NSW GOVERNMENT | Public Works
Manly Hydraulics Laboratory

NSW ESTUARY AND RIVER WATER QUALITY ANNUAL SUMMARY 2014–2015

Report MHL2387
October 2015

prepared for
NSW Office of Environment and Heritage

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NSW Estuary and River Water Quality Annual Summary
2014–2015

Report MHL2387
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Sarah-Kate Dakin
110b King Street
Manly Vale NSW 2093
T: 02 9949 0200
F: 02 9948 6185
E: sarah-kate.dakin@mhl.nsw.gov.au
W: www.mhl.nsw.gov.au

Cover photograph: Kempsey, Macleay River, September 2014

Document Control

Issue/ Revision	Author	Reviewer	Approved for Issue	
			Name	Date
Draft	Melody Wu, MHL	Sarah-Kate Dakin, MHL Martin Fitzhenry, OEH		
Final	Melody Wu, MHL		Adam Joyner, MHL	26/10/2015

Report No. MHL2387
ISSN: 2205-5606 (Print)
ISSN: 2205-5614 (Online)
MHL File No. EDP8-2172
First published October 2015

Manly Hydraulics Laboratory is Quality System Certified to AS/NZS ISO 9001:2008

Foreword

Manly Hydraulics Laboratory (MHL) is a business group within NSW Public Works, a division of the Department of Finance, Services and Innovation. The NSW water quality database has been developed by MHL to support a number of programs associated with coastal, floodplain and estuary management for the NSW Office of Environment and Heritage (OEH), NSW Department of Primary Industries Water (DPI Water) and Wollongong City Council (WCC).

This summary presents an overview of water quality measurements captured by the automatic recording stations along the coastal estuaries and rivers of New South Wales, from 1 July 2014 to 30 June 2015. MHL maintains the automatic recording stations and catalogues the data collected. During the 2014–2015 monitoring period the overall data recovery rate was 98.0%.

The summary provides information on how to access the data and additional data output types that are available on request.

Requests for further information should be directed to:

Manager Environmental Data	email	:	data-request@mhl.nsw.gov.au
Manly Hydraulics Laboratory	WWW	:	http://mhl.nsw.gov.au/
110B King Street	Telephone	:	(02) 9949 0200
MANLY VALE NSW 2093	Facsimile	:	(02) 9948 6185

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Report No. MHL2383
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NSW Wave Climate and Coastal Air Pressure
Annual 2014–2015
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ISSN: 2205-5592 (Online)

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Summary

This report contains:

- a brief description of the water quality programs
- guidelines on how to use this report
- information on how to access the database
- significant developments which occurred in 2014–2015
- the data summaries and station location maps for each station
- Appendix A, which details the data available online
- Appendix B, which shows data output formats available at MHL
- Appendix C, a list of other publications which may be of interest.

Contents

1. Water Quality Monitoring Program

This report presents a summary of the water quality data currently collected by Manly Hydraulics Laboratory (MHL). The network of automatic recorders and the associated analysis routines enable efficient delivery of water quality data. As well as near real time water quality information at 21 stations in NSW, extracts from the historical database of water quality data can be provided on request (refer to Appendix A).

The present program is based on a network of automatic recording stations installed at various estuaries (see Station Location Maps). This network consists of 21 permanent stations funded by the NSW Office of Environment and Heritage (OEH), NSW Department of Primary Industries Water (DPI Water) and Wollongong City Council (WCC) (see Table 1). The logging systems consist of Campbells Scientific CR800 data loggers which record water quality information every 15 minutes. Data is transmitted via telemetry to the database every six hours.

Table 1 Station List

River/ Estuary System	Station Name	Station No.	MGA	Easting	Northing	Station Owner	Data Start	Overall Data Capture Rate 2014–2015
Richmond	Coraki	203403	56	527976	6793772	DPI Water/OEH	21-Oct-09	100%
Richmond	Oakland Road	203470	56	526684	6791185	DPI Water	06-Mar-12	100%
Clarence	Rogans Bridge	204413	56	488813	6723401	DPI Water/OEH	03-Dec-09	98.5%
Clarence	Grafton	204400	56	493398	6715149	DPI Water/OEH	04-Dec-09	99.6%
Macleay	Kempsey	206402	56	485099	6561395	DPI Water/OEH	09-Feb-10	100%
Manning	Wingham	208400	56	440523	6473219	DPI Water/OEH	08-Dec-09	100%
Manning	Taree West	208420	56	447161	6469672	DPI Water	30-Apr-10	93.6%
Myall Lakes	Bombah Point	209475	56	434680	6403299	OEH	13-Jul-09	100%
Myall River	Tea Gardens	209480	56	421723	6385111	OEH	20-Oct-09	97.0%
Paterson	Dunmore	210409	56	369238	6383269	DPI Water/OEH	15-Oct-09	100%
Paterson	Hinton Bridge	210410	56	373245	6379624	DPI Water/OEH	15-Oct-09	95.8%
Hunter	McKimms Corner	210455	56	368162	6378933	DPI Water/OEH	08-Oct-09	100%
Hunter	Hexham	210448	56	376768	6367608	DPI Water/OEH	13-Apr-11	97.9%
Hunter	Fullerton Cove Salinity Buoy	210149	56	386312	6364022	DPI Water	21-Jun-13	89%
Hunter	Green Rocks	210432	56	377459	6378142	DPI Water/OEH	15-Oct-09	100%
Williams	Raymond Terrace	210452	56	382352	6375361	DPI Water/OEH	15-Oct-09	100%
Hawkesbury	Sackville	212406	56	303238	6292029	DPI Water/OEH	30-Oct-09	92.5%
Hawkesbury	Leets Vale	212461	56	309195	6299263	DPI Water	22-Jun-10	98.6%
Lake Illawarra	Koonawarra Bay	214440	56	300064	6179621	WCC	15-Jun-93	99.8%
Lake Illawarra	Cudgeree Bay	214416	56	303885	6177264	WCC	09-Feb-93	100%
Shoalhaven	Grady's Caravan Park	215430	56	268024	6138282	DPI Water/OEH	06-Oct-10	96.3%
							Overall	**98.0%**

The network features three distinctive water quality probe types for obtaining temperature and conductivity readings:

1. EC1500: designed for long-term deployment at unattended monitoring stations. The sensor head is epoxy encapsulated and has a large toroid to allow the flow of water through it. The sensor measures conductivity from zero to full scale with the probe resolution of electrical conductivity (EC) ± 1% at full scale and temperature ± 0.2°C
2. AquiStar CT2X: a submersible sensor with built-in datalogging. The CT2X incorporates 4-pole electrode cell measurement technology with a probe resolution of EC ± 1 microsiemen/cm and temperature ± 0.01°C
3. YSI Sonde 6820 V2: a multi-parameter probe with a probe resolution of EC ± 1 microsiemen/cm and temperature ± 0.01°C.

In 2010 DPI Water requested that logger programs at all DPI Water-funded sites be modified to output salinity as Practical Salinity Units (psu) and specific conductivity at 25°C (microseimens/cm) in addition to the standard outputs of water level, temperature and conductivity. This request is intended to make the near real-time data more usable by the diverse range of end users.

Temperature and conductivity values are obtained directly from the instrumentation. Specific conductivity at 25°C is calculated using the equation:

$$\text{Specific Conductivity [µs/cm]} = C / (1+0.0198933 * (T-25))$$

where C = uncompensated EC, T = temperature

Salinity is calculated using the UNESCO formula (seawater salinity calculation) and the full equation can be found in:

> UNESCO Technical Papers in Marine Science, #36 (1981a) 'The Practical Salinity Scale 1978 and the International Equation of State of Seawater 1980', *UNESCO Division of Marine Sciences* (Paris), pp. 25.

Water quality data is transferred to the NSW Data Collection Warehouse, Data Centre 1 and to MHL's data server using a variety of telemetry techniques including internet protocol, landline telephone and cellular networks. The incoming raw data is then immediately available to external users to view via the web.

The data is stored in a database and subject to a quality assurance process which involves several control steps to ensure data quality is maintained. Computer programs are used to further format and analyse data.

Data is backed up daily and data archived to magnetic tape as a security measure at regular intervals. A backup database is also kept at Data Centre 1.

2. How to Use this Report

This report aims to streamline access to MHL's services and to the water quality database.

The NSW coastline has been divided into geographic regions based on river systems. Location maps display the station locations and the annual plots confirm the availability and suitability of data for the particular period of interest. Extracts from the historical database of water quality data can be made available on request (refer Appendix A).

Once a choice has been made of the period for which information is required, data and services can be obtained in a variety of formats, according to their intended use. Appendix B outlines sample data output types.

There are various factors which can influence the water quality data presented in this report. The reader should be familiar with these factors and data recording limitations when interpreting it. For instance, in coastal streams or estuaries, salt water often mixes with fresh water. The addition of salt water greatly increases conductivity. Caution should be exercised when interpreting the conductivity and derived salinity plots in this report as the water quality station locations range significantly in proximity to the ocean. The ocean records an approximate level of 36 psu compared with fresh water which is almost zero. The auto scaling of the plots can over-emphasise changes in low range locations (inland) caused by rainfall events, which increases freshwater inflows and lowers conductivity. Conversely, during low flow conditions the dissolved solids are more concentrated and therefore conductivity levels are higher. After an event, the station will again be influenced by saltwater intrusion brought upstream by the tides; this can consequently present data to be misread as noisy fluctuations in the trace, and/or misread as instrument malfunction, rather than true responses to the surrounding environment.

3. How to Access the Data

MHL provides a full on-line data access service via the Internet for its clients, and a restricted service for the general public at http://mhl.nsw.gov.au/.

Typically the last seven days of data are available on-line in a non-quality controlled form to aid the fastest possible access to data records. The on-line service for clients can provide access to all data catalogued in Appendix A.

Quality controlled data may be ordered via MHL's web page (http://mhl.nsw.gov.au/), by emailing data-request@mhl.nsw.gov.au, or via customised decision support tools that can be provided on request.

The MHL website has been updated in association with an updated database and data warehouse capability via the NSW Data Collection Warehouse. The latest website was launched in March 2012 and includes updated functionality, data access and availability of water level time-series plots.

Appendix B describes sample data plots and MHL's products that can be provided upon request.

Appendix C provides a list of additional publications that may be of interest.

4. Significant Events and Developments

4.1 Flood Events

This section outlines events and developments which have influenced water quality monitoring during this reporting period. Floods introduce significant freshwater inflows which impact on electrical conductivity and temperature, as shown in the data summaries. Table 2 lists the flood events that occurred during the 2014–2015 reporting period. The flood events are classified according to the NSW State Emergency Service's classification scale.

Table 2 NSW Flood Classifications 2014–2015

River Basin	Date	Flood Classification
Richmond River	August 2014	Minor
	February 2015	Minor
	May 2015	Minor to Moderate
Clarence River	May 2015	Minor
Macleay River	May 2015	Minor
Hunter River	April 2015	Minor to Major

4.2 Cross-sectional Profiling

A cross-sectional profile is taken at more than four points across the channel at the surface and at 0.3 m intervals below the surface. The profile information provides a cross-check as to whether the in situ sensor is providing data that is representative of the complete river cross-section.

In February, March, April and June 2015, cross-sectional water quality profiling was undertaken on the Richmond, Clarence, Macleay, Manning, Paterson, Hunter, Hawkesbury and Shoalhaven rivers, as part of the DPI Water monitoring.

4.3 Station Development

During 2014–2015 the following station developments occurred:

- In October 2014 Sackville was upgraded to a Campbells CR1000 logger and CT2X sensor. In addition, Modbus communications software was developed and trialled.
- Wingham station was upgraded to a Campbells CR1000 logger, new program and CT2X sensor in November 2014.
- In February 2015 all sites in the Hunter River, namely Green Rocks, McKimms Corner, Raymond Terrace and Hexham were upgraded with CR1000 loggers; which provides an independent SDI 12 port for the water quality sensor and improves data recovery rates.
- Rogans Bridge was upgraded with a new water quality probe housing in March 2015.

- In June 2015 Coraki station was upgraded to a Campbells CR1000 logger; which provides an independent SDI 12 port for the water quality sensor and improves the data recovery rate.

4.4 Station Issues

During November 2014 Fullerton Cove salinity buoy was used as a mooring by recreational fishers and its battery was tipped out of its enclosure. In April 2015 the buoy was relocated by flood water further into Fullerton Cove and the sensor was damaged.

5. Water Quality Monitoring Summary

This section documents locality maps and quality assured water quality monitoring summaries for each station. Table 3 provides an index to the figures presented. Daily rainfall data from the nearest available OEH rain gauge is added to the figure to recognise the influence of rainfall events. Rain gauges associated with the water quality results are indicative only and are not necessarily representative of the location of the water quality probes.

