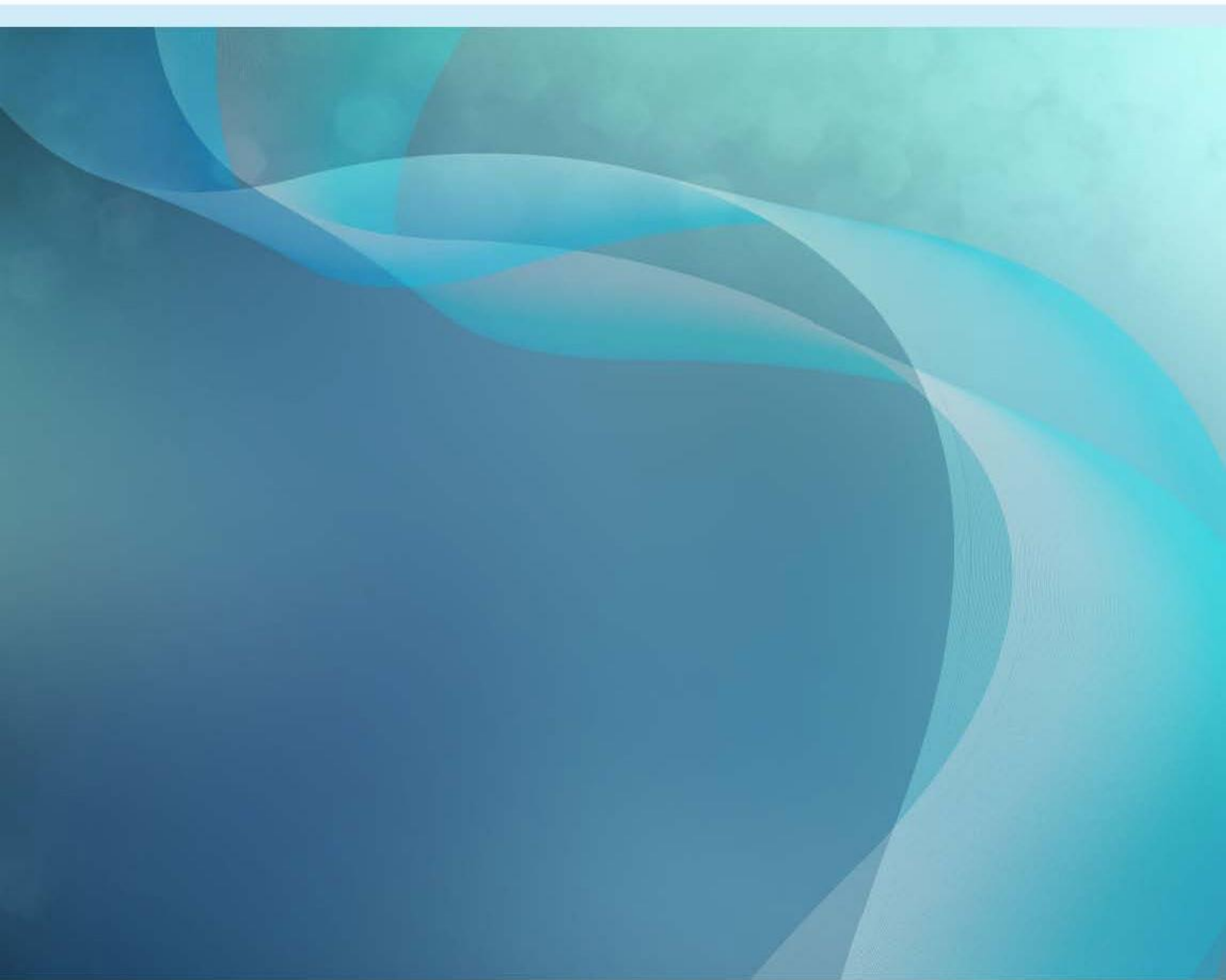




Australian Government
Bureau of Meteorology

Guide to Sensor Observation Services (SOS2) for Water Data Online

Version 1.0.1



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1 Glossary of terms used in this Guide

Term or Abbreviation	Description
ACT	Australian Capital Territory
Aggregated time series	Time series that has been generated by applying a statistical function to calculate each data point based on a group of data points for a specified interval length in a source time series.
As Stored time series	Time series containing data points that have not been aggregated – they are 'as stored' in source data owner system.
Accessible volume or AV	The volume of water that can be released from a storage – the total storage volume minus dead storage volume.
AHD	Australian Height Datum
AWRIS	Australian Water Resource Information System – a Bureau of Meteorology system that receives, stores and processes water data collected from agencies around Australia under the Water Regulations 2008.
Bureau	Australian Government Bureau of Meteorology
CSIRO	Australian Government Commonwealth Scientific and Industrial Research Organisation
Data owner	Organisation named under the Water Regulations 2008 as required to provide specified types of data to the Bureau of Meteorology.
Data provider	Organisation that supplies data to the Bureau of Meteorology, sometimes on behalf of another organisation, under the Water Regulations 2008.
EPSG	European Petroleum Survey Group
FES	Filter encoding standard developed by the OGC
GML	Geographic Markup Language
KVP	Key Value Pair
OGC	Open Geospatial Consortium
SOAP	Simple Object Access Protocol
SOS2	Sensor Observation Services version 2

Term or Abbreviation	Description
SOS2 feature of interest	Geographic feature or location at which data is collected
SOS2 observable property	Parameter or variable measured
SOS2 procedure	Type of time series – which represents the set of rules and methods used to collect and process time series observations.
SOS2 observation offering	Data collected and the method used to process it.
Time series	Collection of data points indexed by time
TV	Total storage volume
QA or Qa	Quality assured
QC or Qc	Quality controlled
WDO	Water Data Online – a website that provides access to Bureau water data sourced from external organisations under the Water Regulations 2008.
WDTF	Water Data Transfer Format – An Australian standard data format for transferring water information.
WaterML2	Water Markup Language version 2 – An OGC standard format for the representation of water data.
WIRADA	Water Information Research and Development Alliance
WISKI	Water Information System Kisters – a time series data management system.

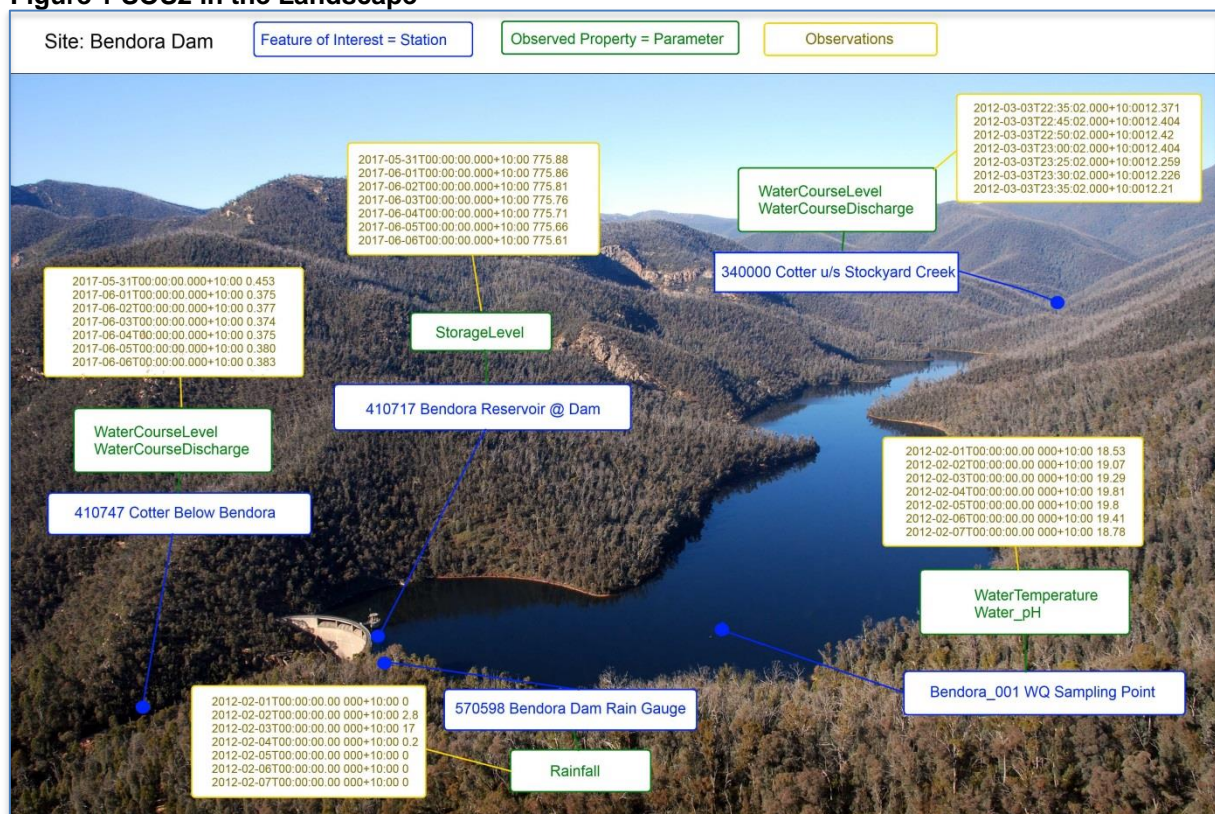
2 Introduction

2.1 SOS2 service

The Australian Government Bureau of Meteorology (the Bureau) has implemented a [Sensor Observation Service standard version 2 \(SOS2\)](#) service to make the time series data it collects and manages under the *Water Regulations 2008* publicly available. The service provides data in [WaterML2](#) format. The SOS2 standard was developed by the [Open Geospatial Consortium \(OGC\)](#) as part of the [OGC Sensor Web Enablement framework](#). The WaterML2 standard was also developed by the OGC with support from the Bureau and CSIRO through the Water Information Research and Development Alliance ([WIRADA](#)).

The picture of Bendora Dam below illustrates at a high level how SOS2 request and response elements translate to data collected by a river observation network:

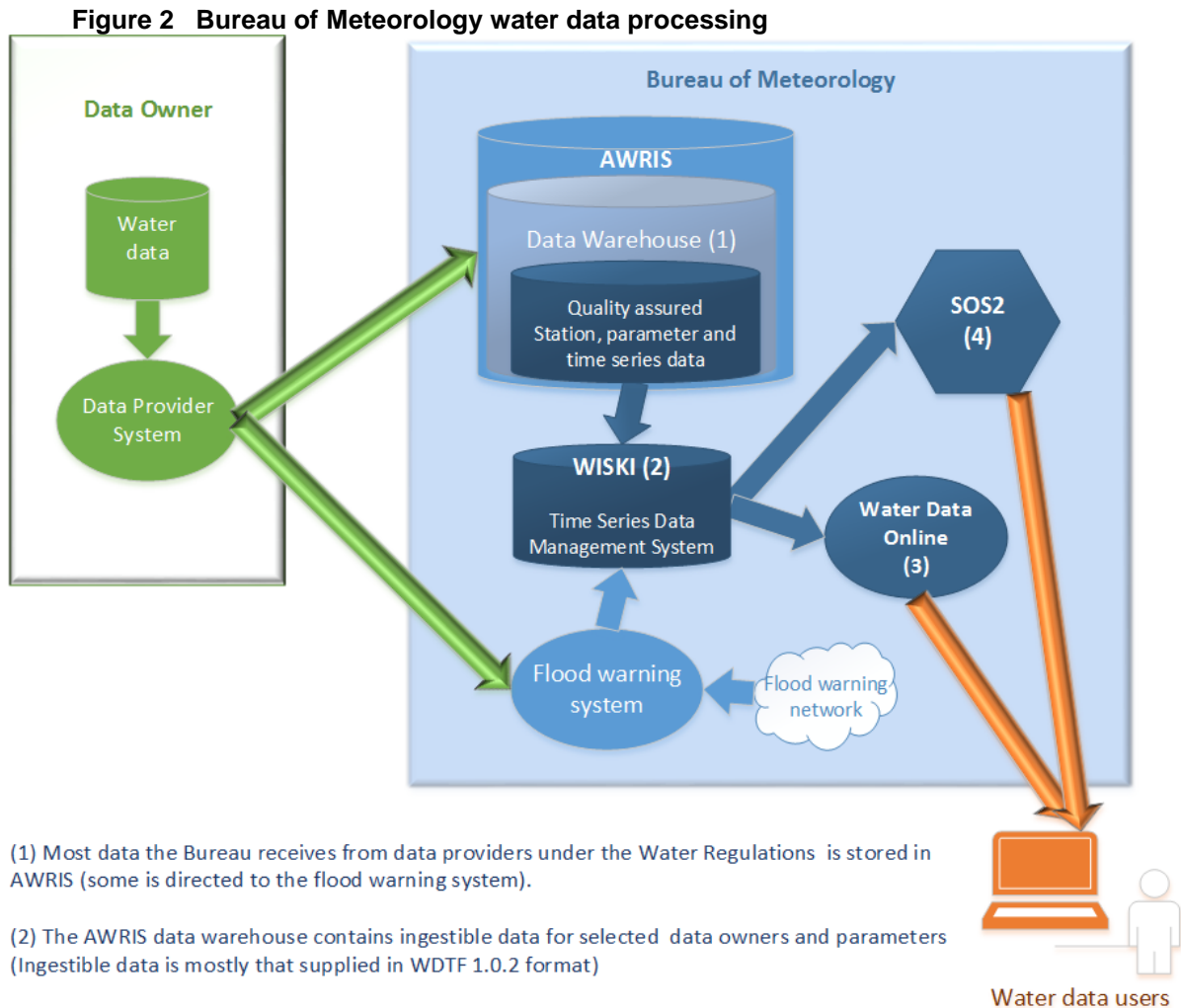
Figure 1 SOS2 in the Landscape



Bendora Dam is located on the Cotter River in the Australian Capital Territory. There are 2 river stations where watercourse level/discharge is measured, one upstream of the dam on Stockyard Creek, the other downstream. There is a storage level measure near the dam wall, a rain gauge near the dam, and a point within the dam at which water quality is sampled. The measurement stations and the sampling points are 'features of interest'. The type of data collected (e.g. storage level) is the 'observable property', this plus the actual data collected and the method used to process it is the 'observation offering'.

