discharge relationship with reference to the organisation's practices and the requirements for the hydrometric site.

The quality assessment shall take, as a minimum, the following issues into account:

a) consistency with validation data – relevant gauging data sets for the period of application of the relationship;
b) results of appropriately selected statistical tests;
c) The physical characteristics of the site (the relationship reflects changes in the control shape); and
d) streamflow conditions experienced at the site through the range of flows.

7.2 Ongoing validation and quality assurance of the stage–discharge relationship

Hydrometric site physical characteristics vary considerably from artificial control structures to streams with continually shifting control features.

AS 3778.2.3—2001 discusses these issues and possible techniques for addressing the more unstable situations.

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[3] Source: AS 3778.2.3—2001 Section 7. © Standards Australia Limited. Copied by the Australian Government Bureau of Meteorology with the permission of Standards Australia and Standards New Zealand under Licence 1901-c052.

Where validation checks and/or quality assurance processes identify that a change in the relationship has occurred, a new relationship shall be developed.

The organisation shall develop and maintain, within its documented processes and practices, a validation program to maintain the currency and confidence of the stage−discharge relationship. All active hydrometric monitoring sites shall have a program developed, though these may vary in scope/requirements between sites, depending on site specific factors including:

a) the site's purpose and organisational requirements;
b) stability of the site's hydraulic characteristics;
c) criticality of the site to the hydrometric network; and
d) practicality/budgetary aspects of the program.

This validation program shall include:

1. Regular validation measurements (gaugings). The frequency and range of the required gaugings shall be identified in the validation program for the site. Additional check gaugings will provide greater confidence for changing rating tables.

   Example 1

   A stream monitoring site may be composed of a stable rock bar control, with the stream/discharge relationship generally not expected to change under normal conditions. A program of lower frequency gauging may be considered to maintain the validity/currency of the relationship if it can be shown that such a frequency will maintain confident validation of the relationship throughout the normal expected streamflow range. However, if lowering the frequency of gaugings is a chosen course of action, consideration should be given to improving surveillance of the control at site visits to ensure that no physical changes have occurred at the site.

   Example 2

   A stream monitoring site is known to suffer from regular scouring/deposition processes through the reach in which the site operates. It would normally be expected that the frequency of gaugings would be higher for this site to identify the time and magnitude of potential relationship changes. The ongoing validation program would determine and document the required frequency based on knowledge of the site, occurrence of events and the priority of the site for the organisation's operations.

   Example 3

   A monitoring site downstream of a licensed release generally measures the same streamflow during the operational period. It is known that the fixed release favours weed growth in the stream reach which impacts on the relationship in a seasonal manner. The validation program would identify this effect and the gauging frequency undertaken to adequately define the changing relationship through the operational season.

2. Validation measurements, as far as practically possible, throughout the full range of expected flows at a site. A series of high flow gaugings during an event will provide

greater confidence in validating the rating table. Where validation data are difficult to obtain, for example high flow gaugings, the organisation may consider other techniques to assist in validating the relationship, utilising information such as hydraulic models, flood slope surveys, data from other nearby sites or alternate data sets for the site.

3. Regular maintenance of the hydrometric site to maintain physical consistency and stability.
4. Regular cross-section surveys to validate survey information, particularly following significant events or incidents.
5. Other maintenance activities at the site in line with relevant standards and organisational requirements.

Periodic desktop reviews (calibration check) of the stage–discharge relationship shall be undertaken. These reviews shall include the stage-discharge relationship against field measurements and any other available information relevant to the site.

8 Extrapolation of the stage–discharge relationship

AS 3778.2.3—2001 Clause 6.9, indicates that normally a stage–discharge relationship would not be applied outside its range of relevant field measurements, but at the same time acknowledges that flow conditions may require estimates of discharges (flow rates) well past the known ends of the relationship.

Techniques that may be applied to assist with extrapolation of the relationship include:

- the Manning equation;
- the Chezy equation;
- the Slope area method (See AS 3778.3.3—2001);
- the weir formula (mainly for low end extrapolations);
- hydraulic modelling;
- log/log straight line extension; and
- theoretical determination of a CTF.