Table 3 Index of Figures

River /Estuary System	Station Name	Station No.	Comparative OEH Rainfall Station Name	Figure
Station Locality Map	Richmond River Region			1
Richmond	Coraki	203403	Lake Ainsworth	2
Richmond	Oakland Road	203470	Lake Ainsworth	3
Station Locality Map	Clarence River Region			4
Clarence	Rogans Bridge	204413	Wooli Caravan Park	5
Clarence	Grafton	204400	Wooli Caravan Park	6
Station Locality Map	Macleay River Region			7
Macleay	Kempsey	206468	Aldavilla Downstream	8
Station Locality Map	Manning River Region			9
Manning	Wingham	208400	Nabiac	10.1
Manning	Wingham		Nabiac	10.2
Manning	Taree West	208420	Nabiac	11
Station Locality Map	Great Lakes Region			12
Myall Lakes	Bombah Point	209475	Bulahdelah	13
Station Locality Map	Port Stephens Region			14
Myall River	Tea Gardens	209480	Bulahdelah	15
Station Locality Map	Paterson River Region			16
Paterson	Dunmore	210409	Belmore Bridge	17
Paterson	Hinton Bridge	210410	Belmore Bridge	18
Station Locality Map	Hunter River Region			19
Hunter	McKimms Corner	210455	Belmore Bridge	20
Hunter	Green Rocks	210432	Hexham	21
Williams	Raymond Terrace	210452	Hexham	22
Hunter	Hexham	210448	Hexham	23
Hunter	Fullerton Cove Salinity Buoy	210149	Hexham	24
Station Locality Map	Hawkesbury River Region			25
Hawkesbury	Sackville	212406	Sackville DS	26
Hawkesbury	Leets Vale	212461	Colo Junction	27
Station Locality Map	Lake Illawarra Region			28
Lake Illawarra	Koonawarra Bay	214440	Darkes Road	29
Lake Illawarra	Cudgeree Bay	214416	Darkes Road	30
Station Locality Map	Shoalhaven River Region			31
Shoalhaven	Grady's Caravan Park	215430	Yellow Rock Road	32

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STATION LOCATIONS
RICHMOND RIVER REGION

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Figure 1

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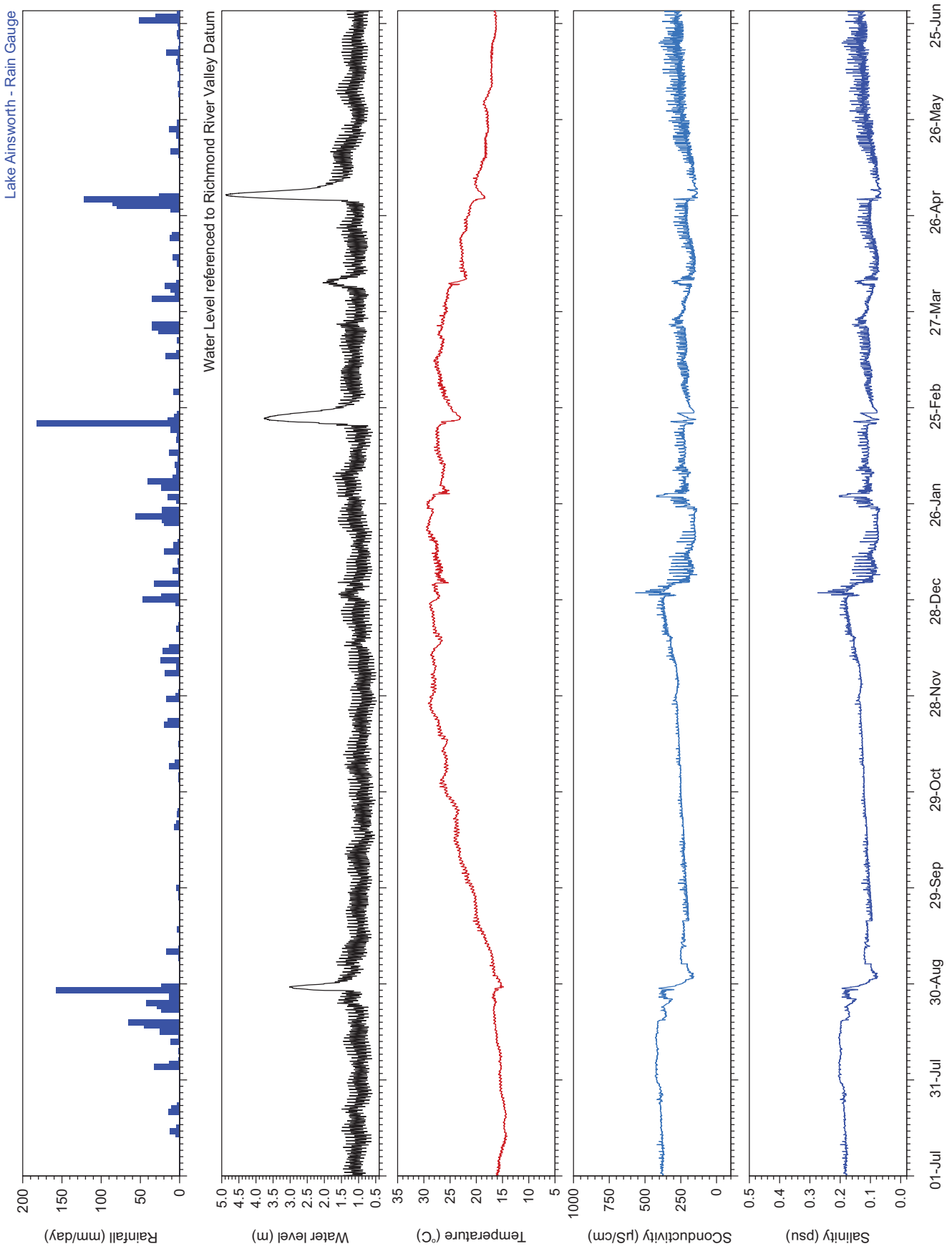

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
CORAKI

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Figure 2

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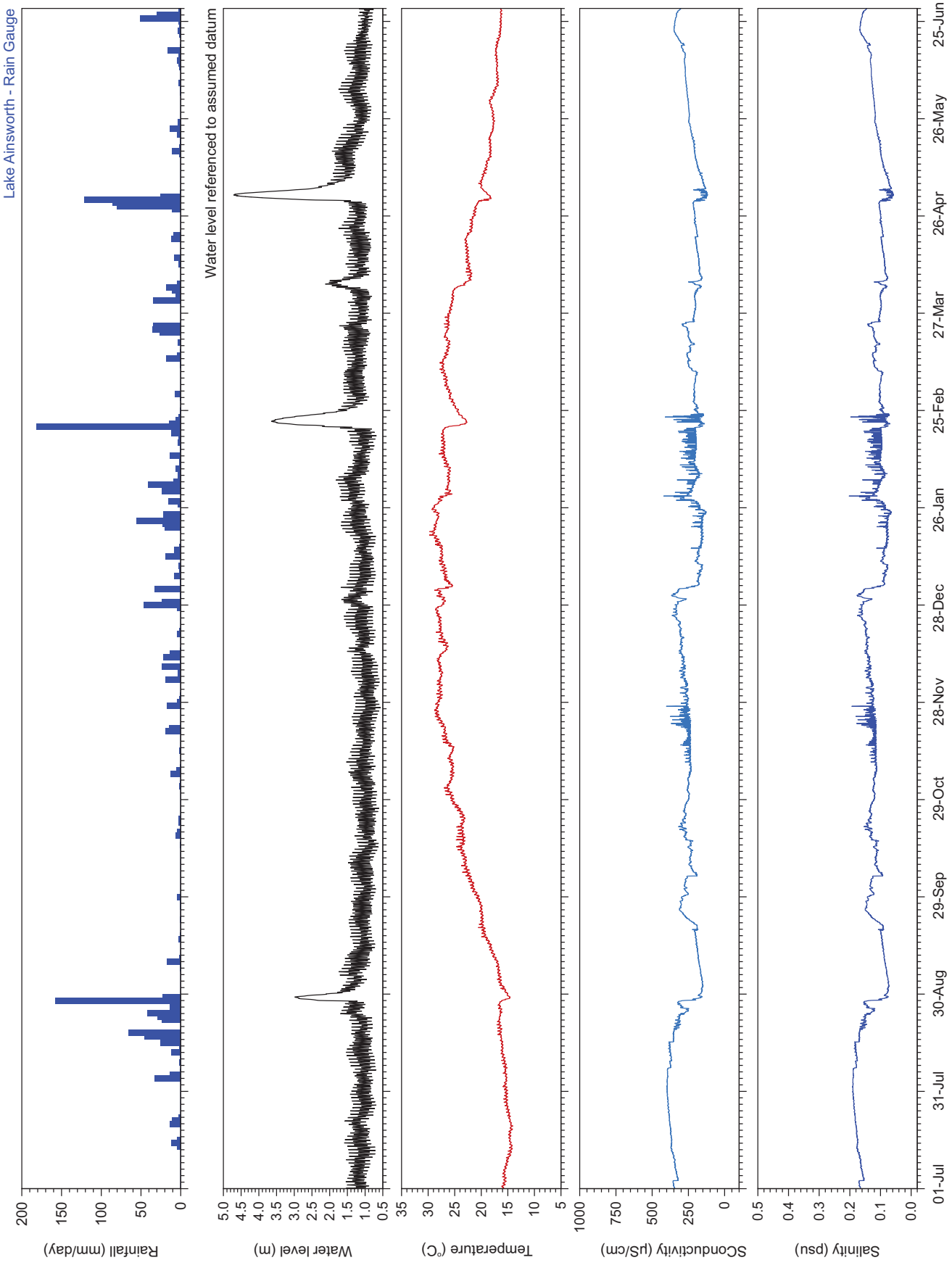

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
OAKLAND ROAD

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Figure 3

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STATION LOCATIONS
CLARENCE RIVER REGION

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Figure 4

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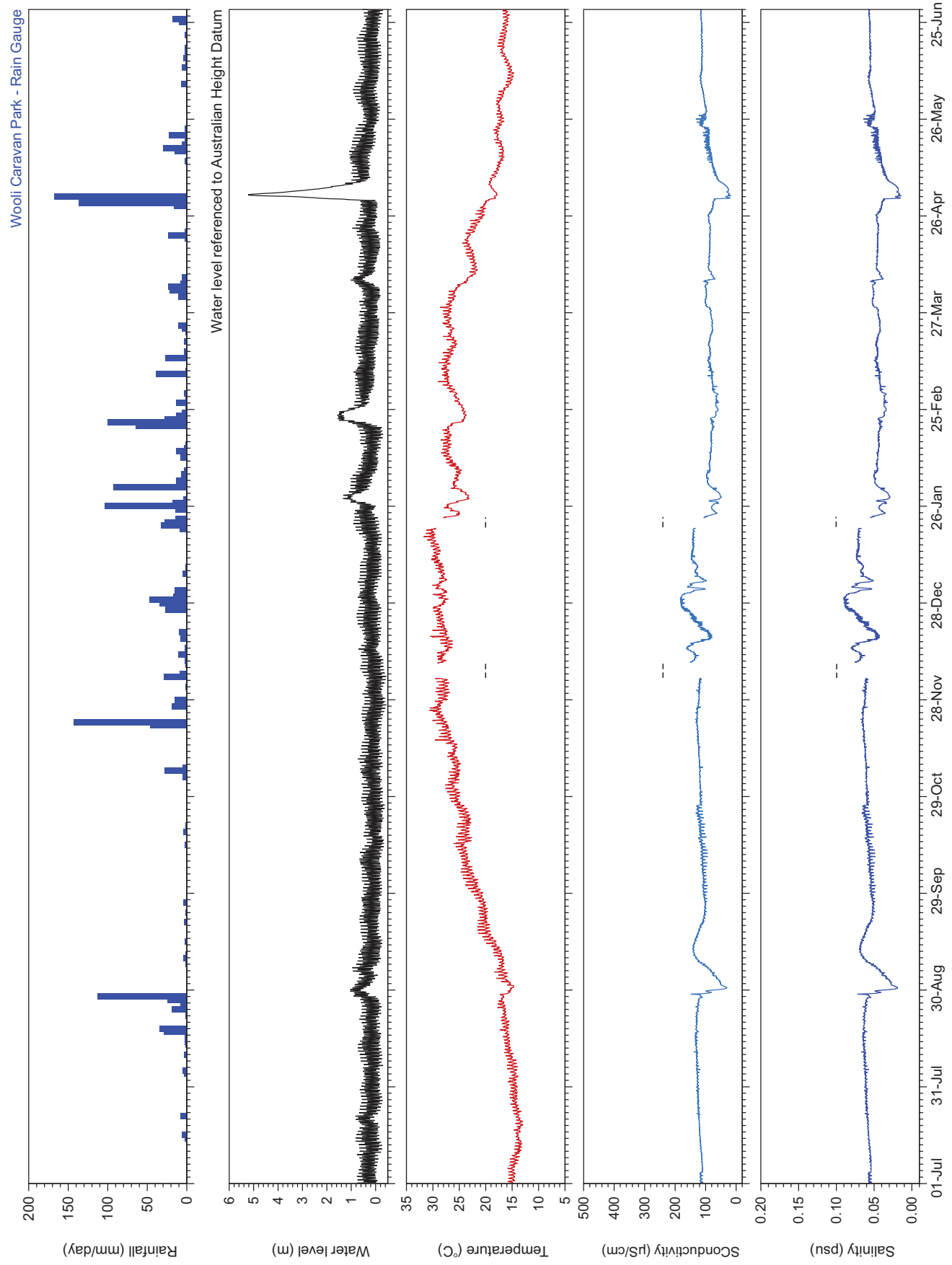

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
ROGANS BRIDGE

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Figure 5

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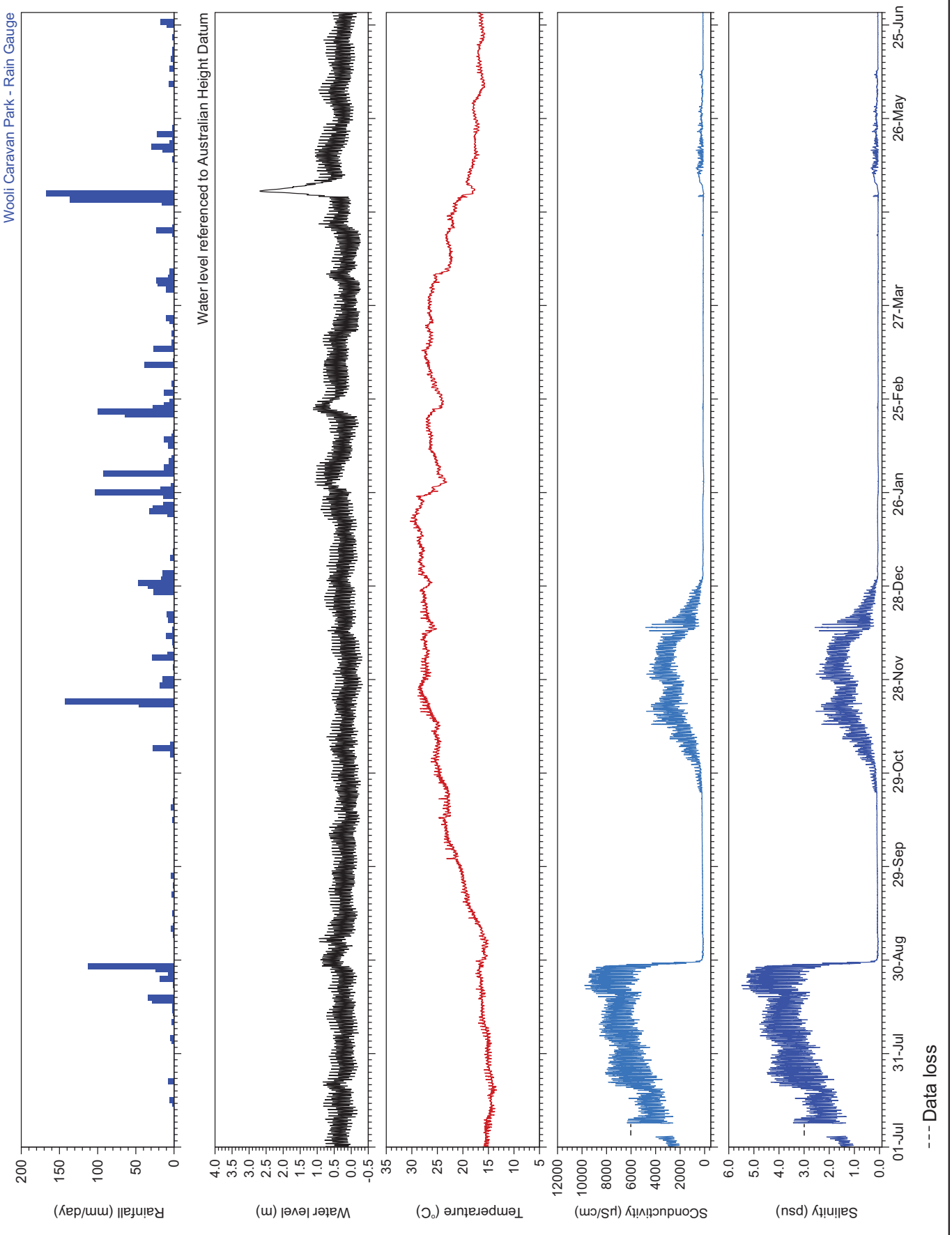