2.2 Water data available

The Bureau is custodian of water data provided by external organisations under the [Water Regulations 2008](#). The organisations from which the data originates are known as 'data owners'. In most cases, these organisations provide data directly to the Bureau, however some use the services of another organisation to send the data to the Bureau. These are known as 'data providers'. Key components of the Bureau's Water Regulations data processing are illustrated in Figure 2:



(1) Most data the Bureau receives from data providers under the Water Regulations is stored in AWRIS (some is directed to the flood warning system).

(2) The AWRIS data warehouse contains ingestible data for selected data owners and parameters (Ingestible data is mostly that supplied in WDTF 1.0.2 format)

(3) WISKI contains most time series data ingested to the data warehouse. Some data owners and parameters may be excluded if they have not been quality assured. WISKI also holds some flood warning data for stations that also have Water Regulations data.

(4) The Water Data Online website provides access to selected data owners, parameters and time series types in WISKI.

(5) SOS2 provides access to data for all data owners, parameters and time series types in WISKI. (Some station reference data is not available via SOS2).

The Bureau stores most data received under the Water Regulations 2008 in the Australian Water Resource Information System (AWRIS). The data is NOT real-time – data providers supply the data to the Bureau at most once per day. A large proportion of the time-series

data received is processed through to the WISKI time-series management system, where it can be accessed by SOS2 web services. This processing generally takes about 24 hours.

Currently the data that can be processed through to WISKI is mainly that sent in Water Data Transfer Format (WDTF) version 1.0 or later, and must be associated with a station (for which the data owner/provider has supplied reference data such as name and location). WISKI also stores some watercourse level time-series data supplied by Bureau flood warning stations.

The parameters (observed properties) available via SOS2 are listed in Table 1. A detailed definition of the Water Regulations data subcategory that each parameter corresponds to is available at [Definitions – subcategories of Water Information](#).

The Water Course Level and Water Course Discharge time series types referred to in Table 1 are described in section 6.2. Standard time series types are sourced from data that has been processed through AWRIS, and include the recommended continuous time series of best available data. Flood warning time series types contain data sourced from the flood warning network.

Table 1 Parameters currently available via SOS2

Parameter (SOS2 Observed Property)	Water Regulations Data Subcategory
Dry Air Temperature	4f
Electrical Conductivity @ 25C	9a
Evaporation	4c
Ground Water Level	2a
Rainfall	4a
Relative Humidity	4h
Storage Level	3a
Storage Volume	3b
Turbidity	9d
Water Course Discharge (standard time series types)	1b
Water Course Discharge (flood warning time series types)	11b
Water Course Level (standard time series types)	1a
Water Course Level (flood warning time series types)	11a
Water pH	9g
Water Temperature	9h
Wind Direction	4d

It is important to note that SOS2 provides access to ALL time-series data stored in WISKI. This is more than can be accessed via the Water Data Online (WDO) website. WDO only provides access to data that has undergone the Bureau's data quality assurance processes.

3 Service offerings

3.1 Introduction

A list of services provided by Water Data Online's SOS2 services can be obtained by entering the following request as a URL in a web browser:

www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=GetCapabilities

The response is in WaterML2 format, an XML style listing describing the services available. It is composed of structured elements containing text and attributes and elements can be made up from child elements.

This implementation of SOS2 provides the following services or request types:

- *GetCapabilities*—Lists services available and the filters that can be used to select data output by those services. It also provides an overview of parameters, time series types and geographic area covered by the services.
- *GetFeatureOfInterest*—Provides details about a set of geographical features or locations at which observations are measured. They can be selected according to the parameter measured, type of time series available, and area or point location.
- *GetDataAvailability*—Lists the type of data available for a 'feature of interest' and its coverage. This includes a list of parameters, the time series types available for each of the parameters, and the observed period of record for each time series type.
- *GetObservation*—Returns observations of a specified 'feature of interest' and parameter, within a specific time series type. Each observation has a datetime, value, quality and interpolation type.

The services above return data stored in the Bureau's time series management system – Water Information System Kisters (WISKI). Each parameter (SOS2 observed property) has a range of different time series types available (SOS2 procedures). These are described in section 6.

Request elements (SOS2) and response elements (WaterML2) for each service are listed in tables in the following sections.

Note: There are many more element types than represented here, the full standard can be downloaded from the OGC website at <http://www.opengeospatial.org/standards/sos>

3.3 GetCapabilities

The *GetCapabilities* request provides an overview of the SOS2 services available for the Bureau's water data. It has no parameters:

www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=GetCapabilities

Table 2 below lists the elements of the *GetCapabilities* response, and describes the data provided in each element:

Table 2. Response—GetCapabilities

Response Element *	Description	Values / Examples
ows:OperationsMetadata: -ows:Operation name	Service/Request type available	<i>GetFeatureOfInterest</i> , <i>GetObservation</i>
sos:filterCapabilities -fes:Filter_Capabilities	Request filters available	Spatial_Capabilities Temporal_Capabilities
---fes:SpatialCapabilities	Types of spatial filter that can be used to select features	Point - "gml:point" Area - "BBOX"
---fes:TemporalOperand	Types of temporal filter that can be used to select observations	Period - "gml:TimePeriod" Instant - "gml:TimeInstant"
---fes:TemporalOperators ----fes:TemporalOperator name	Operators that can be used in temporal filters	"During", "Tequals", "After", "Before"
sos:contents -sos:Contents --swes:observableProperty	Parameter name	Storage Level, Watercourse Discharge
--sws:offering ---sos:observationOffering ----swes:identifier ----swes:procedure ----swes:name ----sos:observedArea	Time Series – described by an identifier, procedure, name and observed area.	<u>identifier:</u> "http://bom.gov.au/waterdata/services/tstypes/Pat7_PR02_1" <u>procedure:</u> "http://bom.gov.au/waterdata/services/tstypes/Pat7_PR02_1" <u>name:</u> "PR02AHDQaQc.Merged.AsStored.1"
----swes:identifier and ----swes:procedure		
----swes:name		
----sos:observedArea -----gml:Envelope (attribute srsName) -----gml:lowerCorner -----gml:upperCorner	<p>Geographic area for which time series observations are available. This is defined by the spatial reference system and the coordinates of the upper and lower corners of a rectangle.</p> <p>srsName: Reference to the spatial reference system in the European Petroleum Survey Group (EPSG) Geodetic Parameter Dataset.</p>	<gml:Envelope srsName="http://www.opengis.net/def/crs/EPSG/0/4326"> <u>gml:lower corner:</u> -86.1204 -161.7533 <u>gml:upper corner:</u> 90.00000000000001 168.80640000000002 (covers Australia)

* The number of '-' before the element name indicates the element's depth in the response element hierarchy

3.4 GetFeatureOfInterest

The *GetFeatureOfInterest* request provides details about a set of geographical features or locations at which observations are measured. For the Bureau's SOS2 water data implementation, all features are point locations. Currently these are all monitoring stations (not sampling points). Example *GetFeatureOfInterest* requests are provided in sections 4.1.2 (SOAP method) and 4.2.1.1 (KVP method). The full set of request elements are listed in Table 3 below:

Table 3 Request - GetFeatureOfInterest

Request Element	Description	Example
sos:procedure	Time series type name	http://bom.gov.au/waterdata/services/tstypes/Pat7_C_B_1_YearlyMean
sos:observedProperty	Parameter name	http://bom.gov.au/waterdata/services/parameters/Water_Course_Discharge
sos:spatialFilter -fes:<operator>	Geographic area that observed feature(s)/stations are located within, or an individual feature's point location. This filter is expressed using the OGC filter encoding standard	<pre><fes:Contains> <fes:ValueReference>om:featureOfInterest/* /sams:shape</fes:ValueReference> <gml:Envelope srsName="http://www.opengis.net/def/crs/E PSG/0/4326"> <gml:lowerCorner>-37.505032 140.999283</gml:lowerCorner> <gml:upperCorner>-28.157021 153.638824</gml:upperCorner> </gml:Envelope> </fes:Contains></pre>

The table below describes the key elements of the *GetFeatureOfInterest* response. A *sos:featureMember* element is returned for every station within the requested spatial area, where the requested parameter and time series type exist.

Table 4 Response - GetFeatureOfInterest

Response Element *	Description	Example
sos:featureMember -wml2:MonitoringPoint (attribute gml:id)	A geographical location that is monitored – i.e. a station where observations are collected.	<wml2:MonitoringPoint gml:id="Ki.FM.0">
--gml:identifier (attribute codespace)	Station or location id	http://bom.gov.au/waterdata/services/stations/425022
--gml:name	Name of the geographic location/station/ feature.	LAKE MENINDEE
--sf:type (attribute xlink:href)	Type of monitoring point xlink:href – link to OGC definition	<pre><sf:type xlink:href="http://www.opengis.net/def/sampli ngFeatureType/OGC- OM/2.0/SF_SamplingPoint"/></pre>
--sf:sampledFeature (optional nil attribute)	Type of feature sampled, e.g. Aquifer. In this implementation the nil attribute is used.	<sf:sampledFeature xsi:nil="true"/>
--sams:shape ---gml:point (attribute gml:id) ----gml:pos (attribute srsName)	Point location or geographic area	<pre><sams:shape> <gml:Point gml:id="Ki.P.1"> <gml:pos srsName="http://www.opengis.net/def/crs/E PSG/0/4326">-29.4472 150.0336</gml:pos> </gml:Point></sams:shape></pre>

* The number of '-' before the element name indicates the element's depth in the response element hierarchy

3.5 GetDataAvailability

This request is an extension to the SOS2 standard. While *GetCapabilities* provides a list of observation offerings (parameters and time series types), these are not available at every feature of interest. *GetDataAvailability* lists observation offerings available at a specified feature of interest. Request elements are listed in Table 5:

Table 5 Request - GetDataAvailability

Request Element	Description	Example
sos:featureOfInterest	location/station identifier	http://bom.gov.au/waterdata/services/stations/41001701
sos:observedProperty	Parameter name	http://bom.gov.au/waterdata/services/parameters/Water Course Discharge
sos:procedure	Time series type name	http://bom.gov.au/waterdata/services/tstypes/Pat4_C_B_1

Note: A temporal filter can be specified in a valid *GetDataAvailability* request, but it is not used (i.e. has no impact on) the response.