As with the area of the stage–discharge relationship developed with valid datasets, the quality of the extrapolation of the relationship shall be defined in accordance with organisational processes and requirements. The analysis process shall also be documented and maintained in accordance with organisational processes.

AS 3778.2.3—2001, Clause 6.9, states the following:

> It is recommended that, whenever possible, extrapolations should be made using two or more of the above described methods. Results can then be compared and the extrapolated part of the rating curve can be defined with added confidence.[4]

[4] Source: AS 3778.2.3—2001 Clause 6.9. © Standards Australia Limited. Copied by the Australian Government Bureau of Meteorology with the permission of Standards Australia and Standards New Zealand under Licence 1901-c052.

Extrapolations shall be undertaken by suitably competent and experienced practitioners.

9 Maintenance of data and records

The organisation shall maintain records within the framework of its organisational processes and/or legislative requirements as follows:

a) all stage–discharge relationships utilised in the production of streamflow data for the hydrometric site;
b) all calibration and spot check data used during the development, assessment and maintenance of the relationships;
c) a full record of the periods of application for the relationships;
d) records of techniques utilised to generate relationships outside the ‘norm’;
e) a history of changes or refinements to relationships, defining reasons for the alteration; and
f) any other metadata relevant to the stage–discharge relationship.

Appendix A Training

A.1 Training Session outline

LEARNING ELEMENTS	RESOURCES	DESCRIPTION	
Identify and understand the 1.1 Purpose, 1.2 Scope and application of this guideline	Copies of all guidelines documents. Access to all reference material.	Discussion with reference to the guidelines document	Face to face delivery
1.3 Normative references	Copies of all guidelines documents. Access to all reference material.	Trainers to ensure the learner's ability to source and use reference material.	Face to face delivery
2. Safety requirements	Copies of all guidelines documents. Access to all reference material.	Discussion with reference to the guidelines document	Face to face delivery
3. Data/Information requirements	Copies of all guidelines documents. Access to all reference material.	Explain how data shall comply with other written guidelines or procedures. Explain the process of recording the process used to develop stage-discharge relationships as metadata	Face to face delivery
3.2 Empirical method data requirements	Copies of all guidelines documents. Access to all reference material.	Explain the minimum data/information required to develop a stage-discharge relationship. Explain additional data/information to assist in developing a stage discharge relationship.	Face to face delivery
3.3 Theoretical method data requirements	Copies of all guidelines documents. Access to all reference material.	Explain why theoretical methods may be required to develop a stage-discharge relationship. Explain: • what minimal information is required • validation of a theoretical stage-discharge relationship.	Face to face delivery
3.4 Record keeping	Copies of all guidelines documents. Access to all reference material.	Explain minimum record keeping requirements	Face to face delivery

LEARNING ELEMENTS	RESOURCES	DESCRIPTION	
4. Stage–discharge relationship development	Copies of all guidelines documents. Access to all reference material.	A reference to AS 3778.2.3—2001 provides information about various techniques.	Face to face delivery
4.1 Natural stream controls	Copies of all guidelines documents. Access to all reference material.	Explain: • requirements for a stage-discharge relationship in a natural stream • methods employed when insufficient data are available • transition areas.	Face to face delivery
4.2 Artificial stream controls	Copies of all guidelines documents. Access to all reference material.	Explain: • artificial controls • how standard mathematical formula can be applied to these controls • installation conditions (e.g. Tailwater, approach velocity etc.).	Face to face delivery
5. Periods of application	Copies of all guidelines documents. Access to all reference material.	Explain: • how and why changes in stage-discharge relationships can change over time • how to identify and manage these changes i.e. “period(s) of applicability” • record keeping identifying different periods of applicability • phased ratings • checking/scrutinising techniques and process used.	Face to face delivery
6. Units of measure and resolution	Copies of all guidelines documents. Access to all reference material.	Discuss the content of the guideline dealing with “units of measure and resolution”.	Face to face delivery
7. Quality assurance and validation	Copies of all guidelines documents. Access to all reference material.	Discuss and as necessary explain, the competencies required to carry out validation and the reasons for validation.	Face to face delivery
7.1 Relationship quality assessment	Copies of all guidelines documents. Access to all reference material.	Define “relationship quality assessment”. Explain the minimum requirements for quality assessment. Documentation of quality assessment.	Face to face delivery