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
GRAFTON

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Figure 6

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STATION LOCATIONS
MACLEAY RIVER REGION

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Figure 7

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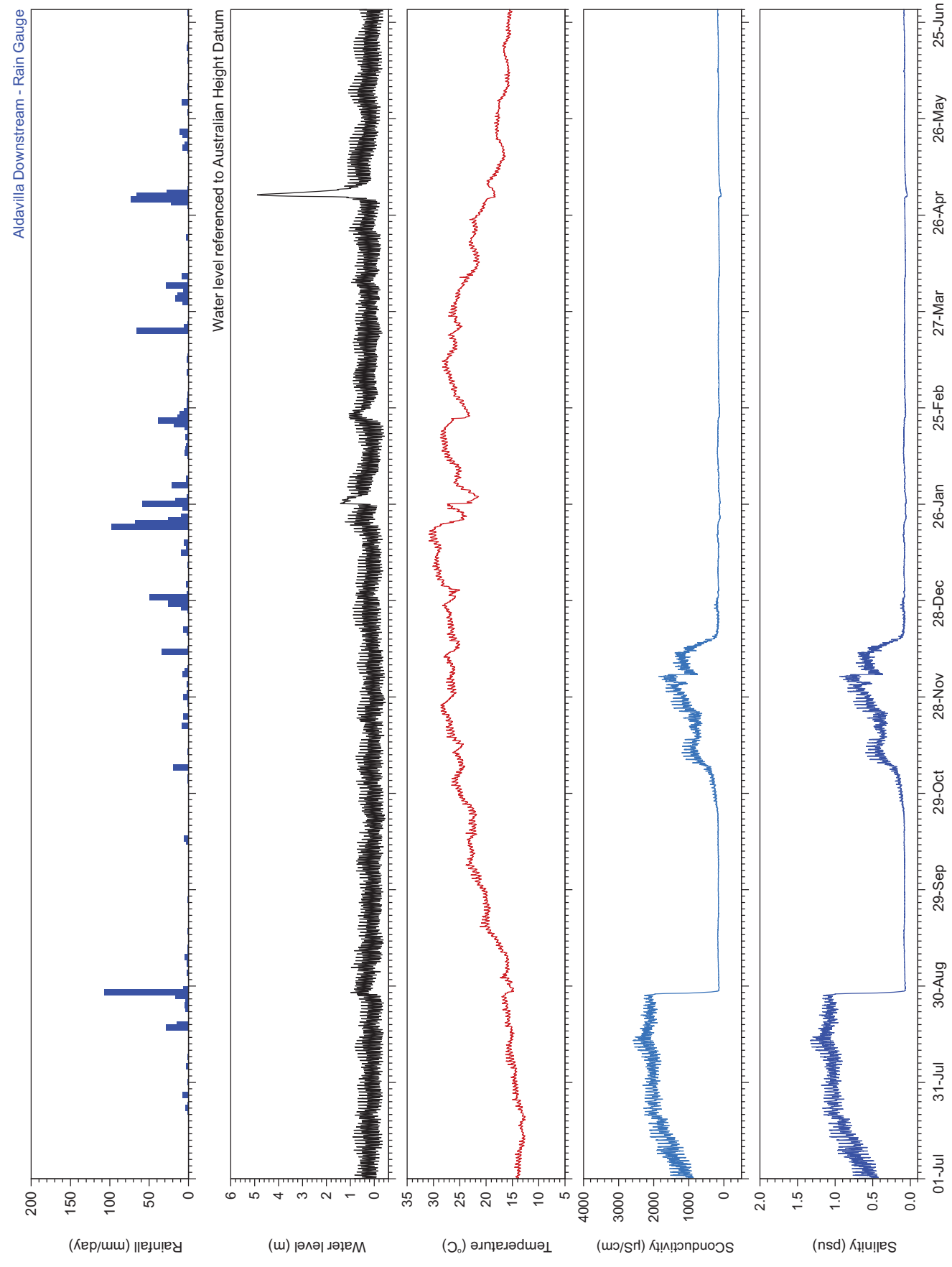

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
KEMPSEY

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Figure 8

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STATION LOCATIONS
MANNING RIVER REGION

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Figure 9

DRAWING 2387-09.cdr

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
WINGHAM

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Figure 10.1

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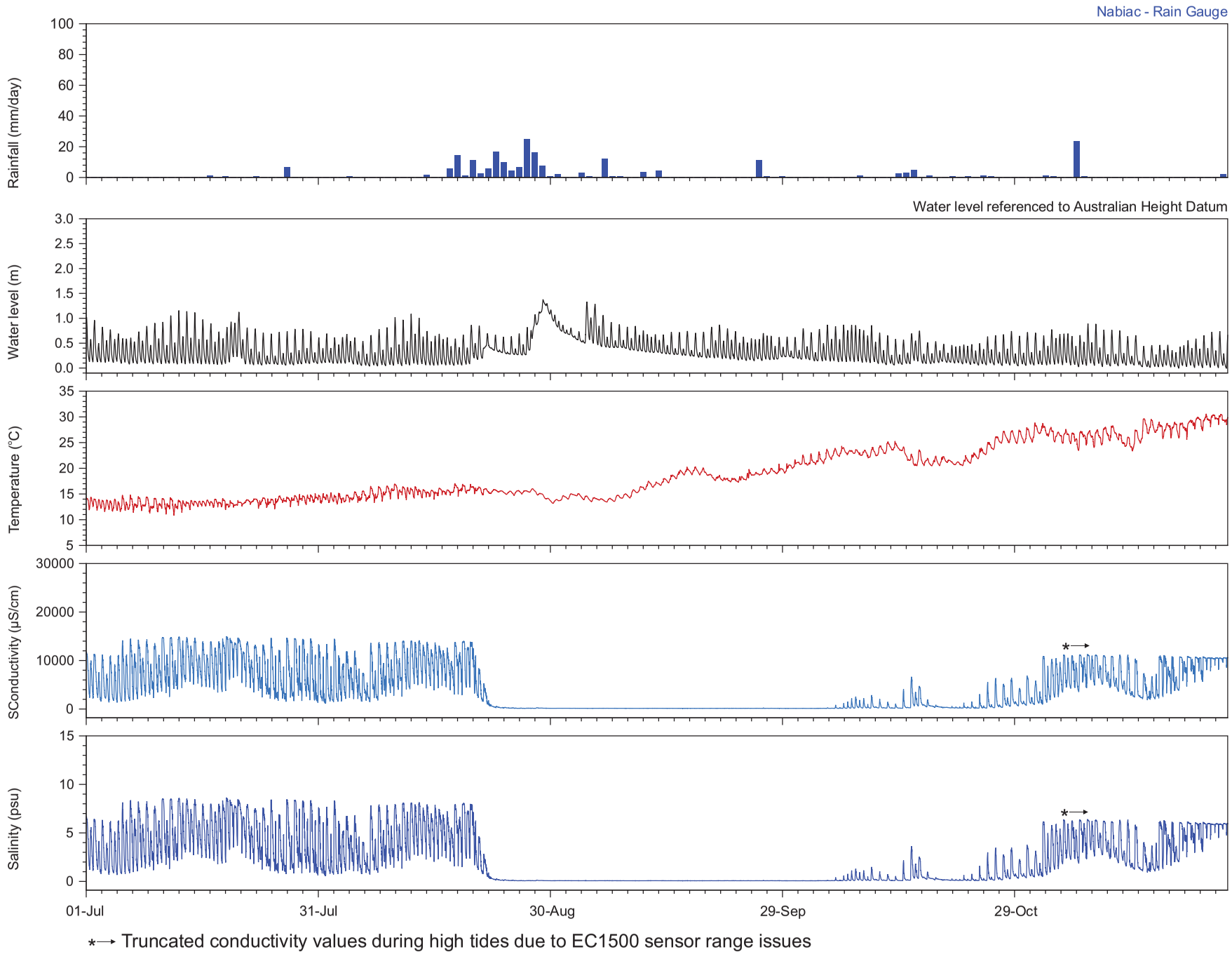

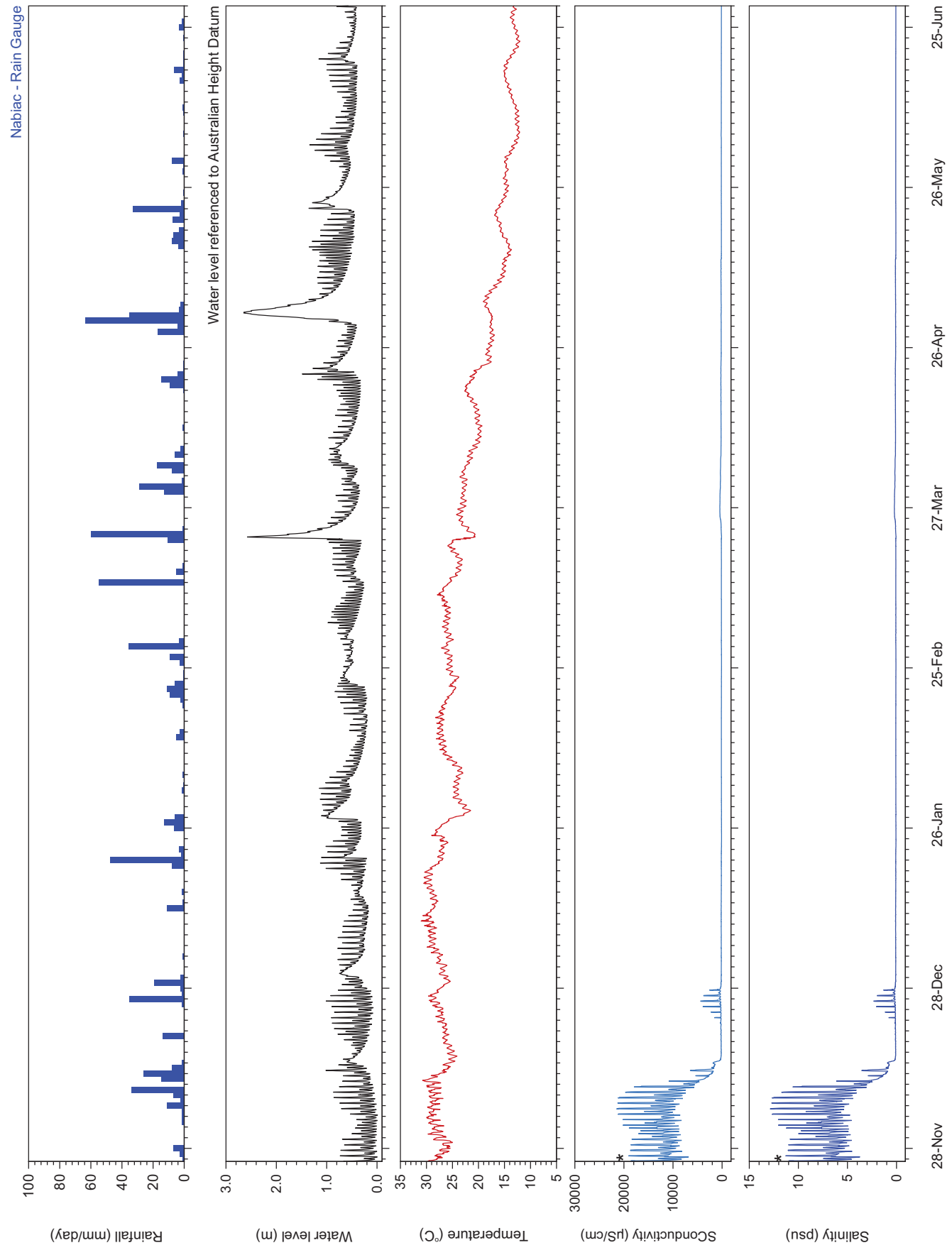

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
WINGHAM

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Figure 10.2

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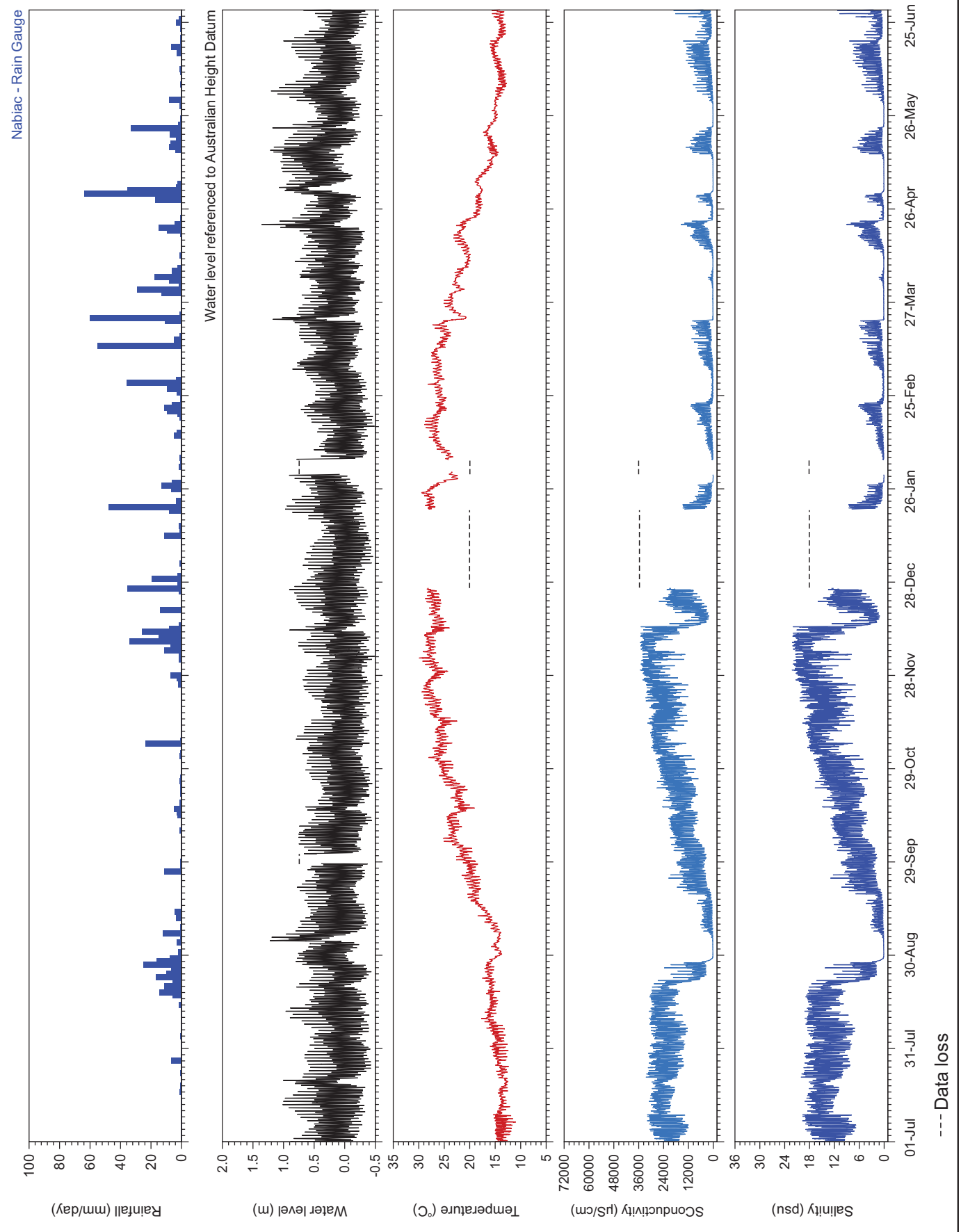