Table 6 Response - GetDataAvailability

Response Element *	Description	Example
gda:dataAvailabilityMember (attribute gml:id)	Time series available gml:id – internal identifier	gml:id="Ki.DAM.0"
-gda:procedure (attributes xlink:href and xlink:title)	Time series type xlink:href – template name xlink:title – time series name	xlink:href="http://bom.gov.au/waterdata/services/tstypes/Pat4_C_B_1_DailyMean" xlink:title="DMQaQc.Merged.DailyMean.24 HR"
-gda:observedProperty (attributes xlink:href and xlink:title)	Parameter xlink:href – parameter reference xlink:title – parameter name	xlink:href="http://bom.gov.au/waterdata/services/parameters/Water Course Discharge" xlink:title="Water Course Discharge"
-gda:featureOfInterest (attributes xlink:href and xlink:title)	Feature / Station / Location where observations are measured. xlink:href – identifier xlink:title - name	xlink:href="http://bom.gov.au/waterdata/services/stations/410713" xlink:title="Paddy's at Riverlea"
-gda:phenomenonTime --gml:timePeriod (attribute gml:id) ---gml:beginPosition ---gml:endPosition	Time period for which observations are available. gml:id - internal identifier	gml:id="Ki.TP.1" <u>Begin position</u> 1957-03-29T00:00:00.000+10:00 <u>End position</u> 2016-12-15T12:00:00.000+10:00

* The number of '-' before the element name indicates the element's depth in the response element hierarchy

3.6 GetObservation

GetObservation returns observations of a specified parameter and time series type, measured/collected at one or more given features of interest (e.g. station). Example requests are provided in sections 4.1.2.2 (SOAP method) and 4.2.1.5 (KVP method). The full set of request elements are listed in Table 7:

Table 7 Request - GetObservation

Request Element	Description	Example
sos:procedure	Time series type name	http://bom.gov.au/waterdata/services/tstypes/Pat7_C_B_1_YearlyMean
sos:observedProperty	Parameter name	http://bom.gov.au/waterdata/services/parameters/Storage Level
sos:featureOfInterest	location/station identifier	http://bom.gov.au/waterdata/services/stations/425022
sos:temporalFilter -fes:<operator>	Instant or time period for which to return observations for all selected locations/stations. This filter is expressed using the OGC filter encoding standard	<fes:During> <fes:ValueReference>om:phenomenonTime</fes:ValueReference> <gml:TimePeriod gml:id="tp1"> <gml:beginPosition>2000-01-01T00:00:00+10</gml:beginPosition> <gml:endPosition>2009-12-31T23:59:59+10</gml:endPosition> </gml:TimePeriod></fes:During>

Table 8 describes the key elements of the *GetObservation* response. A *sos:observationData* element is returned for each *sos:featureOfInterest* in the request - if it is present in the WISKI database, and the requested parameter and time series type also exists. *If a temporal filter is not used, the last observation is returned (NOT every observation).*

Table 8 Response - GetObservation

Response Element	Description	Example
sos:observationData -om:OM_Observation (attribute gml:id)	Observations for a "feature of interest" (station/location) gml:id – internal identifier	<om:OM_Observation gml:id="Ki.OM_Obs.1">
--phenomenonTime ---gml:TimePeriod (attribute gml:id) ---gml:beginPosition ---gml:endPosition	Time/period for which observations were made at the feature/station for the parameter and time series.	<gml:TimePeriod gml:id="Ki.ObsTime.2"> <u>Begin Position:</u> 2000-01-01T00:00:00.000+10:00 <u>End Position:</u> 2006-01-01T00:00:00.000+10:00
--resultTime ---gml:TimeInstant (attribute gml:id) ---gml:timePosition	Datetime of the last recorded observation in the time series.	<gml:TimeInstant gml:id="Ki.resTime.2"> <u>TimePosition</u> 2006-01-01T00:00:00.000+10:00
--om:procedure	Time series type	DMQaQc.Merged.DailyMax.24HR
--om:observedProperty	Parameter	"Water Course Discharge"
--om:featureOfInterest	Station/location	http://bom.gov.au/waterdata/services/stations/410713 xlink:title="Paddy's at Riverlea"
--om:result ---wml2:MeasurementTimeseries	Time series metadata and data	See below
-----wml2:DefaultPointMetadata -- -----wml2: defaultTVP MeasurementMetadata -----qualifier -----uom code -----interpolationType	Default metadata to be used for time series observations where the metadata is not provided.	<u>Uom code</u> "cumec" <u>Interpolation</u> xlink:href="http://www.opengis.net/def/waterml/2.0/interpolationType/ConstSucc" xlink:title="Constant in succeeding interval" <u>Qualifier</u> xlink:href="http://bom.gov.au/waterdata/services/qualifiers/140" xlink:title="140"
-----wml2:point -----wml2:MeasurementTVP -----wml2:time -----wml2:value -----wml2:metadata	Time series observation (time value pair) and its metadata: <ul style="list-style-type: none"> Unit of measure Interpolation type Quality code 	<u>Time</u> 2016-12-11T00:00:00.000+10:00 <u>Value</u> 0.315 <u>Metadata</u> See example for MeasurementMetadata

4 How to submit SOS2 requests

SOS2 requests can be submitted using either the Simple Object Access Protocol (SOAP) or Key Value Pair (KVP) method. The KVP method can be utilised by typing commands into a web browser, but is difficult to use correctly and debug. For this reason, **the Bureau recommends using the SOAP method.**

4.1 SOAP method

To obtain data by using a SOS2–SOAP request it is necessary to send a file containing the request to the Water Data Online server. The format of the file is described below:

Table 9 Format of SOAP request files

Request Element	Description	Example or Value
soap12:Envelope	Describes the location of the web service standard and schema used within the SOAP message body. Note: All elements have the same attributes/text for all request types – see example.	xmlns:soap12="http://www.w3.org/2003/05/soap-envelope" xmlns:sos="http://www.opengis.net/sos/2.0" xmlns:wsa="http://www.w3.org/2005/08/addressing" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:ows="http://www.opengis.net/ows/1.1" xmlns:fes="http://www.opengis.net/fes/2.0" xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:swes="http://www.opengis.net/swes/2.0" xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd http://www.opengis.net/sos/2.0 http://schemas.opengis.net/sos/2.0/sos.xsd">
soap12:Header -wsa:To -wsa:Action -wsa:ReplyTo -wsa:Address -wsa:MessageID	Contains the request type (action). Can be used in some implementations for the request destination. Note: Elements other than wsa:Action have the same attributes/text for all the request types. The wsa:Action contains the request type.	<wsa:To>http://www.ogc.org/SOS</wsa:To> <wsa:Action>http://www.opengis.net/def/serviceOperation/sos/core/2.0/GetObservation</wsa:Action> <wsa:ReplyTo> <wsa:Address>http://www.w3.org/2005/08/addressing/anonymous</wsa:Address> </wsa:ReplyTo> <wsa:MessageID>0</wsa:MessageID>
soap12:Body	Contains the request type and filters. <i>See request tables in section 2 for a list of request elements for each request type.</i>	<sos:GetObservation service="SOS" version="2.0.0"> <sos:procedure>http://bom.gov.au/waterdata/services/tstypes/Pat7_C_B_1_YearlyMean</sos:procedure> <sos:observedProperty>http://bom.gov.au/waterdata/services/parameters/Storage Level</sos:observedProperty> <sos:featureOfInterest>http://bom.gov.au/waterdata/services/stations/425022</sos:featureOfInterest> <sos:featureOfInterest>http://bom.gov.au/waterdata/services/stations/418043</sos:featureOfInterest> - <sos:temporalFilter> - <fes:During> - <fes:ValueReference>om:phenomenonTime</fes:ValueReference> - <gml:TimePeriod gml:id="tp1"> - <gml:beginPosition>2000-01-01T00:00:00+10</gml:beginPosition> - <gml:endPosition>2009-12-31T23:59:59+10</gml:endPosition> </gml:TimePeriod> </fes:During> </sos:temporalFilter>

4.1.1 How to submit a request using the SOAP method

To submit a SOAP request you need to:

1. Obtain and install an http tool. The example below uses 'curl' (available for free download at <https://curl.haxx.se/download.html>). **Note:** There are two methods available under http to exchange data – GET and POST. The curl http tool automatically uses the 'POST' method as data are sent to the service as well as retrieved.
2. Create the SOAP request file described in Table 9. Some example files are available on the [Water Data Online website](#). See FAQ page—Reports, Downloads and Web Services—Web Services for Water Data Online.
3. Submit the SOS2 request from the command line (available from the Windows Start menu) using the http tool, or create and run a script:

```
curl --header "Content-Type: text/xml;charset=UTF-8" --data @<request file.xml>  
http://www.bom.gov.au/waterdata/services?service=SOS
```

4.1.2 Example SOAP requests

The following examples illustrate common uses of SOS2 to list stations, and time series observations for selected stations and parameters. In the request examples colour is used to highlight key information:

- The **blue** text is the SOAP envelope, which specifies the type of web service to be used (SOS2), and other relevant standards.
- The **purple** text is the SOAP header, which contains addressing information for the data exchange. The **orange** highlighted text within the SOAP header selects the request action—the SOS2 web service to be used.
- The **green** text is the SOAP body, which contains request filters.
- Values used to filter the data returned are highlighted in **red**.

4.1.2.1 GetFeatureOfInterest

This example requests a list of stations (features of interest) that have a Yearly Mean Watercourse Discharge time series within the geographic area 'boxed' by coordinates –37.505032 140.999283 (lower corner) and –28.157021 153.638824 (upper corner). The spatial reference system used in the request is defined under <http://www.opengis.net/def/crs/EPSG/0/4326>.

```
<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope
  xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:ows="http://www.opengis.net/ows/1.1"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope http://www.w3.org/2003/05/soap-
envelope/soap-envelope.xsd
  http://www.opengis.net/sos/2.0 http://schemas.opengis.net/sos/2.0/sos.xsd">
  <soap12:Header>
    <wsa:To>http://www.ogc.org/SOS</wsa:To>
    <wsa:Action>http://www.opengis.net/def/serviceOperation/sos/foiRetrieval/2.0/GetFeatureOfInterest</wsa:
Action>
    <wsa:ReplyTo>
      <wsa:Address>http://www.w3.org/2005/08/addressing/anonymous</wsa:Address>
    </wsa:ReplyTo>
    <wsa:MessageID>0</wsa:MessageID>
  </soap12:Header>
  <soap12:Body>
    <sos:GetFeatureOfInterest service="SOS" version="2.0.0">

      <sos:procedure>http://bom.gov.au/waterdata/services/tstypes/Pat7_C_B_1_YearlyMean</sos:procedure>
      <sos:observedProperty>http://bom.gov.au/waterdata/services/parameters/Water Course
Discharge</sos:observedProperty>
      <sos:spatialFilter>
        <fes:Contains>
          <fes:ValueReference>om:featureOfInterest/*/sams:shape</fes:ValueReference>
          <gml:Envelope srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">
            <gml:lowerCorner>-37.505032 140.999283</gml:lowerCorner>
            <gml:upperCorner>-28.157021 153.638824</gml:upperCorner>
          </gml:Envelope>
        </fes:Contains>
      </sos:spatialFilter>
    </sos:GetFeatureOfInterest>
  </soap12:Body>
</soap12:Envelope>
```

4.1.2.2 GetObservation request

This example requests Storage Level – Yearly mean time series observations for the period after 1 January 2010 for two stations:

- 425022 (Tareelaro storage) and;
- 418043 (Lake Menindee).

```
<?xml version="1.0" encoding="UTF-8"?>
<soap12:Envelope
  xmlns:soap12="http://www.w3.org/2003/05/soap-envelope"
  xmlns:sos="http://www.opengis.net/sos/2.0"
  xmlns:wsa="http://www.w3.org/2005/08/addressing"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xmlns:ows="http://www.opengis.net/ows/1.1"
  xmlns:fes="http://www.opengis.net/fes/2.0"
  xmlns:gml="http://www.opengis.net/gml/3.2"
  xmlns:swes="http://www.opengis.net/swes/2.0"
  xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope
http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd

  http://www.opengis.net/sos/2.0 http://schemas.opengis.net/sos/2.0/sos.xsd">
  <soap12:Header>
    <wsa:To>http://www.ogc.org/SOS</wsa:To>

    <wsa:Action>http://www.opengis.net/def/serviceOperation/sos/core/2.0/GetObservation</wsa:Action>
    <wsa:ReplyTo>
      <wsa:Address>http://www.w3.org/2005/08/addressing/anonymous</wsa:Address>
    </wsa:ReplyTo>
    <wsa:MessageID>0</wsa:MessageID>
  </soap12:Header>
  <soap12:Body>
    <sos:GetObservation service="SOS" version="2.0.0">

      <sos:procedure>http://bom.gov.au/waterdata/services/tstypes/Pat7_C_B_1_YearlyMean</sos:procedure>
      <sos:observedProperty>http://bom.gov.au/waterdata/services/parameters/Storage
Level</sos:observedProperty>

      <sos:featureOfInterest>http://bom.gov.au/waterdata/services/stations/425022</sos:featureOfInterest>

      <sos:featureOfInterest>http://bom.gov.au/waterdata/services/stations/418043</sos:featureOfInterest>

      <sos:temporalFilter>
        <fes:After>
          <fes:ValueReference>om:resultTime</fes:ValueReference>
          <gml:TimeInstant gml:id="ti1">
            <gml:timePosition>2010-01-
01T00:00:00+10</gml:timePosition>
          </gml:TimeInstant>
        </fes:After>
      </sos:temporalFilter>

    </sos:GetObservation>
  </soap12:Body>
</soap12:Envelope>
```

4.1.3 How to interpret SOAP responses

The response below contains the monitoring point identifier, station id, station name, spatial reference system and coordinates for the *GetFeatureOfInterest* example 4.2.1.1, i.e. stations that have a Yearly Mean time series for Watercourse Discharge within the selected spatial area.