LEARNING ELEMENTS	RESOURCES	DESCRIPTION	
7.2 Ongoing validation and quality assurance of the stage–discharge relationship	Copies of all guidelines documents. Access to all reference material.	Explain why an organisation requires a validation program. Explain and discuss the minimum requirements and documentation of a validation program. Work through the examples contained in the text of the guideline. Discuss desk top reviews and their frequency.	Face to face delivery
8. Extrapolation of the stage–discharge relationship	Copies of all guidelines documents. Access to all reference material.	Explain and discuss some of the acceptable techniques that may be applied to assist with extrapolation. Discuss: • level of competency to carry out extrapolation • documentation of processes/techniques used.	Face to face delivery
9. Maintenance of data and records	Copies of all guidelines documents. Access to all reference material.	Discuss and explain the minimum elements required to document an organisation's processes.	Face to face delivery

A.2 Training Learning resources

A.2.1 Introduction

Welcome to the learner resource for National Industry Guidelines for hydrometric monitoring, Part 6: *Stream Discharge Relationship and Maintenance*, NI GL 100.06–2019. The purpose of this resource is to develop your knowledge and skills and improve your competency in this guideline.

A.2.2 Section references

The table below shows elements of the guideline that are covered in this learner resource. This may help the learner to map their progress as they work their way through this resource.

Section	Unit element
1 Scope and general	1.1 Purpose 1.2 Scope and application 1.3 Normative references 1.4 Definitions
2 Safety requirements	
3 Data/Information requirements	3.1 General 3.2 Empirical method data requirements 3.3 Theoretical method data requirements 3.4 Record keeping
4 Stage–discharge relationship development	Reference to AS 3778.2.3—2001 provides information about various techniques. 4.1 Natural stream controls 4.2 Artificial stream controls
5 Periods of application	
6 Units of measure and resolution	
7 Quality assurance and validation	7.1 Relationship quality assessment 7.2 Ongoing validation and quality assurance of the stage–discharge relationship
8 Extrapolation of the stage–discharge relationship	
9 Maintenance of data and records	

A.2.3 Who needs this competency?

This learning material covers the skills and knowledge required for a person to use and understand National Industry Guidelines for hydrometric monitoring, Part 6: *Stream Discharge Relationship and Maintenance*, NI GL 100.06–2019.

A.2.4 Learning outcomes

At the completion of this learner resource you will be competent in the following:

- use the guideline document for reference
- use the guideline in day to day operations
- access the material referenced in the guideline document
- use and understand related internal procedures and work instructions.

A.2.5 Health and safety considerations

Health and safety legislation shall always be considered when implementing National Industry Guidelines, workplace procedures and work instructions.

Employees carrying out work related to the National Industry Guidelines should be adequately trained in all relevant health and safety matters.

A.2.6 Environmental considerations

Compliance with this guideline may involve working in the environment. As such care should be taken to:

- prevent unnecessary damage to the site environment
- prevent unnecessary disturbance of the natural environment
- carefully construct any infrastructure to minimise impacts on the environment and river flow conditions
- plan access roads to sites to minimise impacts during all seasonal conditions.

A.2.7 What resources will I need?

- Workplace policies and procedures
- Manufacturer manuals, requirements and specifications
- Codes of practice
- Workplace equipment, tools and instruments
- Workplace reports
- Workplace maps, plans and instructions
- Permits and access to locations and worksites

Other useful resources

- Relevant Health and Safety Act
- Safe Work Australia Model Codes of Practice
- Organisations procedures and work instructions
- Australian Standards