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
TAREE WEST

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Figure 11

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STATION LOCATIONS
GREAT LAKES REGION

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Figure 12

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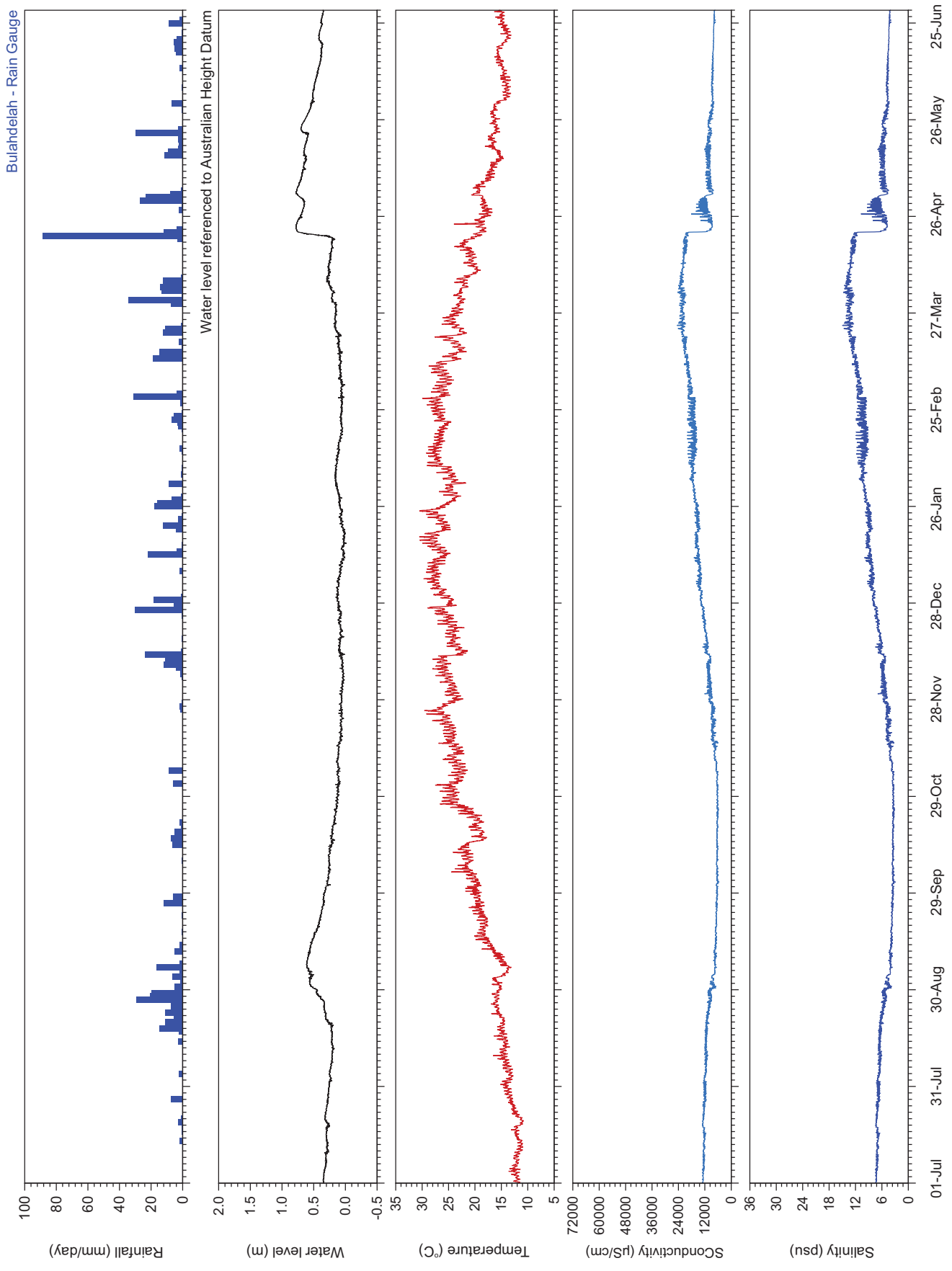

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
BOMBAH POINT

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Figure 13

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STATION LOCATIONS
PORT STEPHENS REGION

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Figure 14

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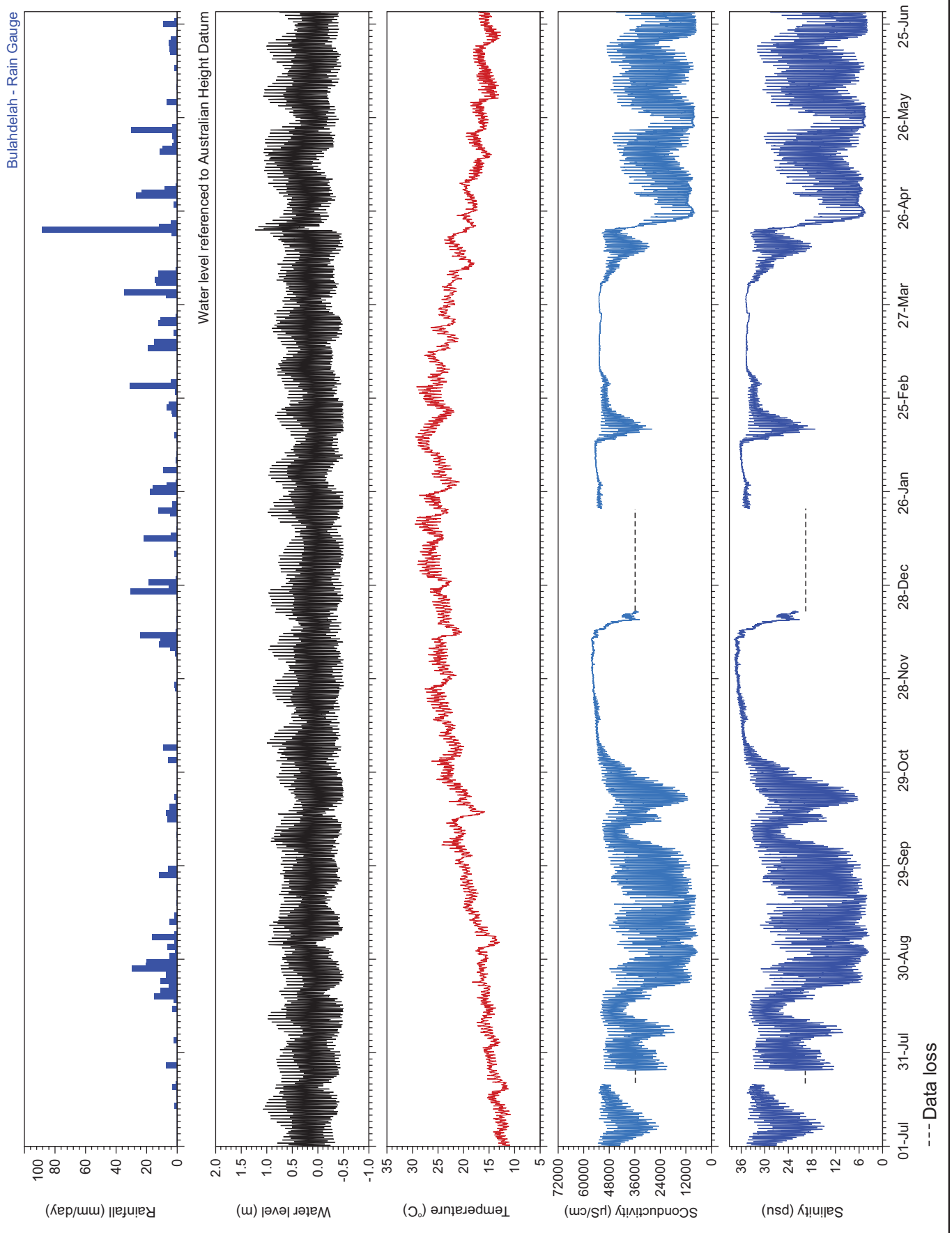

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
TEA GARDENS

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Figure 15

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STATION LOCATIONS
PATERSON RIVER REGION

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Figure 16

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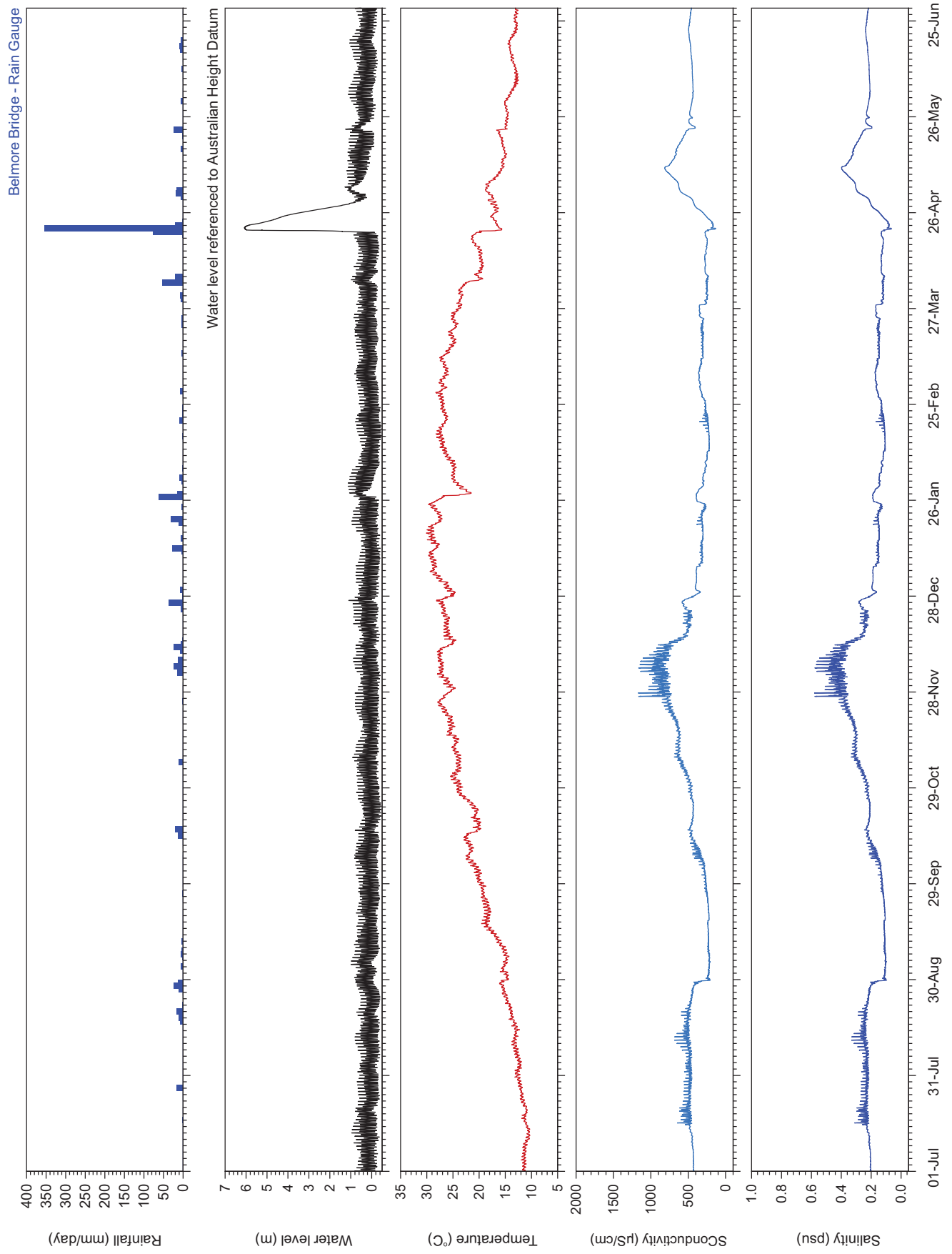

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
DUNMORE

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Figure 17

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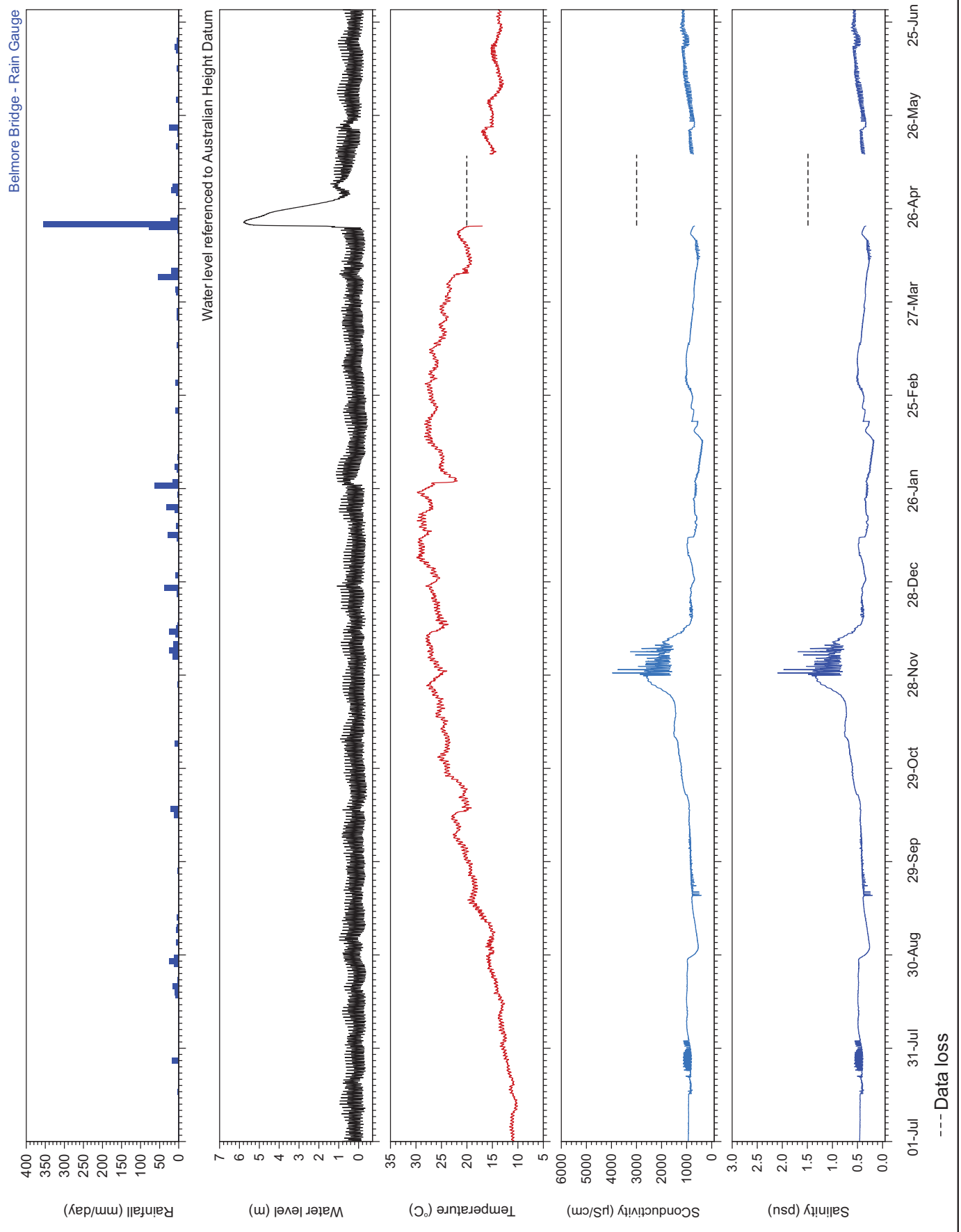