- The **blue** text is the SOAP envelope, which specifies the type of web service to be used (SOS2), and other relevant standards.
- The **purple** text is the SOAP header, which contains addressing information for the data exchange. The **orange** highlighted text within the SOAP header selects the request action – the SOS2 web service to be used.
- The **green** text is the SOAP body, which contains request filters.
- Requested data items returned are highlighted in **red**.

```
<?xml version="1.0" ?><soap12:Envelope xmlns:soap12="http://www.w3.org/2003/05/soap-envelope" xsi:schemaLocation="http://www.w3.org/2003/05/soap-envelope http://www.w3.org/2003/05/soap-envelope/soap-envelope.xsd http://www.opengis.net/sos/2.0 http://schemas.opengis.net/sos/2.0/sos.xsd http://www.opengis.net/samplingSpatial/2.0 http://schemas.opengis.net/samplingSpatial/2.0/spatialSamplingFeature.xsd http://www.opengis.net/waterml/2.0 http://schemas.opengis.net/waterml/2.0/waterml2.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:wsa="http://www.w3.org/2005/08/addressing" xmlns:sos="http://www.opengis.net/sos/2.0" xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:fes="http://www.opengis.net/fes/2.0" xmlns:swe="http://www.opengis.net/swe/2.0" xmlns:swes="http://www.opengis.net/swes/2.0" xmlns:sams="http://www.opengis.net/samplingSpatial/2.0" xmlns:sf="http://www.opengis.net/sampling/2.0" xmlns:wml2="http://www.opengis.net/waterml/2.0" xmlns:xlink="http://www.w3.org/1999/xlink">
<soap12:Header><wsa:To>http://www.w3.org/2005/08/addressing/anonymous</wsa:To><wsa:Action>http://www.opengis.net/def/serviceOperation/sos/foiRetrieval/2.0/GetFeatureOfInterestResponse</wsa:Action><wsa:RelatesTo>0</wsa:RelatesTo></soap12:Header>
<soap12:Body><sos:GetFeatureOfInterestResponse>
<sos:featureMember>
<wml2:MonitoringPoint gml:id="Ki.FM.0">
<gml:identifier
codeSpace="http://www.opengis.net/def/nil/OGC/0/unknown">http://bom.gov.au/waterdata/services/stations/410771</gml:identifier>
<gml:name>Tugg Ck at Weir</gml:name>
<sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGCOM/2.0/SF_SamplingPoint"/>
<sf:sampledFeature xsi:nil="true"/>
<sams:shape>
<gml:Point gml:id="Ki.P.0">
<gml:pos srsName="http://www.opengis.net/def/crs/EPSSG/0/4326">-35.41905556 149.07383333</gml:pos>
</gml:Point>
</sams:shape>
</wml2:MonitoringPoint>
</sos:featureMember>

( ---- WaterML2 formatted data for 20 more sos:featureMember ----)

</sos:GetFeatureOfInterestResponse></soap12:Body></soap12:Envelope>
```


4.2 Key-Value Pair (KVP) method

KVP requests can be either submitted from the command line using an http tool (as per the SOAP method), or typed into a web browser. See tables in section 3 for keys (request elements) and values to use for each of the service types.

4.2.1 Example KVP requests

4.2.1.1 GetFeatureOfInterest - return stations in a geographic area

This example returns stations that fall within the geographic area 'boxed' by coordinates -27.5 153.5 (lower corner) and -27.4 153.6 (upper corner):

<http://www.bom.gov.au/waterdata/services?service=SOS&request=getfeatureofinterest&datasource=0&version=2.0&spatialFilter=sams:shape,-27.5,153.5,-27.4,153.6>

4.2.1.2 GetFeatureOfInterest - return all stations with a parameter

This example returns a list of stations that have a Storage Volume parameter:

[http://www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=Getfeatureofinterest&observedproperty=http://bom.gov.au/waterdata/services/parameters/Storage Volume](http://www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=Getfeatureofinterest&observedproperty=http://bom.gov.au/waterdata/services/parameters/Storage%20Volume)

4.2.1.3 GetDataAvailability for a station

This example returns the period of record for all parameters and time series types measured at station 410713 – Paddy's River at Riverlea:

<http://www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=GetDataAvailability&featureofinterest=http://bom.gov.au/waterdata/services/stations/410713>

4.2.1.4 GetObservation – return the period of record for all time series for a station

This example returns the period of record and last observation for all parameters and time series types measured at station 410713 – Paddy's River at Riverlea. The last observation in the time series is returned as there were no time filters in the request.

<http://www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=Getobservation&featureofinterest=http://bom.gov.au/waterdata/services/stations/410713>

4.2.1.5 GetObservation - return observations in a period for a station, parameter and time series

This example returns a continuous time series *Pat2_C_B_1* (merged provisional and validated data) for Rainfall measured at station 41001701 (Numeralla @ Chakola) for the time period 1 January to 1 February 2012:

http://www.bom.gov.au/waterdata/services?service=SOS&request=getobservation&datasource=0&version=2.0&featureOfInterest=http://bom.gov.au/waterdata/services/stations/41001701&procedure=http://bom.gov.au/waterdata/services/tstypes/Pat2_C_B_1&observedProperty=http://bom.gov.au/waterdata/services/parameters/Rainfall&temporalFilter=om:phenomenonTime,2012-01-01T00:00:00Z/2012-02-01T00:00:00Z

Alternatively, a range of years can be specified (in this case, 2014–2017):

http://www.bom.gov.au/waterdata/services?service=SOS&request=getobservation&datasource=0&version=2.0&featureOfInterest=http://bom.gov.au/waterdata/services/stations/41001701&procedure=http://bom.gov.au/waterdata/services/tstypes/Pat2_C_B_1&observedProperty=http://bom.gov.au/waterdata/services/parameters/Rainfall&temporalFilter=om:phenomenonTime,2014/2017

A specific instant in time can also be selected (in this case 5am, 12 October 2015):

http://www.bom.gov.au/waterdata/services?service=SOS&request=getobservation&datasource=0&version=2.0&featureOfInterest=http://bom.gov.au/waterdata/services/stations/41001701&procedure=http://bom.gov.au/waterdata/services/tstypes/Pat2_C_B_1&observedProperty=http://bom.gov.au/waterdata/services/parameters/Rainfall&temporalFilter=om:phenomenonTime,2015-10-12T05:00:00.000+10:00

4.2.2 How to interpret KVP responses

For KVP requests there is no SOAP envelope, and the response is not set within a SOAP body element. Keys are shown in **green**, Values in **red**.

The example below illustrates how to interpret the response from a GetObservation request where there is no time period specified. There are two features of the response that should be noted:

- Only the last observation (time value pair) in the time series is returned as there were no filters in the request. This is a built in feature to prevent unintended large data downloads.
- The value in the time value pair (for the last observation in the time series) is null. This is a feature built into WISKI for standard time series types. The Bureau receives the time series data from external organisations, this occurs at most daily. A gap marker (null value) is placed at the end of the time series in case the next observation is at a much later date. It ensures the system does not interpolate across large gaps in received data.

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```
<sos:GetObservationResponse xsi:schemaLocation="http://www.opengis.net/sos/2.0
http://schemas.opengis.net/sos/2.0/sos.xsd http://www.opengis.net/waterml/2.0
http://schemas.opengis.net/waterml/2.0/waterml2.xsd" xmlns:wml2="http://www.opengis.net/waterml/2.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:gml="http://www.opengis.net/gml/3.2"
xmlns:om="http://www.opengis.net/om/2.0" xmlns:sos="http://www.opengis.net/sos/2.0"
xmlns:sa="http://www.opengis.net/sampling/2.0" xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
xmlns:xlink="http://www.w3.org/1999/xlink">
  - <extension xmlns="http://www.opengis.net/swes/2.0">
  - <wml2:SOSProfileExtension>
  - <wml2:metadata>
  - <wml2:DocumentMetadata gml:id="Ki.DocMD.1">
    <wml2:generationDate>2016-12-18T23:30:32.122+00:00</wml2:generationDate>
    <wml2:generationSystem>KISTERS KiWIS</wml2:generationSystem>
  - </wml2:DocumentMetadata>
  - </wml2:metadata>
  - </wml2:SOSProfileExtension>
  - </extension>
  - <sos:observationData>
  - <om:OM_Observation gml:id="Ki.OM_Obs.1">
    + <om:phenomenonTime>
    - <gml:TimePeriod gml:id="Ki.ObsTime.1">
      <gml:beginPosition>2016-09-13T12:00:02.000+10:00</gml:beginPosition>
      <gml:endPosition>2016-09-13T12:00:02.000+10:00</gml:endPosition>
    - </gml:TimePeriod>
    - </om:phenomenonTime>
    + <om:resultTime>
    - <gml:TimeInstant gml:id="Ki.resTime.1">
      <gml:timePosition>2016-09-13T12:00:02.000+10:00</gml:timePosition>
    - </gml:TimeInstant>
    - </om:resultTime>
    - <om:procedure xlink:href="http://bom.gov.au/waterdata/services/tstypes/R_V_1ST"
      xlink:title="Received.Validated.AsStored.1" />
    - <om:observedProperty xlink:href="http://bom.gov.au/waterdata/services/parameters/Water Course Level"
      xlink:title="Water Course Level" />
    - <om:featureOfInterest xlink:href="http://bom.gov.au/waterdata/services/stations/410713" xlink:title="Paddy's at
      Riverlea" />
    + <om:result>
    - <wml2:MeasurementTimeseries gml:id="Ki.Ts.1378010">
    - <wml2:defaultPointMetadata>
    - <wml2:DefaultTVPMeasurementMetadata>
      <wml2:uom code="m" />
      <wml2:interpolationType xlink:href="http://www.opengis.net/def/waterml/2.0/interpolationType/Discontinuous"
      xlink:title="Discontinuous" />
    - </wml2:DefaultTVPMeasurementMetadata>
    - </wml2:defaultPointMetadata>
    - <wml2:point>
    - <wml2:MeasurementTVP>
      <wml2:time>2016-09-13T12:00:02.000+10:00</wml2:time>
      <wml2:value xsi:nil="true" />
    - </wml2:MeasurementTVP>
    - </wml2:point>
    - </wml2:MeasurementTimeseries>
    - </om:result>
  - </om:OM_Observation>
</sos:observationData>
```

(---- WaterML2 formatted data for 63 more sos:observationData ----)

```
</sos:GetObservationResponse>
```

5 SOS2 Workflow

5.1 Generic workflow

Use the following steps to find stations, and obtain associated time series observations for specific parameters and time series types:

1. See what information the service can provide using the *GetCapabilities* request: www.bom.gov.au/waterdata/services?service=SOS&version=2.0&request=GetCapabilities
2. Find stations using the *GetFeatureOfInterest* request. You can specify a combination of (optional) filters to select the stations you require. Use:
 - *sos:procedure* to select stations that record measurements using a particular method
 - *sos:observedProperty* to select stations that record measurements for a specific parameter.
 - *sos:spatialFilter* to select stations within a specified geographical area.

Take note of each *gml:identifier*, this is needed to select stations as the *featureOfInterest* in the next steps.

3. Retrieve time series data by performing a *GetObservation* request. You can select time series data to return using a combination of (optional) filters. Use:
 - *sos:procedure* to select the time series type
 - *sos:observedProperty* to select the parameter
 - Any number of *sos:featureOfInterest* identifiers (*gml:identifier* values from step 2) to specify which stations you need the time series data for.
 - *sos:temporalFilter* to specify the time period for which data is to be provided.

5.2 Workflow for specific scenarios

The full workflow outlined above is only required when there is no prior knowledge of services, stations or data available, and time-series data is required. The following sections outline alternate workflows for two other scenarios.

5.2.1 Scenario 1: Find stations at which a specific parameter is measured

The GetFeatureOfInterest request can be used to find stations within a specified geographic area. Filters can be added to select specific parameters and time series types. The SOAP method is used:

1. Create a request file: *GetFeatureOfInterestRequest.xml* (see the example provided in 4.1.2.1. Populate the following request elements:

- `<sos:observedProperty>`

This request element requires the text 'http://bom.gov.au/waterdata/services/parameters/' followed by the parameter name – for example Water Course Discharge.

- `<sos:spatialFilter>`

Spatial feature elements are specified within filter encoding standard (fes) elements. They describe the top left and bottom right of a rectangular area within which stations (features) are to be found. The gml envelope element's srsName identifies the spatial reference system used, the lowerCorner and upperCorner elements each contain a set of coordinates. The example below describes an area in southeastern Australia bounded by coordinates 35 degrees south 145 degrees east, and 33 degrees south and 147 degrees east:

```
<fes:Contains>
<fes:ValueReference>om:featureOfInterest/*/sams:shape</fes:ValueReference>
<gml:Envelope
srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
  <gml:lowerCorner>-35 145</gml:lowerCorner>
  <gml:upperCorner>-33 147</gml:upperCorner>
```

2. Submit the request to the Water Data Online server using an http tool, for example:

```
curl --header "Content-Type: text/xml; charset=UTF-8" --data
@<GetFeatureOfInterestRequestFile.xml>
http://www.bom.gov.au/waterdata/services?service=SOS
```

5.2.2 Scenario 2: Get time-series observations for a specific station, parameter and period

In this scenario, only a *GetObservation* request is required. It is difficult to construct KVP queries that return time-series data, so the SOAP method should be used. The steps are:

1. **Make sure you choose the correct time series type.** There are many different types available—some have continuous data, others aggregated. Some of the continuous time series types contain provisional data, some only contain quality edits made by Bureau scientists. The types of data to be found in each time series type are described in section 6.2, with recommendations as to which time series should be used. For example if you want mean daily observations for Watercourse Discharge, calculated from midnight to midnight, this is *Pat4_C_B_1_DailyMean*.
2. Create a request file: *GetObservationRequestFile.xml*. An example is provided in 4.1.2.2. Populate the following request elements:

- `<sos:procedure>`

This request element requires the text 'http://bom.gov.au/waterdata/services/tstypes/' followed by the name of the time series type identified in step 1.

- `<sos:featureOfInterest>`

Insert the Station Id within this element.

- `<sos:temporalFilter>`

Several different types of temporal filter (e.g. before, between, after) can be specified within this element using filter encoding standard (fes) elements. Please refer to <http://www.opengeospatial.org/standards/sos>.

3. Submit the request to the Water Data Online server using an http tool, for example:

```
curl --header "Content-Type: text/xml; charset=UTF-8" --data
@<GetObservationRequestFile.xml>
http://www.bom.gov.au/waterdata/services?service=SOS
```

6 How to interpret the Bureau's water data

6.1 Station (FeatureOfInterest)

All time-series data in WISKI are currently associated with a station. As a result, the Bureau's water data implementation of SOS2 uses station id as the *gml:identifier* for a 'featureOfInterest'. Unfortunately different data organisations (data owners) can use the same station id for different physical stations. Also, more than one organisation can provide data for the same physical station (usually over different periods). The result is that station id is not unique.

For example, both ACT's Icon Water and the Environment and Planning directorate supply data to the Bureau for the same physical station — Murrumbidgee at Angle Crossing. This is the case for many (if not all) ACT stations.

There can also be multiple stations placed at/around a geographic feature. This is often the case for large storages/dams such as Lake Argyle in Western Australia.

6.2 Time-series type (procedure)

6.2.1 Template patterns

Within WISKI a 'template' is used to generate a set of time series types. Templates represent a set of rules and processing methods. The set of time series types generated by a template is referred to as a 'pattern'. Patterns are identified by a number. The template pattern used to generate time series for each parameter is listed in Table 10 below:

Table 10 Time series pattern for each parameter

Pattern Number	Parameters template is used for
1	Dry air temperature, Relative Humidity, Wind Speed, Electrical conductivity at 25C, Turbidity, Water pH, Water Temperature
2	Rainfall, Evaporation
3	Watercourse Level
4	Watercourse Discharge
5	Water Volume (not currently used, represents water usage)
6	Storage Volume
7	Storage Level
8	Wind Direction
9	Groundwater Level

The same set of time series types are used for all parameters to store and process the initial data received from data owners/providers. The types of time series required for a parameter generally only differ for aggregations (e.g. at the monthly level).

6.2.2 Time-series identifiers

The time-series identifier provides information as to the methods/rules to generate the time series. These time-series identifiers, used to specify time series in SOS2 requests, are listed in the 'Procedure / identifier' column in Table 12 to Table 23.

The format of the identifier is not fixed, in general it has the following components:

<source type>_<data type>_<quality>_<instance>_<aggregation type>_<product>

Each of the components above is described in Table 11:

Table 11 Time Series Identifier - Name Components

Identifier Component	Description	Values
Source type	Indicates whether the time series is received directly from the data provider, or generated at the Bureau	R - Received Pat<x> - Template pattern <x> where x can be 1-9.
data type	type of data used to generate the time series	P - provisional PB - provisional best PC - combined provisional & validated R_PF - received provisional flood V - validated D - derived
quality	Optional indicator of quality.	B - best available Std_QaQC - automated quality assurance/control checks applied Std - standardised
instance	Instance or sensor number	Usually 1
accumulation type	Period of aggregation, method used to define period	Hourly, HourlyMean, DailyMin, DailyMax, DailyMean, DailyMean09, DailyMean24, DailyTot24, MonthlyMean, MonthlyTot24, YearlyMean, YearlyTot24
product	Optional Bureau product identifier.	PR01 - Streamflow Forecasts PR02 - Water Storages website

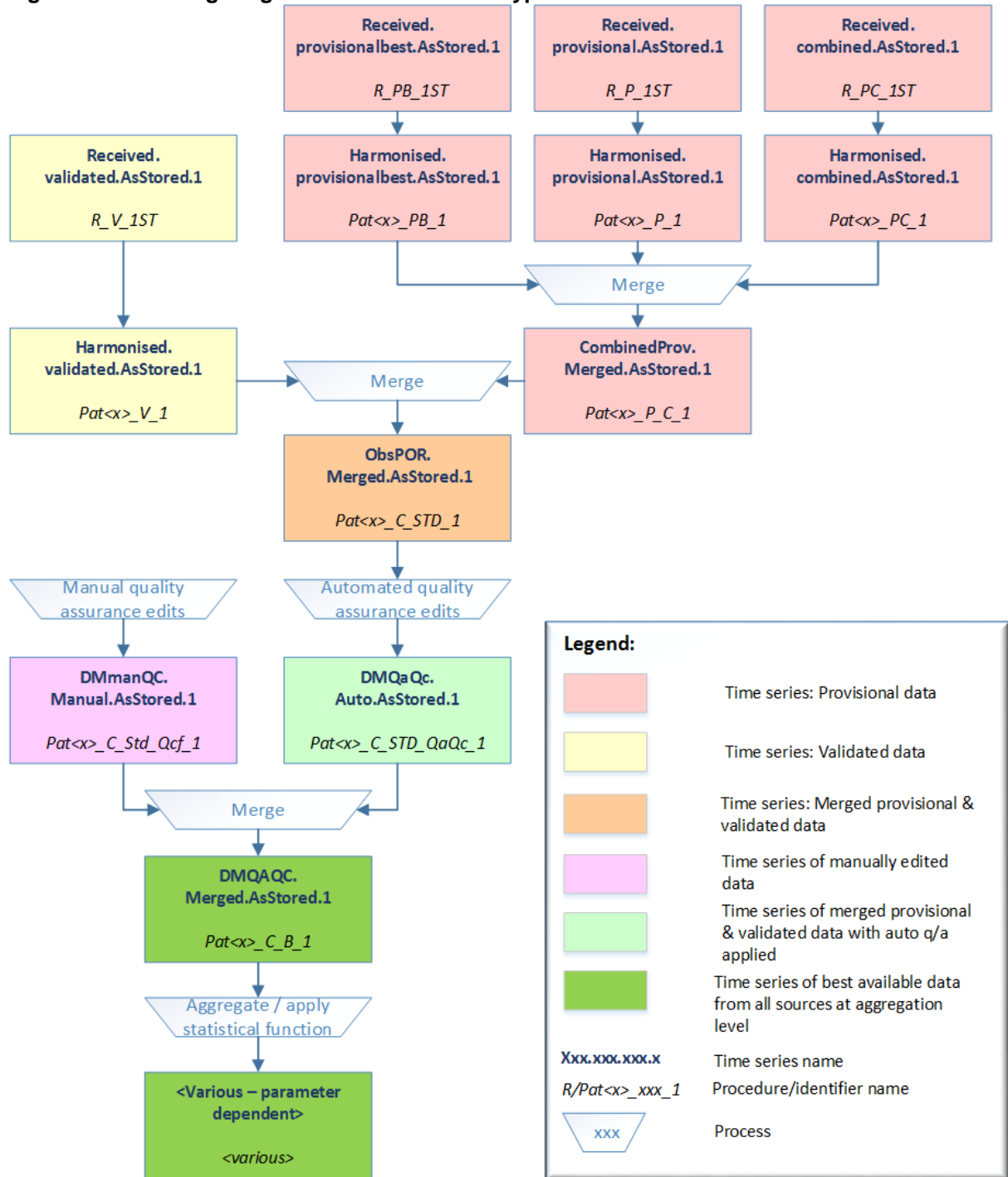
6.2.3 Time series types generated for all parameters

Data can be received from multiple sensors for the same parameter at the same station. Providers later validate and check time series data. Processing is required to 'harmonize' multiple instances of a time series into one that is best to use. There are a standard set of processing rules used to cater for these features of time series data received by the Bureau. These rules are implemented in all the templates used to generate sets of time series (patterns) for each parameter. At a high level, the rules are:

- Multiple instances of the same time series (e.g. from multiple sensors) are 'harmonised' into a single time series. Instance numbers are prioritised, those with a lower value have a higher priority. If data for a point in time is present for a higher priority instance/sensor, the data for that time in other time series instances is not used.
- The best available data is used when merging provisional, provisional best and validated time series:
 - Validated data is used in preference to 'provisional best'
 - 'Provisional best' in preference to 'provisional'.

Figure 3 illustrates how time series data received from the provider is processed to generate time series that are standard across all parameters in WISKI. The aggregated time series at the bottom of the diagram vary according to parameter.

Figure 3 Processing Diagram - All Time Series Types



The time series types that are standard for all parameters are listed in Table 12. The '<x>' in the procedure/identifier varies according to parameter. It is a number identifying the 'pattern', or template that is used to generate the time series. Patterns and the parameter(s) they apply to are listed in Table 10. The background colour in Table 12 indicates whether the time series should be used:

- **green** - Recommended
- **yellow** - Can be used, but one of the following apply:
 - there is a better time series type to use in terms of coverage
 - the time series contains only provisional or derived data.
- **red** - NOT appropriate use

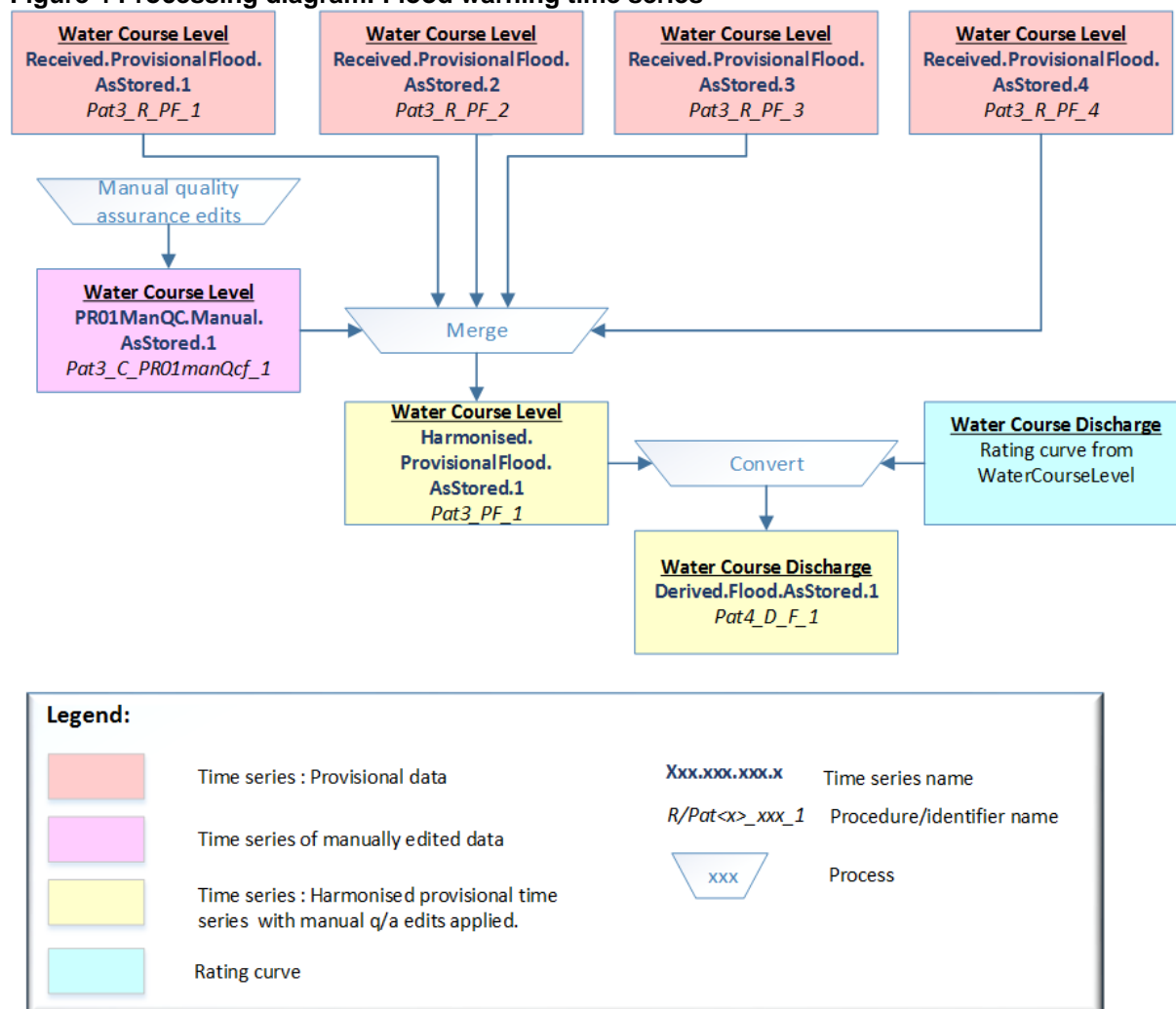
Table 12 Time series types available for all parameters

Time series name	Procedure / identifier	Time series description	For non-Bureau use
Received. Provisional.AsStored.1	R_P_1ST	Raw/unedited data, as received from the agency.	No
Received. Provisionalbest.AsStored.1	R_PB_1ST	Raw data with minor automated editing done by agency, as received.	No
Received. Combined.AsStored.1	R_PC_1ST	Combination of Validated and ProvisionalBest values, as received.	No
Received. Validated.AsStored.1	R_V_1ST	Inspected and validated by the agency, as received.	Yes
Harmonised. Provisional.AsStored.1	Pat<x>_P_1	Combine multiple instances to make one series.	No
Harmonised. Provisionalbest.AsStored.1	Pat<x>_PB_1	Combine multiple instances to make one series.	No
Harmonised. Combined.AsStored.1	Pat<x>_PC_1	Combine multiple instances to make one series.	No
CombinedProv. Merged.AsStored.1	Pat<x>_P_C_1	To merge all the provisional data. Combined, Provisional best and Provisional data.	No
Harmonised. Validated.AsStored.1	Pat<x>_V_1	Combine multiple instances to make one series.	No
ObsPOR. Merged.AsStored.1	Pat<x>_C_STD_1	The complete period of record data as observed by the provider. This is created by merging the Validated and Provisional data to make one series.	No
DMQaQc. Auto.AsStored.1	Pat<x>_C_Std_QaQc_1	Copy of ObsPOR.Merged.AsStored.1 with automated quality checks applied by BoM i.e. identify spikes and change quality code and add a standard comment against data point in Wiski.	No
DMmanQC. Manual.AsStored.1	Pat<x>_C_Std_Qcf_1 Pat<4>_C_Std_DMmanQcf_1 Pat<7>_C_Std_DMmanQcf_1	Manual quality edits applied by the BoM. These edits will be applied to DMQaQc.Auto.AsStored.1 to form DMQaQc.Merged.AsStored.1.	No
DMQaQc. Merged.AsStored.1	Pat<x>_C_B_1	Validated and provisional data merged, plus auto and manual quality edits applied. Temporal aggregation is as received from agency. <i>This is the time series used by the Water Data Online - Time Series Explorer for periods up to 1 year.</i>	Yes

6.2.4 Flood warning time series

The common time series types in the previous section contain data sourced from external organisations under the Water Regulations 2008. WISKI also stores time series sourced from a selection of Bureau flood warning stations. Each flood warning station can have up to four sensors to measure Water Course Level. WISKI merges the time series from all the sensors and applies manual edits performed by Bureau analysts to form a single 'harmonised' time series of Water Course Level data. A rating curve is used to derive a Water Course Discharge time series from the harmonised Water Course Level – see Figure 4:

Figure 4 Processing diagram: Flood warning time series



Flood warning time series available are listed in Table 13 and Table 14.

Note that one or more rating curves must be present for the station to perform the level/discharge conversion to create the flood warning Water Course Discharge time series. Currently the rating curves are sourced from external organisations.

Table 13 Flood warning time Series (Watercourse Level)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
Received. ProvisionalFlood.AsStored.1	Pat3_R_Pf_1	Raw/unedited data, as received from the Bureau's flood warning station sensor #1.	No
Received. ProvisionalFlood.AsStored.2	Pat3_R_Pf_2	Raw/unedited data, as received from the Bureau's flood warning station sensor #2.	No
Received. ProvisionalFlood.AsStored.3	Pat3_R_Pf_3	Raw/unedited data, as received from the Bureau's flood warning station sensor #3.	No
Received. ProvisionalFlood.AsStored.4	Pat3_R_Pf_4	Raw/unedited data, as received from the Bureau's flood warning station sensor #4.	No
PR01ManQC.Manual. AsStored.1	Pat3_C_PR01manQcf_1	Manual edits applied to / merged with Received.ProvisionalFlood.AsStored time series to create Harmonised.ProvisionalFlood.AsStored.1	No
Harmonised. ProvisionalFlood.AsStored.1	Pat3_Pf_1	A combination of the 5 time series above. Highest priority is given to the manual edit time series then instance number 1, 2, 3 and 4 in that order. <i>This is the source time series for the watercourse discharge 'Derived.Flood.AsStored.1' time series.</i>	Yes

Table 14 Flood warning time series (Watercourse Discharge)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
Derived. Flood.AsStored.1	Pat4_D_F_1	Time-series derived from the Water Course Level – Flood time-series (Harmonised.ProvisionalFlood.AsStored.1) using the ratings supplied by the agency.	Yes

6.2.5 Standardised time series – not used

Standardised time series types were setup to allow adjustment of received data to a common datum. These been created for the Groundwater level parameter, but no processing of received data is currently performed.

Table 15 Standardised time series – Groundwater Level

Time series name	Procedure / identifier	Time series description	For non-Bureau use
Standard. Provisional.AsStored.1	Pat9_P_Std_1	Placeholder time series – to standardise provisional data received from the agency to a level datum.	No
Standard. Validated.AsStored.1	Pat9_V_Std_1	Placeholder time series – to standardise validated data received from the agency to a level datum.	No

6.2.6 Aggregated time series types - specific parameters

The set of aggregated time series varies according to parameter. For example, the appropriate daily aggregation for rainfall is a total, where for watercourse level this would not make sense – a mean is used. Some parameters, such as Rainfall and Evaporation require