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
HINTON BRIDGE

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Figure 18

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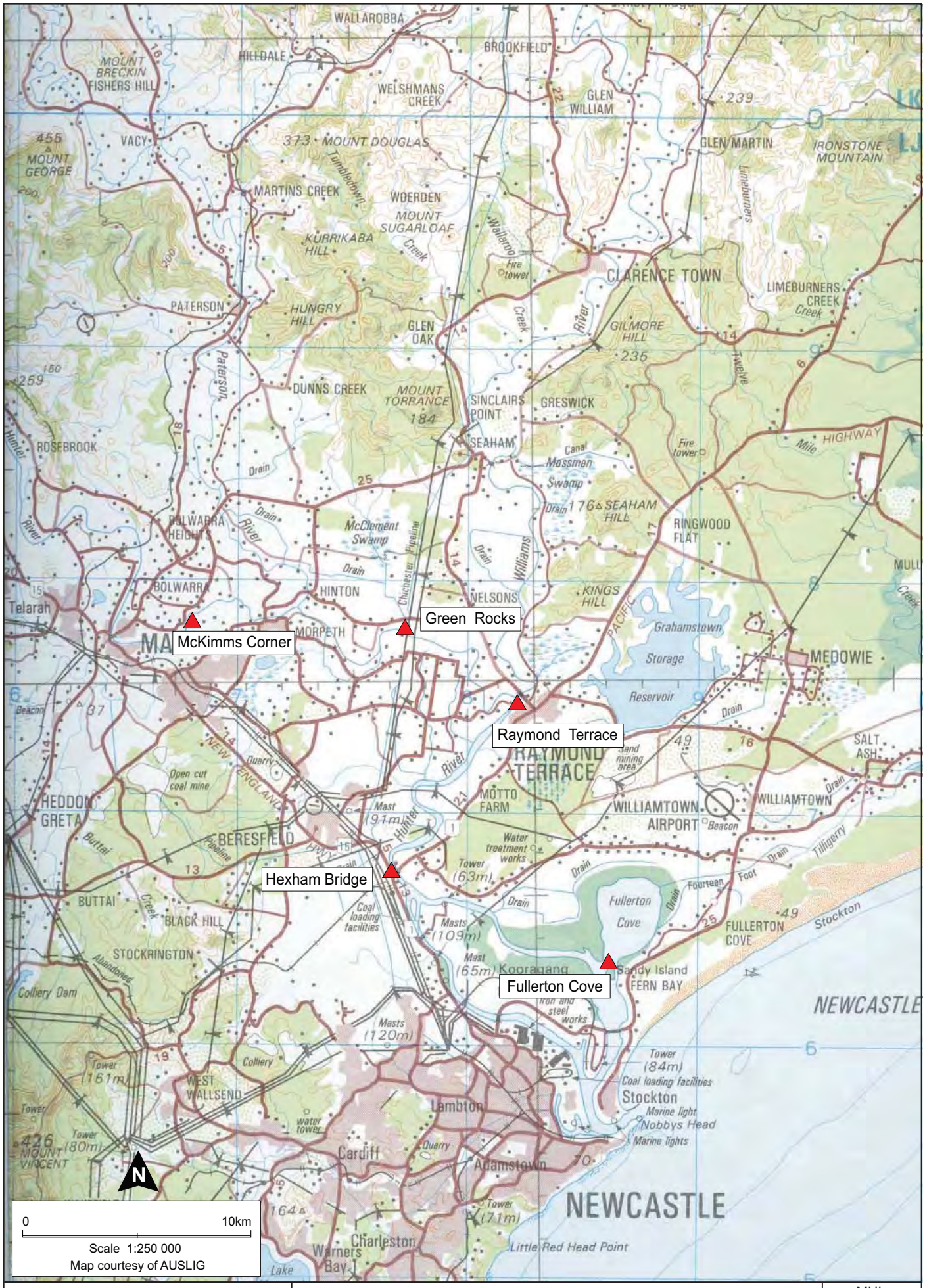

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STATION LOCATIONS
HUNTER RIVER REGION

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Figure 19

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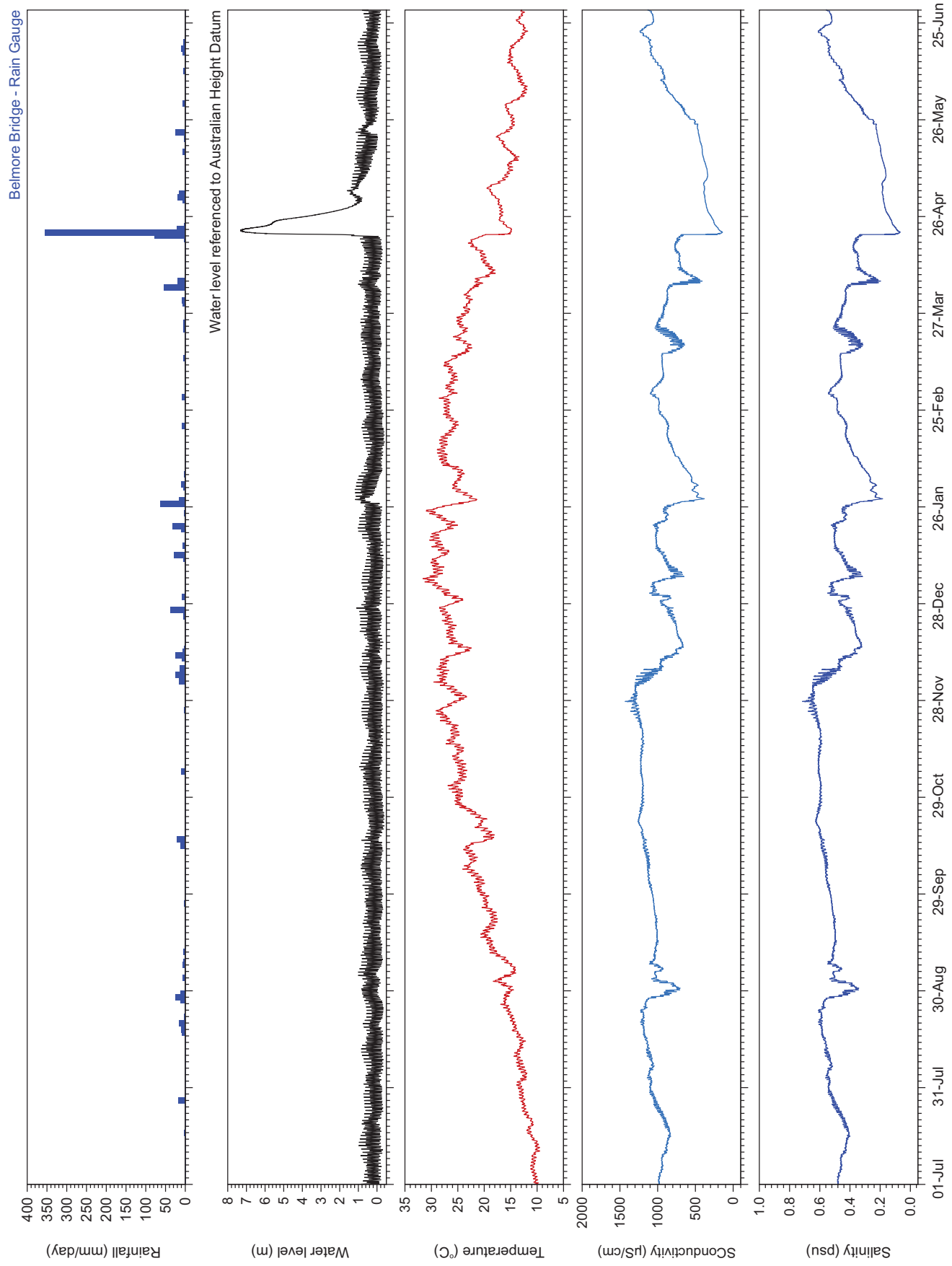

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
McKIMMS CORNER

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Figure 20

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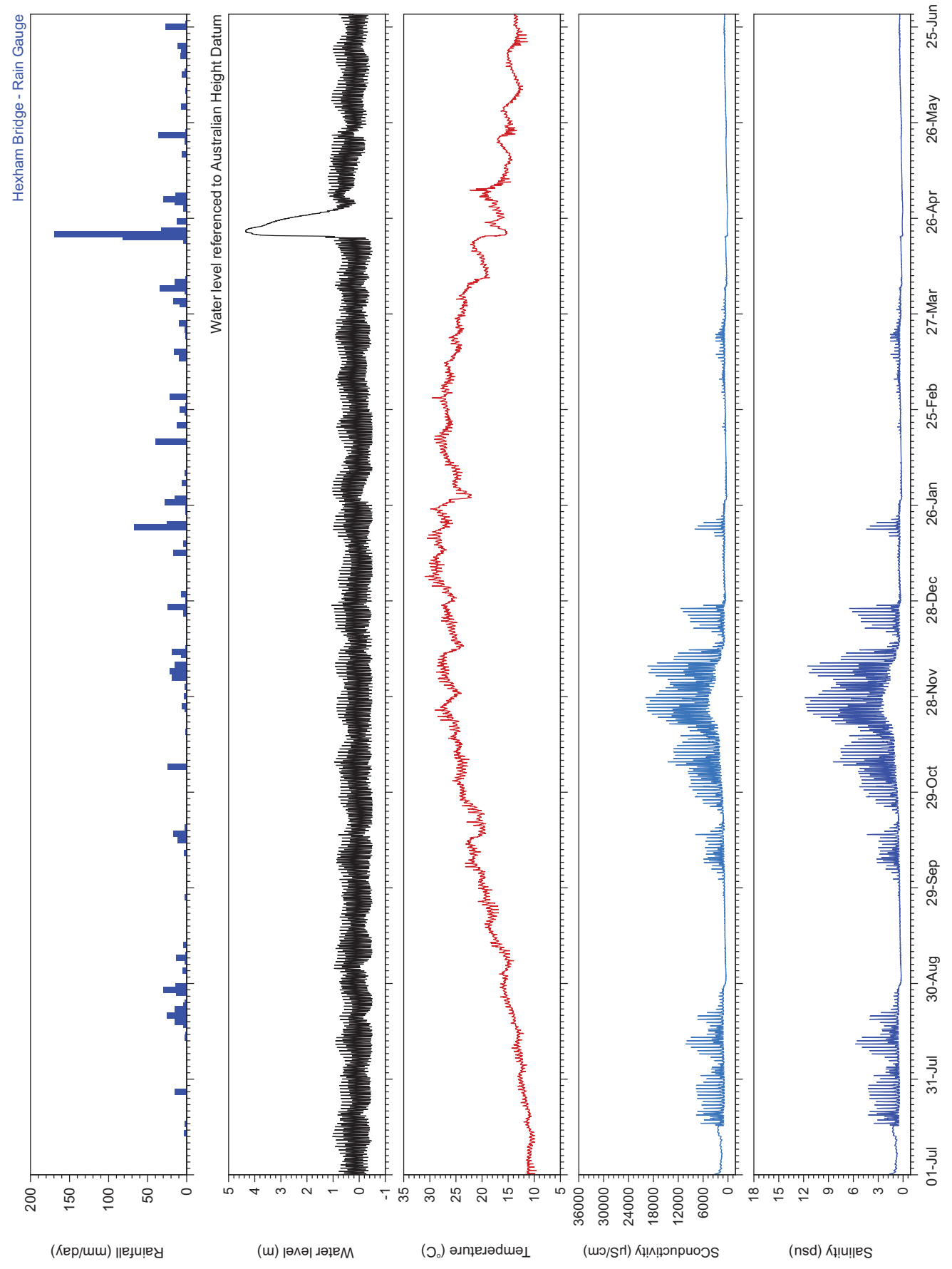