the same types of aggregated time series. There are no aggregated time series for Wind Direction – aggregation can only be represented as a wind rose.

The following types of rules are applied when processing aggregations:

- For data aggregated for a time period, a large proportion of the period must be covered before a value is calculated. For example, 90% of the day must be covered by continuous data observations before a daily mean value is calculated.
- Daily aggregations are usually performed from midnight to midnight. There are exceptions for some parameters, where they are aggregated from 9am to 9am.

The aggregated time series available as a standard for all stations, designed for general use are listed in Table 16 to Table 20.

Note: There are other aggregated time series designed for specific data products, which are not necessarily populated for all stations. Such product specific time series are listed in section 6.2.7.

The time series types that are

- **green** - Recommended
- **yellow** - Can be used, but one of the following apply:
 - there is a better time series type to use in terms of coverage
 - the time series contains only provisional or derived data.
- **red** - NOT appropriate

For many parameters, data is aggregated to daily, monthly and yearly means, and daily minimum and maximum time series are also generated. The time series listed in Table 16, are generated by pattern 1 and 9 templates for Dry air temperature, Relative Humidity, Wind Speed, Electrical conductivity at 25C, Turbidity, Water pH and Water Temperature (pattern 1) and Groundwater Level (pattern 9) parameters.

Table 16 Pattern 1 and 9 Aggregated time series (several parameters)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
DMQaQc. Merged.DailyMean.24HR	Pat1_C_B_1_DailyMean Pat9_C_B_1_DailyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to daily means, reported from midnight to midnight.	Yes
DMQaQc. Merged.DailyMax.24HR	Pat1_C_B_1_DailyMax Pat9_C_B_1_DailyMax	Maximum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.DailyMin.24HR	Pat1_C_B_1_DailyMin Pat9_C_B_1_DailyMin	Minimum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.MonthlyMean. CalMonth	Pat1_C_B_1_MonthlyMean Pat9_C_B_1_MonthlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to monthly means.	Yes
DMQaQc. Merged.YearlyMean. CalYear	Pat1_C_B_1_YearlyMean Pat9_C_B_1_YearlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to yearly means.	Yes

For Rainfall and Evaporation, data is aggregated to totals rather than means. The pattern 2 template generates this set of time series types – see Table 17:

Table 17 Pattern 2 Aggregated time series (Rainfall and Evaporation)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
DMQaQc. Merged.DailyTotal.09HR	Pat2_C_B_1_DailyTot09	DMQaQc.Merged.AsStored.1 time-series aggregated to daily totals, reported from 9am to 9am.	Yes
DMQaQc. Merged.DailyTotal.24HR	Pat2_C_B_1_DailyTot24	DMQaQc.Merged.AsStored.1 time-series aggregated to daily totals, reported from midnight to midnight.	Yes
DMQaQc. Merged.MonthlyTotal. CalMonth	Pat2_C_B_1_MonthlyTot24	DMQaQc.Merged.AsStored.1 time-series aggregated to monthly totals.	Yes
DMQaQc. Merged.YearlyTotal. CalYear	Pat2_C_B_1_YearlyTot24	DMQaQc.Merged.AsStored.1 time-series aggregated to yearly totals.	Yes

The same basic set of aggregations are provided for Watercourse Level as most parameters, additionally an hourly mean aggregation is provided. Table 18 provides a list of aggregated time series generated by template pattern 3 for Watercourse Level:

Table 18 Pattern 3 Aggregated time series (Watercourse Level)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
DMQaQc. Merged.HourlyMean.HR	Pat3_C_B_1_HourlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to hourly means.	Yes
DMQaQc. Merged.DailyMean.24HR	Pat3_C_B_1_DailyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to daily means, reported from midnight to midnight.	Yes
DMQaQc. Merged.DailyMax.24HR	Pat3_C_B_1_DailyMax	Maximum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.DailyMin.24HR	Pat3_C_B_1_DailyMin	Minimum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.MonthlyMean. CalMonth	Pat3_C_B_1_MonthlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to monthly means.	Yes
DMQaQc. Merged.YearlyMean. CalYear	Pat3_C_B_1_YearlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to yearly means.	Yes

Watercourse Discharge time series differ from Watercourse Level in that an additional time series is provided that accumulates daily data from 9am to 9am (rather than midnight to midnight). Table 19 provides a list of aggregated time series generated by template pattern 4 for Watercourse Discharge:

Table 19 Pattern 4 Aggregated Time Series (Watercourse Discharge)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
DMQaQc. Merged.HourlyMean.HR	Pat4_C_B_1_HourlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to hourly means.	Yes
DMQaQc. Merged.DailyMean.09HR	Pat4_C_B_1_DailyMean09	DMQaQc.Merged.AsStored.1 time-series aggregated to daily means, reported from 9am to 9am.	Yes
DMQaQc. Merged.DailyMax.24HR	Pat4_C_B_1_DailyMax	Maximum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.DailyMin.24HR	Pat4_C_B_1_DailyMin	Minimum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.DailyMean.24HR	Pat4_C_B_1_DailyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to daily means, reported from midnight to midnight.	Yes
DMQaQc. Merged.MonthlyMean. CalMonth	Pat4_C_B_1_MonthlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to monthly means.	Yes
DMQaQc. Merged.YearlyMean. CalYear	Pat4_C_B_1_YearlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to yearly means.	Yes

Table 20 Patterns 6 and 7 Aggregated time series (Storage Level, Storage Volume)

Time series name	Procedure / identifier	Time series description	For non-Bureau use
DMQaQc. Merged.HourlyMean.HR	Pat6_C_B_1_HourlyMean Pat7_C_B_1_HourlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to hourly means.	Yes
DMQaQc. Merged.DailyMean.24HR	Pat6_C_B_1_DailyMean Pat7_C_B_1_DailyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to daily means, reported from midnight to midnight.	Yes
DMQaQc. Merged.DailyMax.24HR	Pat6_C_B_1_DailyMax Pat7_C_B_1_DailyMax	Maximum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.DailyMin.24HR	Pat6_C_B_1_DailyMin Pat7_C_B_1_DailyMin	Minimum of values in the DMQaQc.Merged.AsStored.1 time-series - from midnight to midnight.	Yes
DMQaQc. Merged.MonthlyMean. CalMonth	Pat6_C_B_1_MonthlyMean Pat7_C_B_1_MonthlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to monthly means.	Yes
DMQaQc. Merged.YearlyMean. CalYear	Pat6_C_B_1_YearlyMean Pat7_C_B_1_YearlyMean	DMQaQc.Merged.AsStored.1 time-series aggregated to yearly means.	Yes

6.2.7 Product time series

Some specialised time series types have been developed to support specific Bureau water information products:

- Watercourse discharge time series have been designed to meet the needs of streamflow forecasting.
- Storage level and Storage volume time series have been designed to support the Water Storages website.

6.2.7.1 Streamflow forecast products

Streamflow forecast time series are generated from a combination of historic data collected under the Water Regulations 2008, and for many stations, data from the Bureau's flood warning system. Flood warning data is only used in the absence of Water Regulations data.

Figure 5 Processing diagram: Streamflow forecast time series

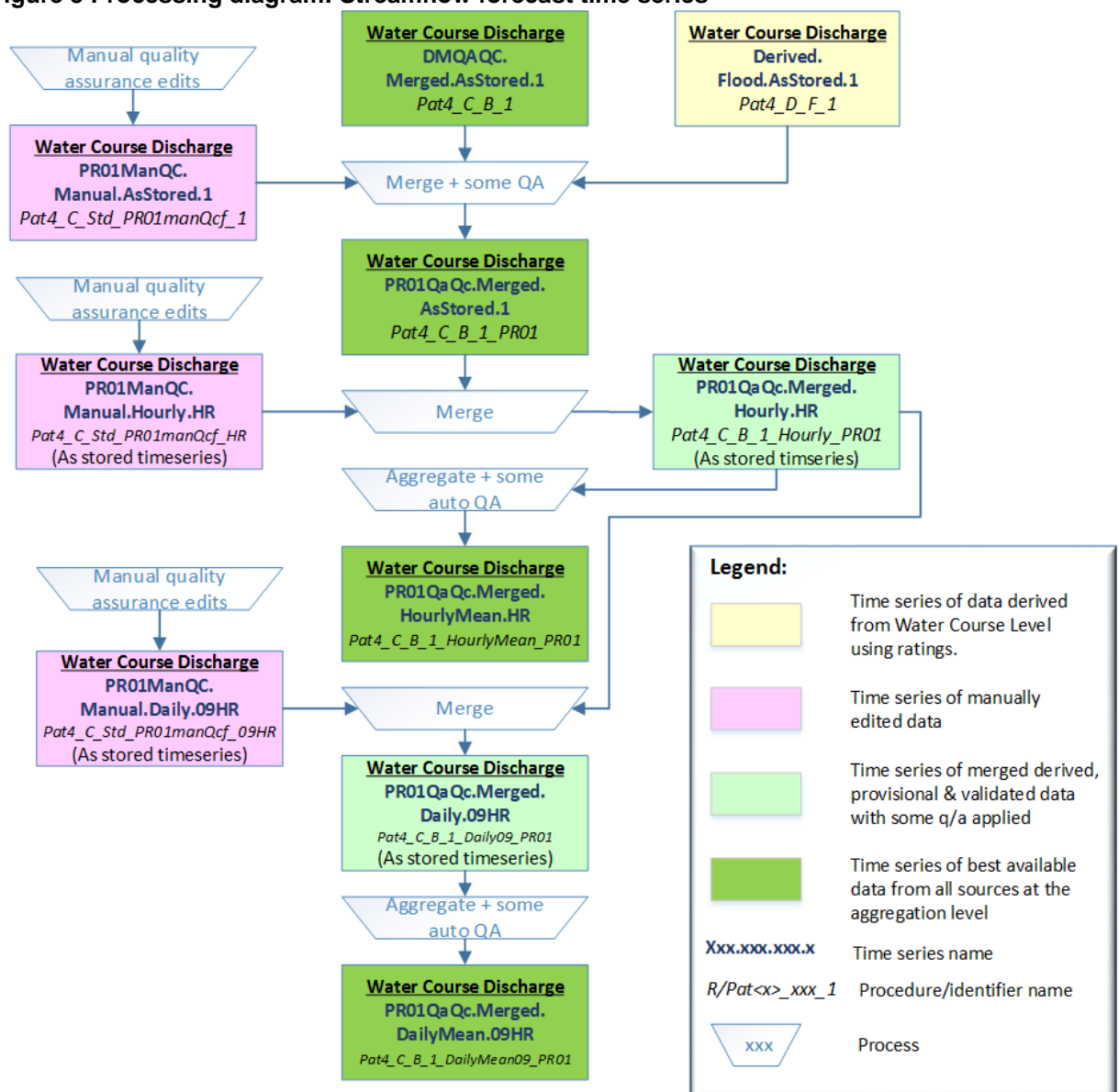


Table 21 provides a list of specialised time series used to provide historic data for streamflow forecasting. The PR01QaQc.Merged.HourlyMean.HR time series is used for the [7 day streamflow forecast](#), and the PR01QaQc. Merged.DailyMean.09HR time series is used for the [3 month seasonal streamflow forecast](#).

Table 21 Streamflow forecast product time series – Watercourse Discharge

Time series name	Procedure / identifier	Time series description	For non-Bureau use
Derived. Merged.AsStored.1	Pat4_D_1	Time-series derived from the Water Course Level DMQaQc.Merged.AsStored.1 time-series using the ratings supplied by the agency.	Yes
Derived. Flood.AsStored.1	Pat4_D_F_1	Time-series derived from the Water Course Level – Flood time-series Harmonised. ProvisionalFlood.AsStored.1 using the ratings supplied by the agency.	Yes
PR01ManQc. Manual.AsStored.1	Pat4_C_Std_PR01ManQcf_1	Manual quality edits applied to/ merged with DMQaQc.Merged.AsStored.1 and Derived.Flood.AsStored.1 to generate PR01QaQc.Merged.AsStored.1.	No
PR01QaQc. Merged.AsStored.1	Pat4_C_B_1_PR01	A merger of manual edit, agency and flood warning system data (PR01ManQc.Manual.AsStored.1, DMQaQc.Merged.AsStored.1, Derived.Flood.AsStored.1). Flood warning data is appended to the end of agency data. Automatic corrections are applied to delete negative values. Temporal interval is as received/ entered.	Yes
PR01ManQc. Manual.Hourly.HR	Pat4_C_Std_PR01ManQcf_HR	Manual quality edits applied to PR01QaQc.Merged.AsStored to generate PR01QaQc.Merged.HourlyMean.HR.	No
PR01QaQc. Merged.Hourly.HR	Pat4_C_B_1_Hourly_PR01	Actually an 'as stored' time series' that is a merger of PR01QaQc. Merged.AsStored.1 and PR01ManQc.Manual.Hourly.HR.	No
PR01QaQc. Merged.HourlyMean.HR	Pat4_C_B_1_HourlyMean_PR01	An hourly mean time series created by accumulating PR01QaQc.Merged.Hourly.HR. Must have data coverage for 90% of the hour (54 mins) for an hourly mean value to be calculated. Otherwise a gap will exist.	Yes
PR01ManQc. Manual.Daily.09HR	Pat4_C_Std_PR01ManQcf_09hr	Manual quality edits applied to PR01QaQc.Merged.Hourly.HR to generate PR01QaQc.Merged.Daily.09HR	No
PR01QaQc. Merged.Daily.09HR	Pat4_C_B_1_Daily09_PR01	Actually an 'as stored' time series that is a merger of PR01QaQc.Merged.Hourly.HR with PR01ManQc. Manual.Daily.09HR	No
PR01QaQc. Merged.DailyMean.09HR	Pat4_C_B_1_DailyMean09_PR01	A daily mean time series created by aggregating PR01QaQc.Merged.Daily.09HR. Must have data coverage for 90% of the day (21.6 hours) for a daily mean value to be calculated. Otherwise a gap will exist.	Yes

6.2.7.2 Water storages product

Storage Volume is usually (but not always) supplied by data providers as a total volume. Sometimes a data provider will supply Storage Level time series data and a capacity table, but no Storage Volume time series. In such cases, a Storage Volume time series is derived from the Storage Level.

Dead Storage is the volume in a storage that cannot be released. This volume is subtracted (where applicable) from Storage Volume time series values to produce an Accessible Storage Volume time series. Both Storage Volume and Accessible Storage Volume continuous 'as stored' time series are aggregated to daily mean values. The Daily Mean Accessible Storage Volume time series is used for the [Water Storages website](#).

Figure 6 Processing diagram: Water Storages product time series – Storage Volume

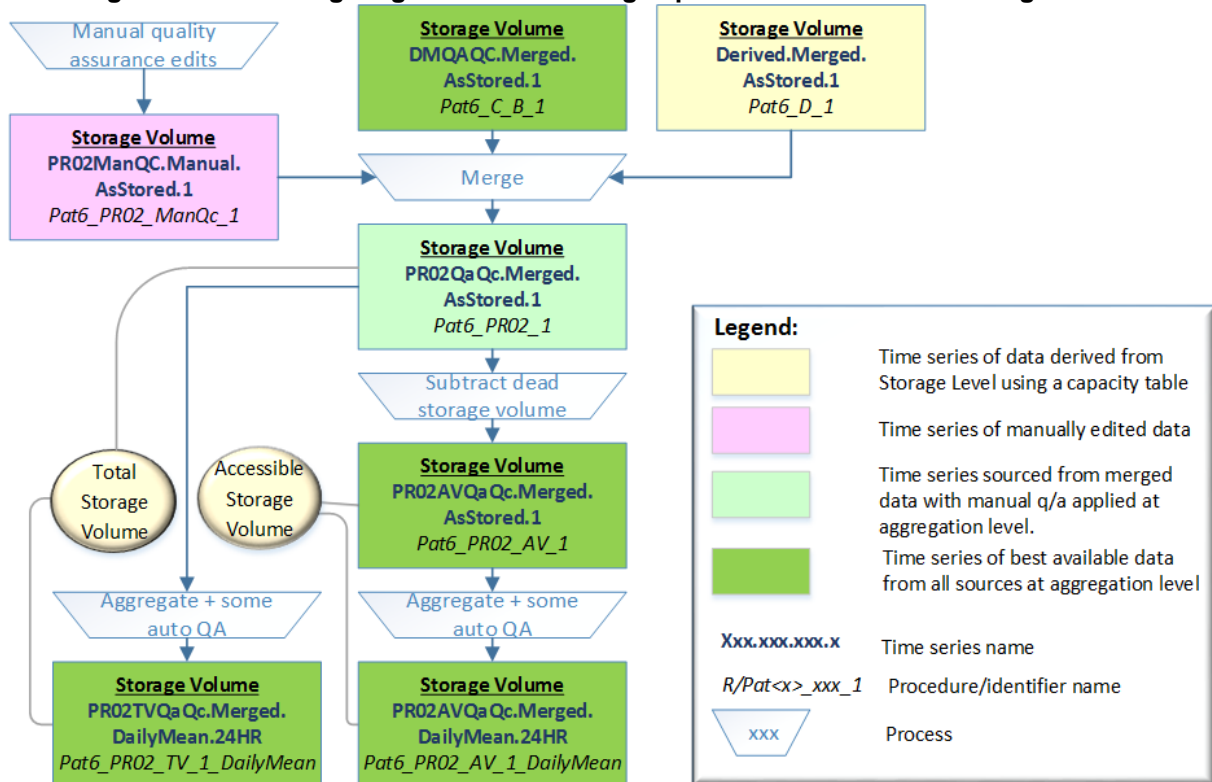


Table 22 Water Storages product time series – Storage Volume

Time series name	Procedure / identifier	Time series description	For non-Bureau use
PR02ManQC. Manual.AsStored.1	Pat6_PR02_ManQc_1	Manual edits applied to either agency data in DMQaQc.Merged.AsStored.1 (if it exists) or derived data in Derived.Merged.AsStored.1 to generate PR02QaQc.Merged.AsStored.1.	No
Derived. Merged.AsStored.1	Pat6_D_1	Time-series derived from the Storage Level DMQaQc.Merged.AsStored.1 time-series using the ratings supplied by the agency.	Yes
PR02QaQc.Merged.AsStored.1	Pat6_PR02_1	A merger of manual edit, agency supplied and derived data (PR02ManQC.Manual.AsStored.1, DMQaQc.Merged.AsStored.1, (Derived.Merged.AsStored.1). Merger priority from highest to lowest: 1. Manual edits 2. Agency supplied data 3. Derived data Automatic corrections are applied to fill gaps less than 1 year in length with a linear interpolation. A rate of change validation is also applied which checks the previous days value to ensure it hasn't changed by more than 20%.	Yes
PR02AVQaQc. Merged.AsStored.1	Pat6_PR02_AV_1	Accessible volume time series - a copy of PR02QaQc.Merged.AsStored.1 with the dead storage volume subtracted from the data.	Yes
PR02AVQaQc. Merged.DailyMean.24HR	Pat6_PR02_AV_1_DailyMean	Daily mean accessible volume time series created from PR02AVQaQc.Merged.AsStored.1	Yes
PR02TVQaQc. Merged.DailyMean.24HR	Pat6_PR02_TV_1_DailyMean	Daily mean total volume time series created from PR02QaQc.Merged.AsStored.1	Yes

Storage levels may be supplied by data providers in a local reference system or Australian Height Datum (AHD). Where a local system is used, the time series values are standardised to AHD by subtracting the local system's AHD offset. The continuous 'as stored' Storage Level AHD time series is then aggregated to daily mean values to produce the AHD Storage Level time series used for the Water Storage product.

Figure 7 Processing diagram: Water Storages product time series - Storage Level

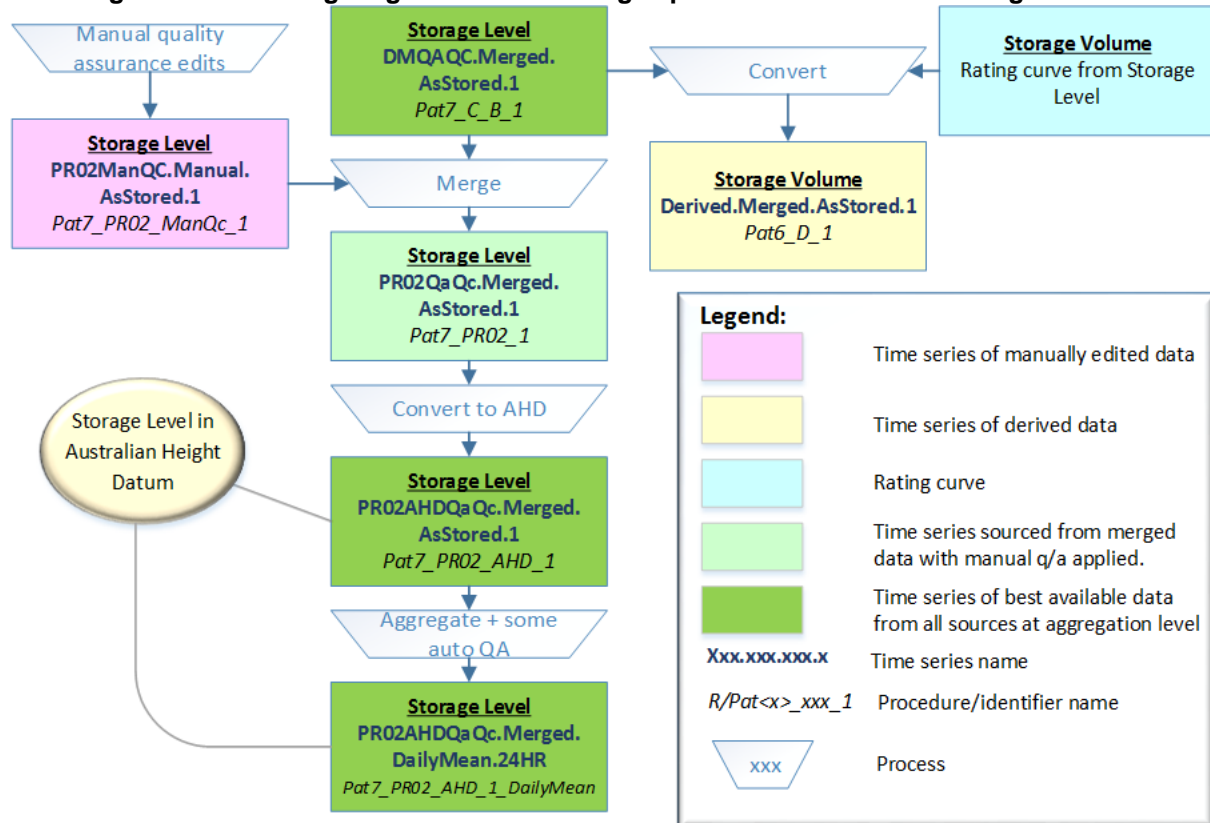


Table 23 Water Storages product time series – Storage Level

Time series name	Procedure / identifier	Time series description	For non-Bureau use
PR02ManQC.Manual.AsStored.1	Pat7_PR02_ManQc_1	Manual edits applied to generate PR02QaQc.Merged.AsStored.1.	No
PR02QaQc.Merged.AsStored.1	Pat7_PR02_1	A merger of manual edit (PR02ManQC.Manual.AsStored.1) and agency data (DMQAQC.Merged.AsStored.1). Manual edits have priority over agency data in the merger. Automatic corrections are applied to fill all gaps less than 1 year in length with a linear interpolation. A rate of change validation is also applied which checks the previous days value to ensure it hasn't changed by more than 20%. This time series is the source for PR02AHDQaQc.Merged.AsStored.1.	Yes
PR02AHDQaQc.Merged.AsStored.1	Pat7_PR02_AHD_1	Storage level adjusted to Australian Height Datum (AHD): created by applying the AHD offset to data in PR02QaQc.Merged.AsStored.1	Yes
PR02AHDQaQc.Merged.DailyMean.24HR	Pat7_PR02_AHD_1_DailyMean	Daily mean storage level adjusted to Australian Height Datum (AHD): created by accumulating PR02AHDQaQc.Merged.AsStored.1	Yes

6.2.8 Recommended time series list

The following time series types contain the best available data at each aggregation level. Note that the time series with 'PR' at the start of the name are used in Bureau products, and so may have manual edits applied by Bureau specialists. In the case of Watercourse Discharge, the 'PR' time series may include data from Bureau flood warning stations.

Table 24 Recommended time series types

Parameter(s)	Aggregation	Time series name	Procedure / identifier
All	As Stored	DMQaQc.Merged.AsStored.1	Pat<x>_C_B_1
Dry air temperature, Relative Humidity, Wind Speed, Electrical conductivity at 25C, Turbidity, Water pH, Water Temperature, Groundwater Level, Watercourse Level, Watercourse Discharge (See Table 10 for pattern number to use for <x> in procedure/identifier)	Daily Mean (12-12)	DMQaQc.Merged.DailyMean.24HR	Pat<x>_C_B_1_DailyMean
	Daily Max (12-12)	DMQaQc.Merged.DailyMax.24HR	Pat<x>_C_B_1_DailyMax
	Daily Min (12-12)	DMQaQc.Merged.DailyMin.24HR	Pat<x>_C_B_1_DailyMin
	Monthly Mean	DMQaQc.Merged.MonthlyMean.CalMonth	Pat<x>_C_B_1_MonthlyMean
	Yearly Mean	DMQaQc.Merged.YearlyMean.CalYear	Pat<x>_C_B_1_YearlyMean
Rainfall, Evaporation	Daily Total (9-9)	DMQaQc.Merged.DailyTotal.09HR	Pat2_C_B_1_DailyTot09
	Daily Total (12-12)	DMQaQc.Merged.DailyTotal.24HR	Pat2_C_B_1_DailyTot24
	Monthly Total	DMQaQc.Merged.MonthlyTotal.CalMonth	Pat2_C_B_1_MonthlyTot24
	Yearly Total	DMQaQc.Merged.YearlyTotal.CalYear	Pat2_C_B_1_YearlyTot24
Watercourse Level, Storage Level, Storage Volume	Hourly Mean	DMQaQc.Merged.HourlyMean.HR	Pat<x>_C_B_1_HourlyMean
Watercourse Discharge	Daily Mean (9-9)	DMQaQc.Merged.DailyMean.09HR	Pat4_C_B_1_DailyMean09
	As Stored	PR01QaQc.Merged.AsStored.1	Pat4_C_B_1_PR01
	Hourly Mean	PR01QaQc.Merged.HourlyMean.HR	Pat4_C_B_1_HourlyMean_PR01
	Daily Mean (9-9)	PR01QaQc.Merged.DailyMean.09HR	Pat4_C_B_1_DailyMean09_PR01
Storage Volume	As Stored	PR02QaQc.Merged.AsStored.1	Pat6_PR02_1
Accessible Storage Volume	As Stored	PR02AVQaQc.Merged.AsStored.1	Pat6_PR02_AV_1
	Daily Mean (12-12)	PR02AVQaQc.Merged.DailyMean.24HR	Pat6_PR02_AV_1_DailyMean
Total Storage Volume	Daily Mean (12-12)	PR02TVQaQc.Merged.DailyMean.24HR	Pat6_PR02_TV_1_DailyMean
Storage Level	As Stored	PR02QaQc.Merged.AsStored.1	Pat7_PR02_1
Storage Level - AHD	As Stored	PR02AHDQaQc. Merged.AsStored.1	Pat7_PR02_AHD_1
	Daily Mean (12-12)	PR02AHDQaQc. Merged.DailyMean.24HR	Pat7_PR02_AHD_1_DailyMean

6.3 Observation metadata

6.3.1 Units of measure

Table 27 lists the default unit of measure used for each type of parameter, and the code SOS2 returns for the unit.

Table 25 Default units of measure for each parameter

Parameter	Default unit of measure	Abbreviation	SOS2 Unit
WaterCourseLevel	Metres	m	M
WaterCourseDischarge	Cubic metres/second	m ³ /s	CUMC
GroundWaterLevel	Metres	m	KM
GroundWaterPressure	KiloPascal	Kpa	KM
StorageLevel	Metres	m	M
StorageVolume	Megalitres	ML	ML
StorageOutflow*	Megalitres/day	ML/d	ML
StorageInflow*	Megalitres/day	ML/d	ML
StorageInflowFromEachSource*	Megalitres/day	ML/d	ML
Rainfall	Millimetres	mm	MM
WindSpeed	Metres/second	m/s	MS
WindDirection	Degrees	deg	DEG
WindRun	Metres/second	m/s	KM
Evaporation	Millimetres	mm	MM
DryAirTemperature	Degrees Celsius	Cel	DEGC
WetAirTemperature	Degrees Celsius	Cel	DEGC
RelativeHumidity	Percentage	%	PERC
ElectricalConductivityAt25C	MicroSiemens/cm	uS/cm	MISC
GWElectricalConductivityAt25C	MicroSiemens/cm	uS/cm	MISC
SuspendedSolids	Milligrams/litre	mg/L	MGL
Turbidity	Nephelometric Turbidity Unit	[NTU]	NTU
TotalPhosphorus	Milligrams/litre	mg/L	MGL
NitrogenConcentration	Milligrams/litre	mg/L	MGL
WaterpH	pH	[pH]	SCAL
WaterTemperature	Degrees Celsius	Cel	DEGC

*These parameters are planned, but not yet available at time of writing.

6.3.2 Interpolation types

Table 26 lists interpolation types used in the Bureau's water data time series.

Table 26 Interpolation types

Code	Name	Description / usage
101	Continuous data points - No interpolation	Spot samples, irregular sparse readings (such as groundwater readings or staff gauge readings). There is no expression possible between 2 values.
102	Continuous data points - Linear interpolation	Instantaneously recorded, continuous time series data.
103	Continuous data points - Constant until next time stamp	Mean value or constant instantaneous value. Examples for means are water level, flow recorded as mean values and examples for constant instantaneous values are pump rates and gate settings.
104	Continuous data points - Constant since previous time stamp	Mean value related to the end of interval.
201	Continuous totals - No interpolation	Tipping buckets, between two tips a zero-total is returned.
202	Continuous totals - Linear interpolation	Instantaneously recorded continuous time series data.
205	Continuous totals - Linear until next time stamp	A total value that is stored at the beginning of the totalling interval. The total itself is assumed to grow linear until the next value.
206	Continuous totals - Linear since previous time stamp	A total value that is stored at the end of the totalling interval. The total itself is assumed to grow linear since the previous value
301	Continuous Directional Values - No interpolation	Spot samples of directions (such as wind direction).
302	Continuous Directional Values - Linear interpolation	Direction measurements with linear interpolation. The value type "directional" expresses the wrap at 360 degrees.
303	Continuous Directional Values - Constant until next time stamp	Constant direction until next time stamp of direction measurement (such as gate setting).
304	Continuous Directional Values - Constant since previous time stamp	Constant direction since previous time stamp of direction measurement (such as gate setting).
403	Aggregated Minimum - Constant until next time stamp	The minimum is representative for the observation interval. The interval main time stamp is equidistant and is stored at the beginning of the interval.
404	Aggregated Minimum - Constant since previous time stamp	The minimum is representative for the observation interval. The interval main time stamp is equidistant and is stored at the end of the interval.
503	Aggregated Maximum - Constant until next time stamp	The maximum is representative for the observation interval. The interval main time stamp is equidistant and is stored at the beginning of the interval.
504	Aggregated Maximum - Constant since previous time stamp	The maximum is representative for the observation interval. The interval main time stamp is equidistant and is stored at the end of the interval.
603	Aggregated Means - Constant until next time stamp	The interval main time stamp is stored at the beginning of the interval. The mean is representative until the next time stamp.
604	Aggregated Means - Constant since previous time stamp	The interval main time stamp is stored at the end of the interval. The mean is representative since the previous time stamp.
703	Aggregated Totals - Constant until next time stamp	The interval main time stamp is stored at the beginning of the interval. The total is representative until the next time stamp.
704	Aggregated Totals - Constant since previous time stamp	The interval main time stamp is stored at the end of the interval. The total is representative since the previous time stamp.

6.3.3 Quality codes

Table 27 lists SOS2 qualifiers that represent quality codes in the Bureau's water data time series.

Table 27 Quality codes (SOS2 Qualifier)

SOS2 Qualifier	Quality code	Description
10	A	The record set is the best available given the technologies, techniques and monitoring objectives at the time of classification.
90	B	The record set is compromised in its ability to truly represent the parameter.
110	C	The record set is an estimate.
140	E	The record set's ability to truly represent the monitored parameter is not known.
210	F	The record set is not of release quality or contains missing data.

7 References

KISTERS, June 2013, A Hydrology Profile For The SOS. Available from <http://slideplayer.com/slide/8285647/> [9/1/2017]

Open Geospatial Consortium Inc, 20 October 2014, OGC Sensor Observation Service 2.0 Hydrology Profile, OGC 14-004r1 version 1.0. Available from <http://www.opengeospatial.org/standards/sos> [9/1/2017]