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
GREEN ROCKS

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Figure 21

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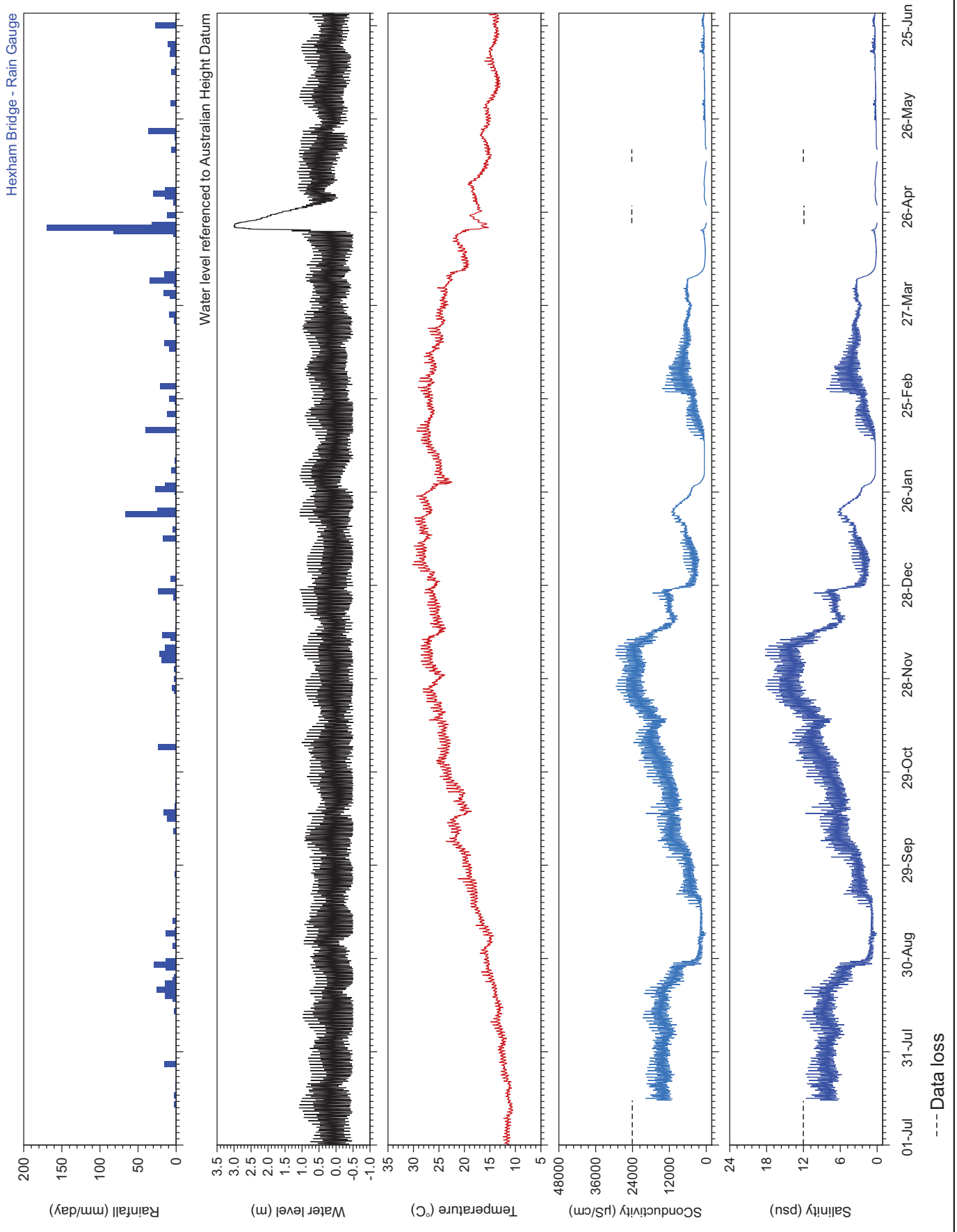

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
RAYMOND TERRACE

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Figure 22

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WATER LEVEL AND WATER QUALITY DATA
2014–2015
HEXHAM

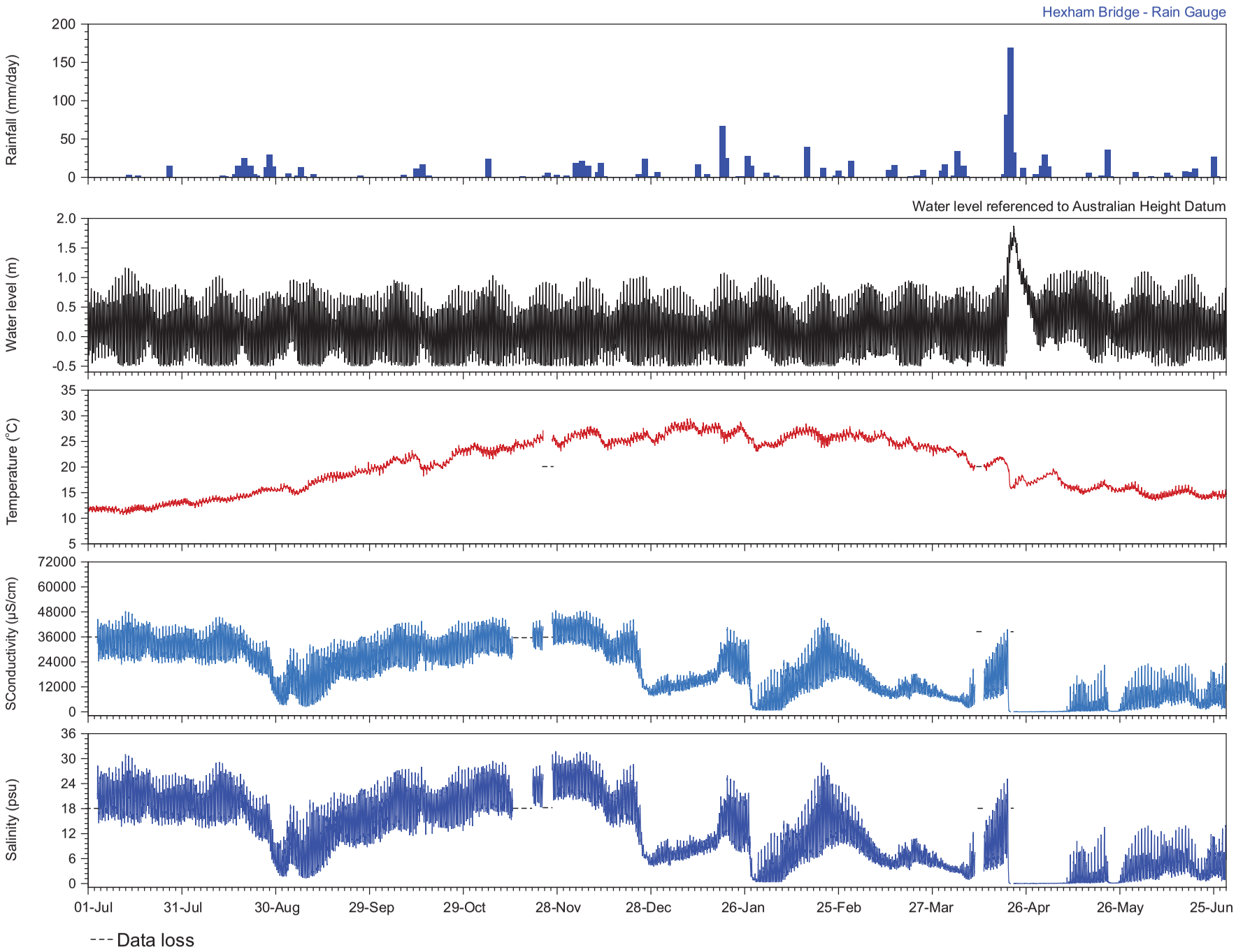

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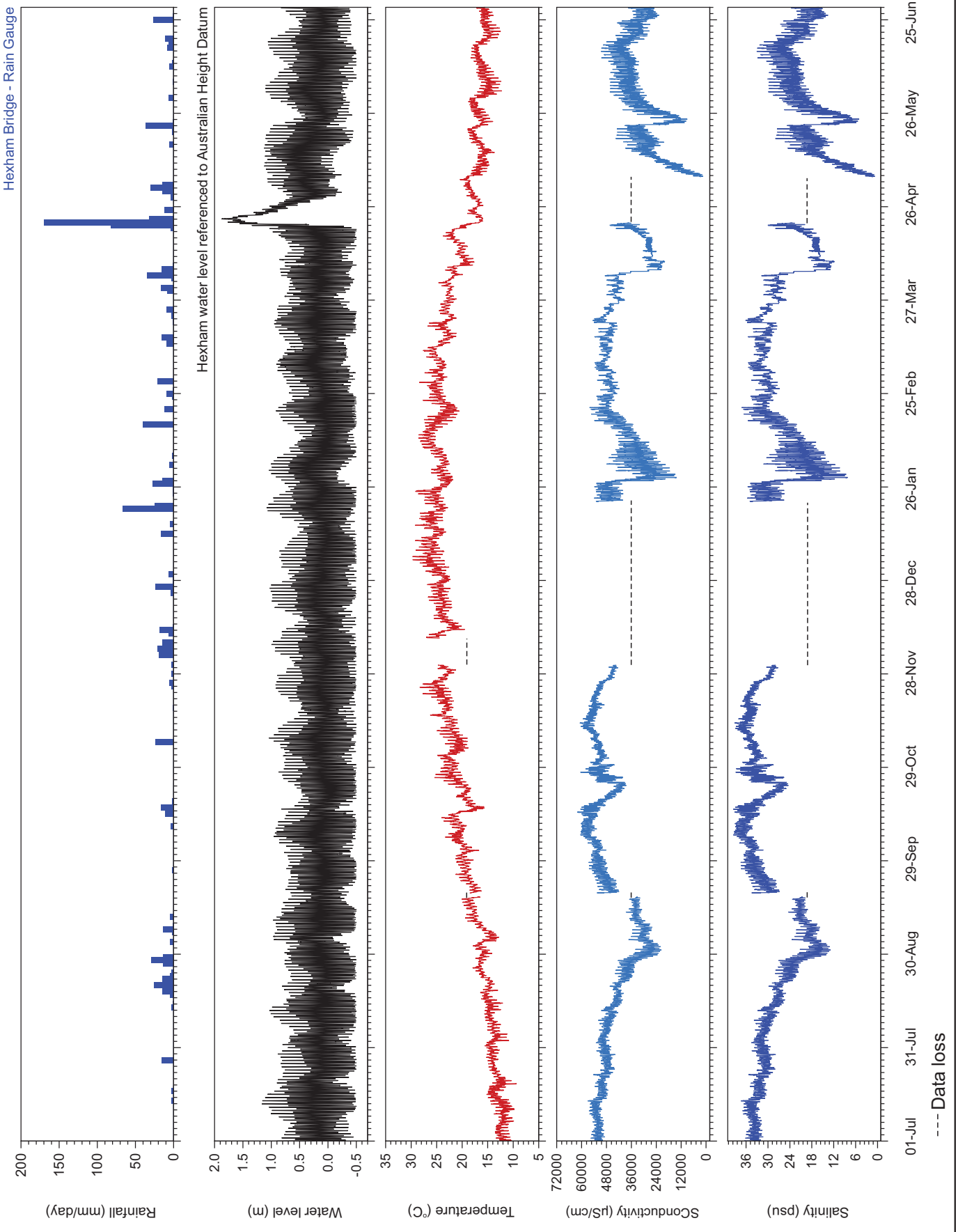
Figure 23

DRAWING 2387-19.cdr



Public Works
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WATER LEVEL AND WATER QUALITY DATA
2014–2015
FULLERTON COVE SALINITY BUOY

MHL Report 2387

Figure 24

DRAWING 2387-19.cdr

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STATION LOCATIONS
HAWKESBURY RIVER REGION

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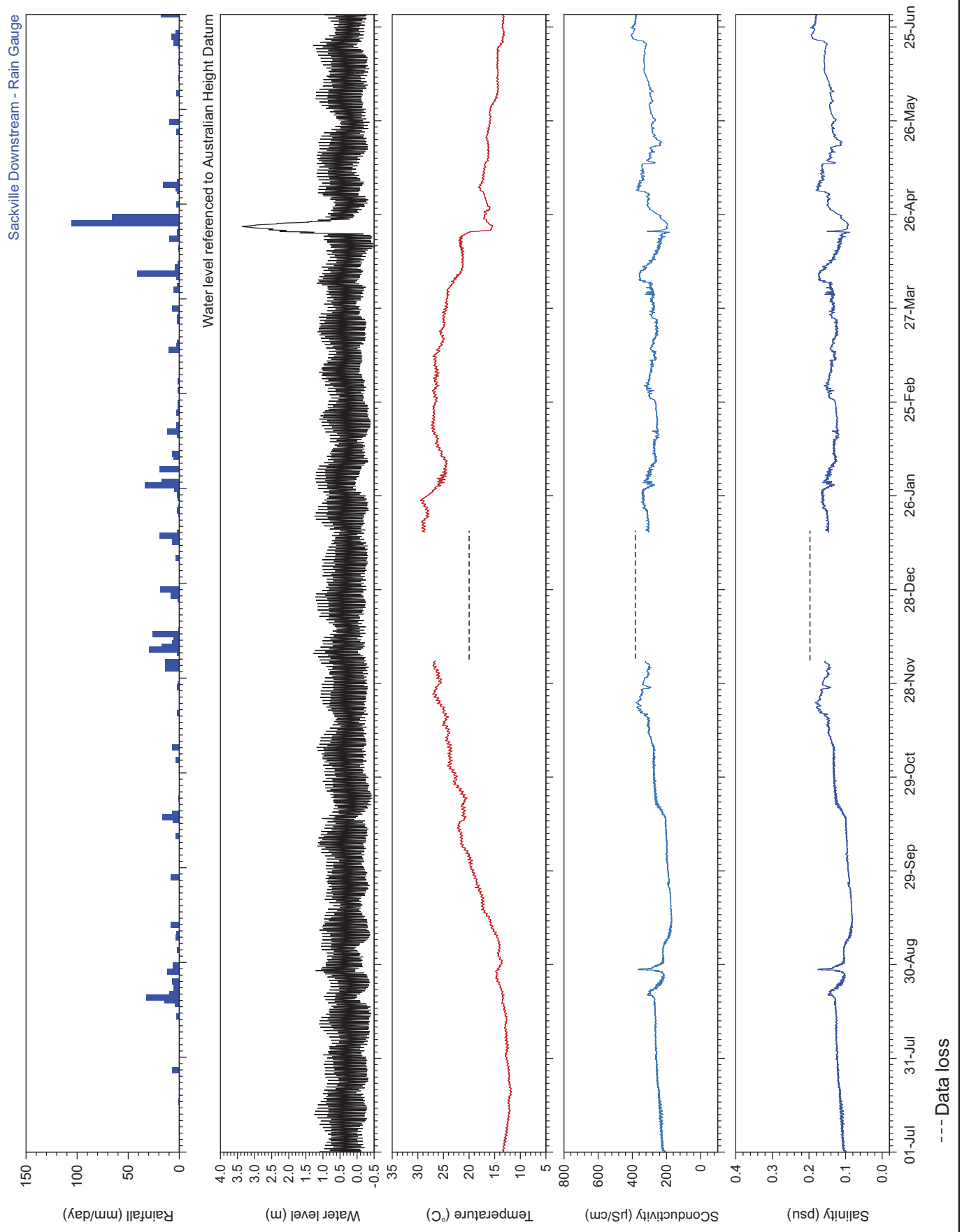
Figure 25

DRAWING 2387-25.cdr



Public Works
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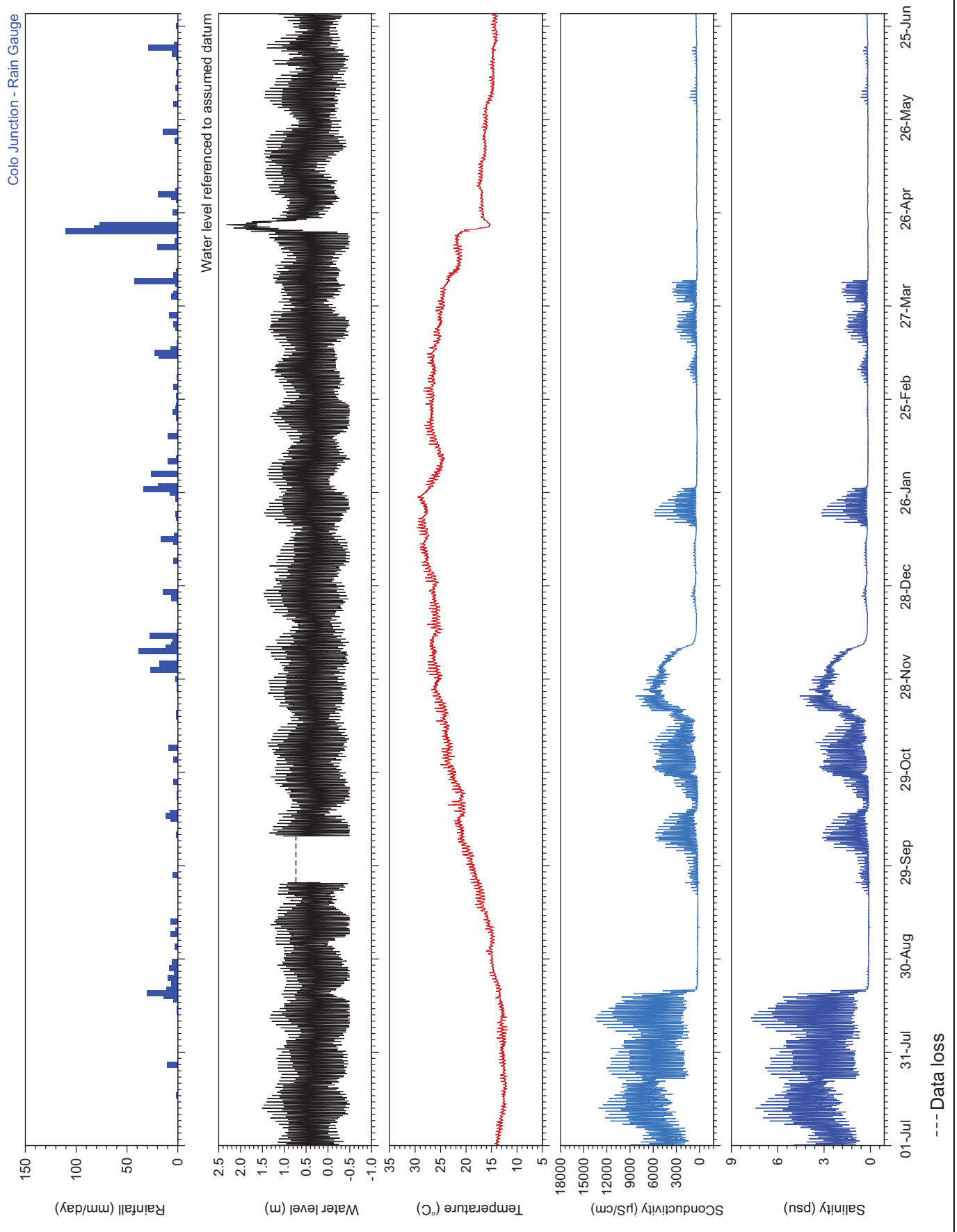
WATER LEVEL AND WATER QUALITY DATA
2014–2015
SACKVILLE

MHL Report 2387

Figure 26

DRAWING 2387-25.cdr



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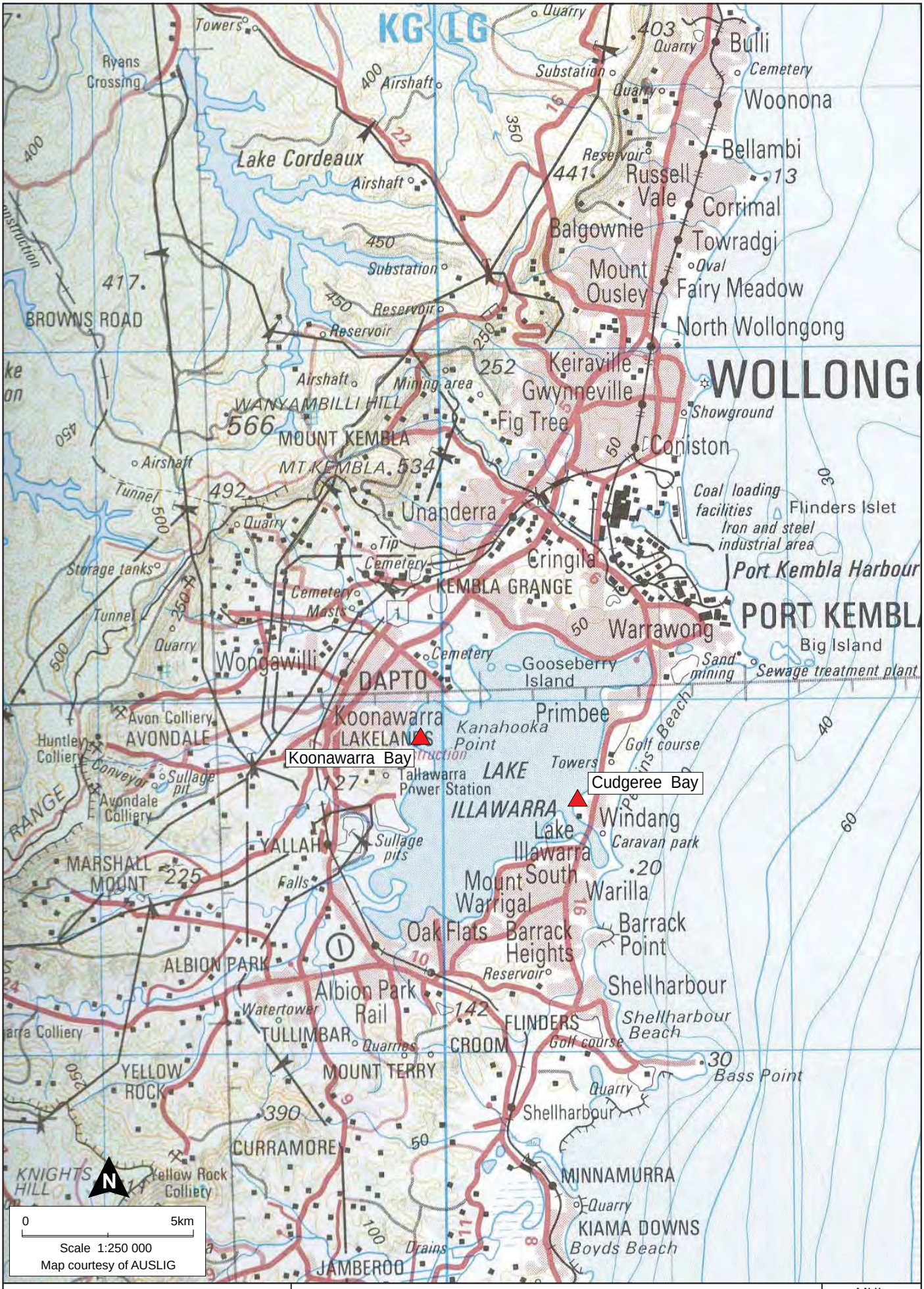
WATER LEVEL AND WATER QUALITY DATA
2014–2015
LEETS VALE

MHL Report 2387

Figure 27

DRAWING 2387-25.cdr



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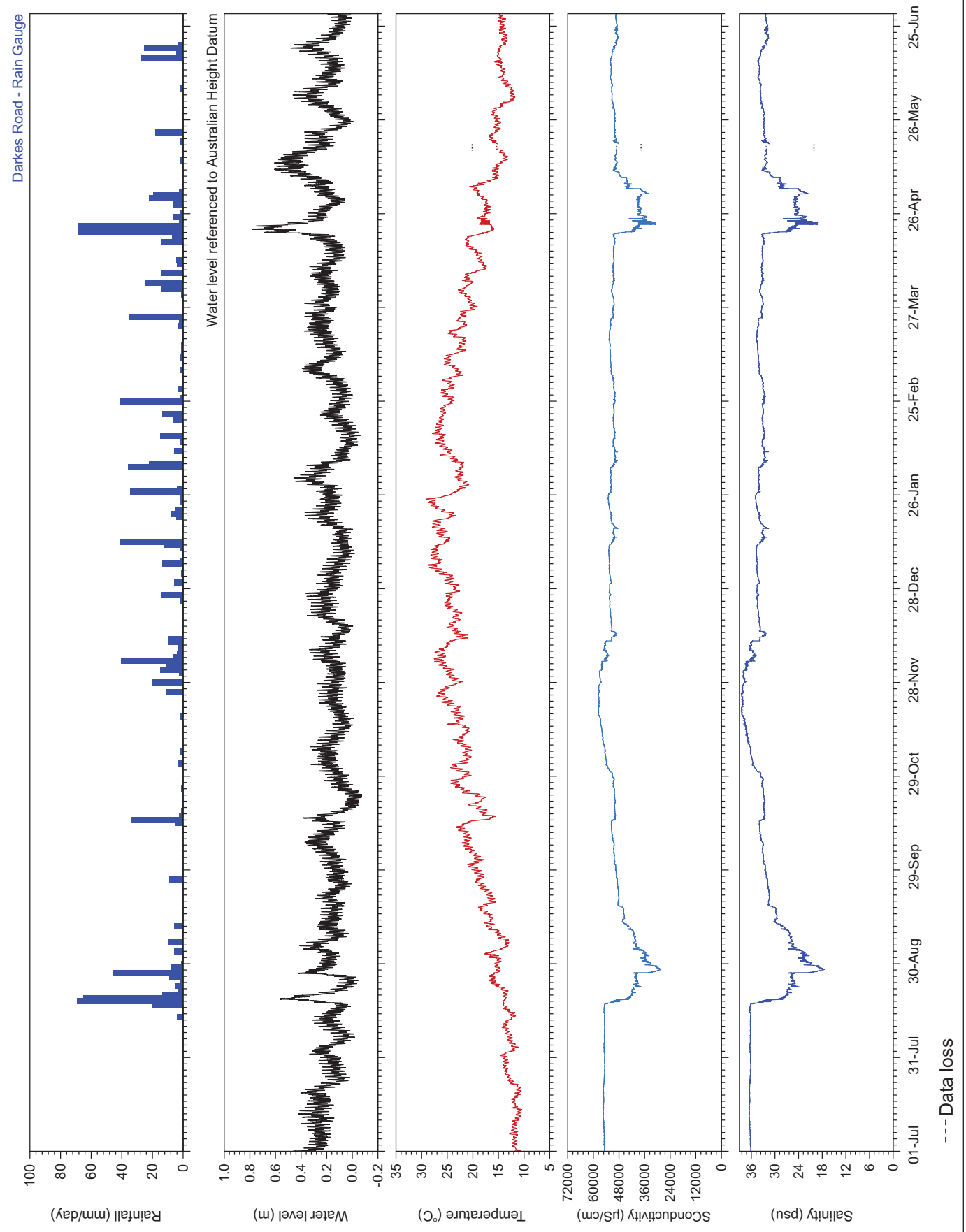
STATION LOCATIONS
LAKE ILLAWARRA REGION

MHL Report 2387

Figure 28

DRAWING 2387-28.cdr



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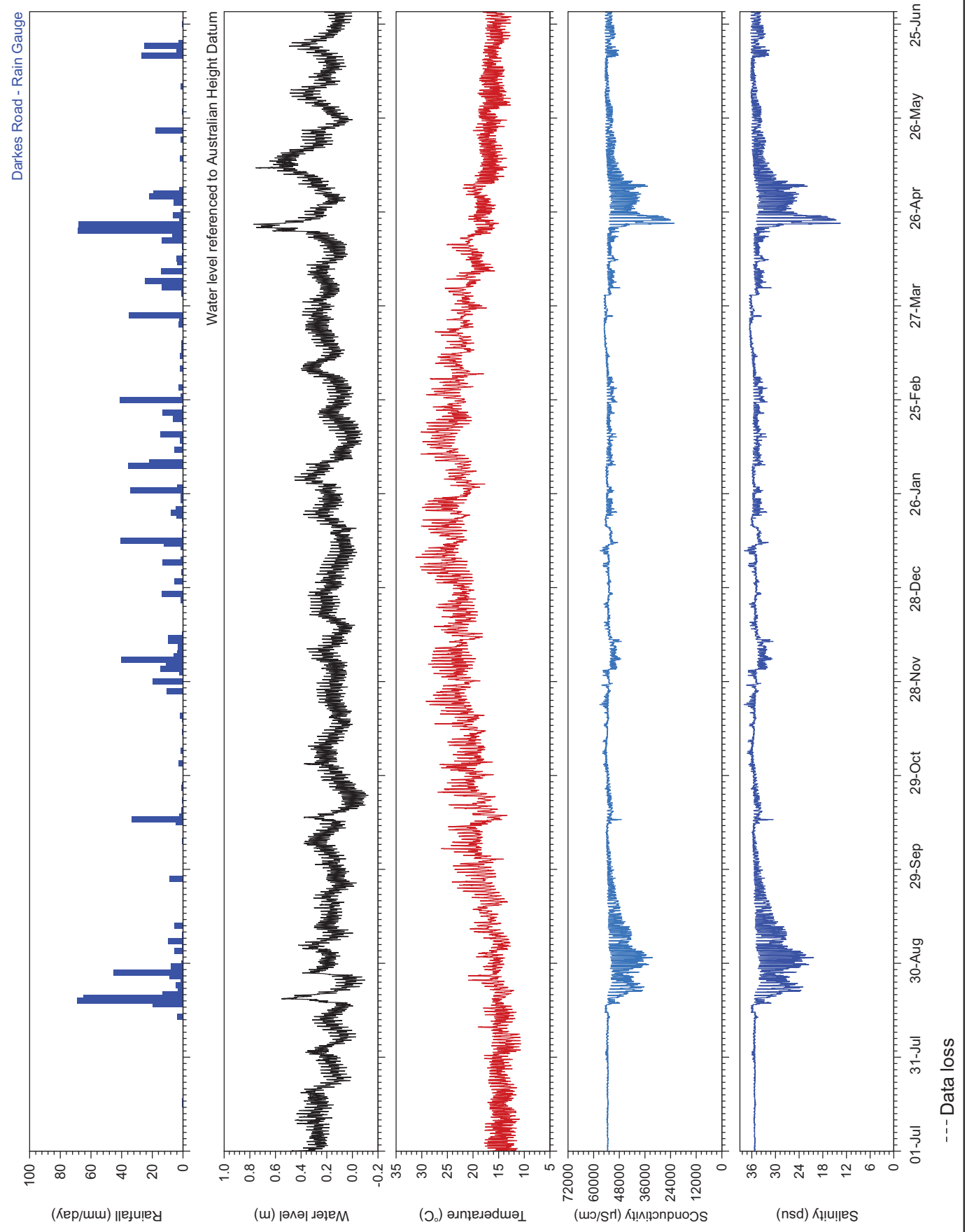
Manly Hydraulics Laboratory

WATER LEVEL AND WATER QUALITY DATA
2014–2015
KOONAWARRA BAY

MHL Report 2387

Figure 29

DRAWING 2387-28.cdr



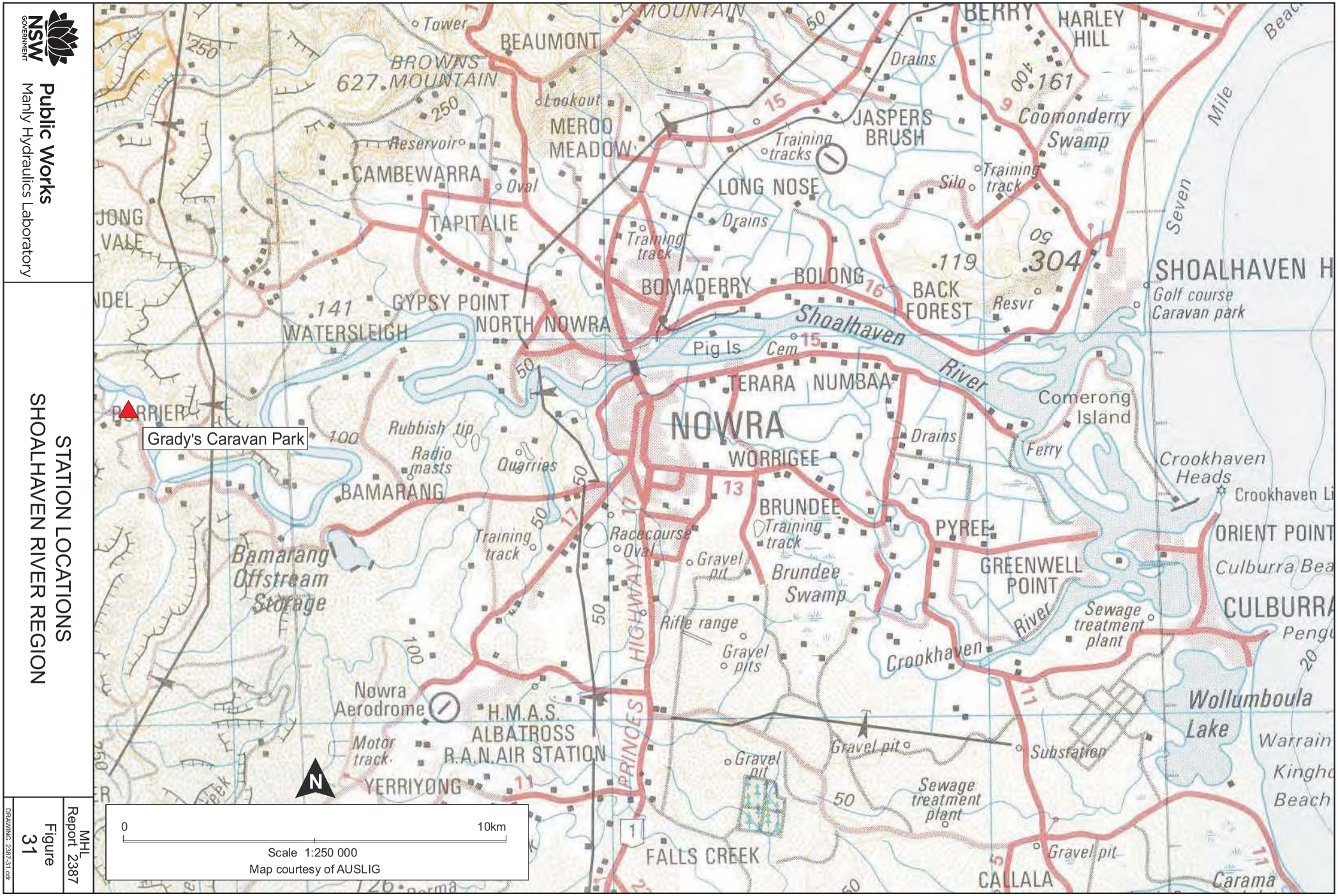
Public Works
Manly Hydraulics Laboratory

WATER LEVEL AND WATER QUALITY DATA
2014–2015
CUDGEREE BAY

MHL Report 2387

Figure 30

DRAWING 2387-28.cdr



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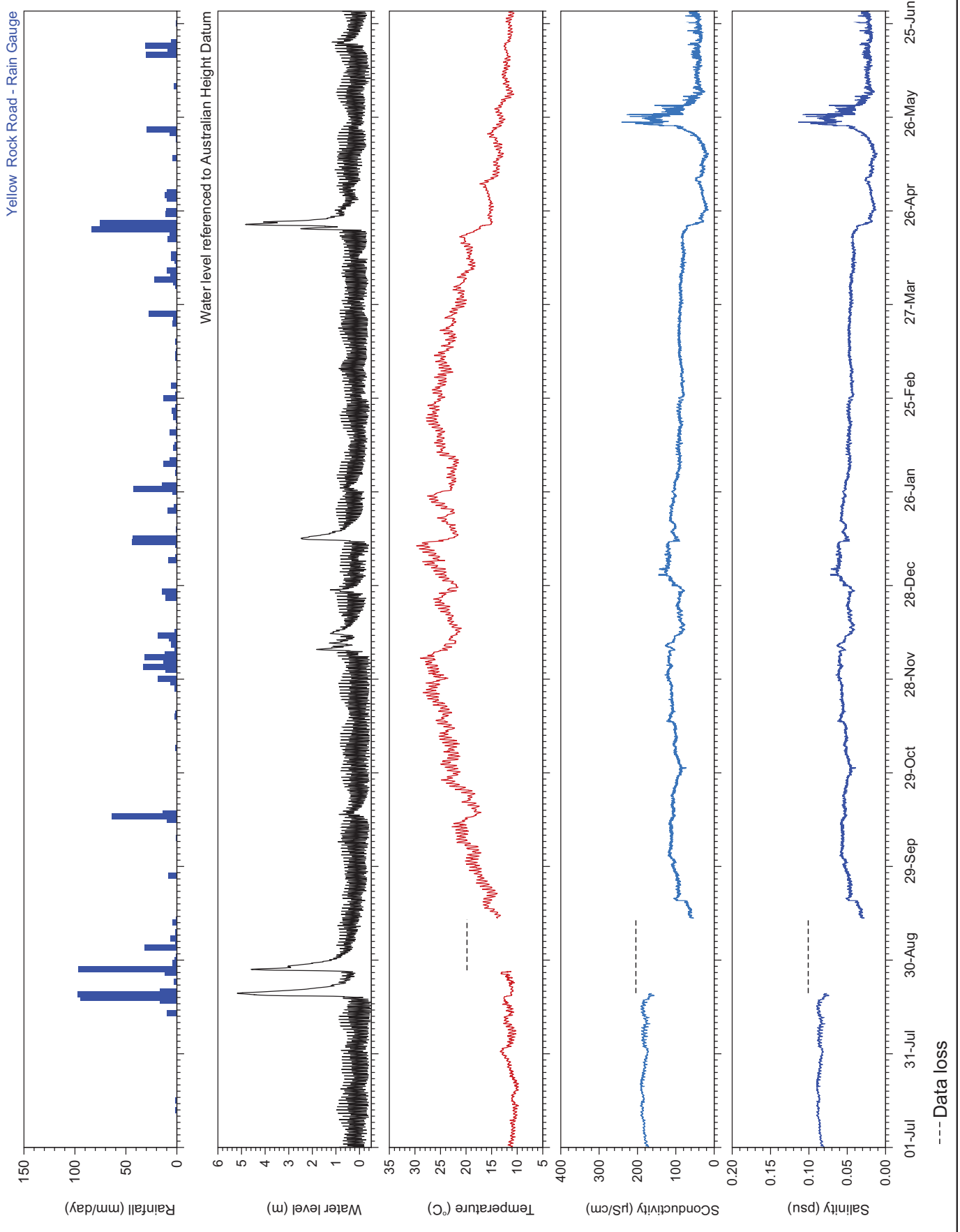
STATION LOCATIONS
SHOALHAVEN RIVER REGION

MHL Report 2387

Figure 31

DRAWING 2387-31.cdr



Public Works
Manly Hydraulics Laboratory

WATER LEVEL AND WATER QUALITY DATA
2014–2015
GRADY'S CARAVAN PARK

MHL Report 2387

Figure 32

DRAWING 2387-31.cdr

Appendix A

Data On-line

Appendix A Data On-line

Station Longname	Station Name	Station Number	Start Date	End Date	Additional MHL Report Number Reference
Brunswick River at Mullumbimby	Mullumbimby	202402	08-Apr-98	18-Mar-99	1000
Richmond River at Coraki	Coraki	203403	20-Sep-94	ongoing	749
Richmond River at Oakland Road	Oakland Road	203470	06-Mar-12	ongoing	
Tucombil Canal at Tucombil Highway Bridge	Tucombil Highway Bridge	203411	21-Aug-97	29-Aug-98	961
Rocky Mouth Creek at Rocky Mouth Creek	Rocky Mouth Creek	203432	06-Sep-94	21-Aug-96	794
Tucombil Canal at Tucombil Floodgate	Tucombil Floodgate	203434	09-Sep-94	29-Sep-95	961
Richmond River at Bungawalbin	Bungawalbin	203450	09-Sep-94	28-Aug-13	
Lennox Head at Lake Ainsworth	Lake Ainsworth	203455	15-Nov-95	30-Nov-96	851
Clarence River at Grafton	Grafton	204400	02-Mar-99	ongoing	1065
Clarence River at Rogans Bridge	Rogans Bridge	204413	09-Mar-99	ongoing	1065
Clarence River at Mylneford	Mylneford	204460	21-May-10	29-Jan-13	
Nambucca River at Macksville	Macksville	205416	17-Feb-99	22-Feb-00	1050
Coffs Creek at Coffs Creek Highway Bridge	Coffs Creek Highway Bridge	205439	14-Dec-92	23-Nov-96	
Bonville Creek at Bonville	Bonville	205480	08-Aug-97	15-Feb-99	985
Borirgala Creek at Borirgala Creek	Borirgala Creek	206450	06-Apr-01	26-Sep-01	1151
Macleay River at South West Rocks	South West Rocks	206456	01-Mar-96	01-Mar-99	986
Macleay River at Euroka Upstream	Euroka Upstream	206458	07-Dec-09	17-Jun-11	
Macleay River at Kempsey	Kempsey	206402	09-Feb-10	ongoing	
Maria River at Green Valley	Green Valley	207406	30-Sep-94	01-Nov-95	760
Lake Cathie at Lake Cathie	Lake Cathie	207441	18-Aug-93	07-Sep-94	
Manning River at Wingham	Wingham	208400	08-Dec-09	ongoing	
Manning River at Taree	Taree	208410	16-Feb-10	30-Oct-13	
Manning River at Taree West	Taree West	208420	30-Apr-10	ongoing	
Myall River at Bombah Point	Bombah Point	209475	09-Jul-96	ongoing	906
Myall River at Tea Gardens	Tea Gardens	209480	20-Oct-09	ongoing	

Station Longname	Station Name	Station Number	Start Date	End Date	Additional MHL Report Number Reference
Paterson River at Dunmore	Dunmore	210409	15-Oct-09	ongoing	
Paterson River at Hinton Bridge	Hinton Bridge	210410	03-Dec-93	ongoing	750
Wallis Creek at Wallis Creek Downstream	Wallis Creek Downstream	210428	21-Sep-95	01-Oct-98	965
Hunter River at Green Rocks	Green Rocks	210432	03-Dec-93	ongoing	750
Hunter River at Hexham Bridge	Hexham Bridge	210448	17-Dec-93	ongoing	750
Hunter River at Hexham	Hexham	210448	13-Apr-11	ongoing	
Williams River at Raymond Terrace	Raymond Terrace	210452	15-Oct-09	ongoing	
Hunter River at McKimms Corner	McKimms Corner	210455	08-Oct-09	ongoing	
Hunter River at Belmore Bridge	Belmore Bridge	210458	01-Dec-93	ongoing	750
Nepean River at Castlereagh	Castlereagh	212404	01-Jul-94	01-Jul-98	
Hawkesbury River at Sackville	Sackville	212406	01-Jul-94	ongoing	
Hawkesbury River at Colo Junction	Colo Junction	212407	07-Nov-09	05-Jul-13	
Hawkesbury River at Ebenezer	Ebenezer	212427	01-Jul-94	01-Jul-98	
Hawkesbury at Wisemans Ferry Wharf	Wisemans Ferry Wharf	212460	10-Jun-10	19-Jul-13	
Hawkesbury at Leets Vale	Leets Vale	212461	22-Jun-10	ongoing	
Lake Illawarra at Cudgeree Bay	Cudgeree Bay	214416	09-Feb-93	ongoing	994
Lake Illawarra at Koonawarra Bay	Koonawarra Bay	214440	15-Jun-93	ongoing	994
Shoalhaven at Grady's Caravan Park	Grady's Caravan Park	215430	06-Oct-10	ongoing	
Wollumboola Lake at Wollumboola	Wollumboola	215454	01-Feb-99	06-Jan-11	1145
Crookhaven River at Crookhaven Heads	Crookhaven Heads	215471	06-Mar-95	07-Apr-95	
Currarong Creek at Currarong Creek	Currarong Creek	216405	04-Mar-96	04-Mar-97	858
Swan Lake at Swan Lake	Swan Lake	216425	02-Feb-99	02-Feb-00	
Clyde River at Nelligen	Nelligen	216453	17-Sep-96	17-Sep-97	889
Tomaga at George Bass Drive	George Bass Drive	216455	28-Aug-96	28-Aug-97	890
Tuross River at Coila Lake	Coila Lake	218405	08-Mar-96	21-Nov-96	848
Wagonga River at Barlows Bay	Barlows Bay	218415	30-Aug-96	30-Aug-97	888
Wallaga Lake at Regatta Point	Regatta Point	219405	06-Mar-95	07-Apr-95	
Bega River at Bega	Bega	219410	24-Feb-10	21-May-13	
Back Lagoon at Back Lagoon	Back Lagoon	219415	25-Sep-97	25-Sep-98	963
Lake Curalo at Lake Curalo	Lake Curalo	220420	09-Mar-96	09-Mar-98	920
Wonboyn River at Agnew Wharf	Agnew Wharf	220425	20-Aug-97	20-Aug-98	964

Station Longname	Station Name	Station Number	Start Date	End Date	Additional MHL Report Number Reference
Bartletts Creek at Bartletts Creek	Bartletts Creek	NA	06-Jun-95	19-Mar-96	780
Leddays Creek at Leddays Creek	Leddays Creek	NA	02-Jun-95	31-Jul-96	780
Officer Drain at Officer Drain	Officer Drain	NA	02-Jun-95	21-Mar-96	780
McLeods Drain at McLeods Drain	McLeods Drain	NA	21-Mar-96	31-Jul-96	780
McLeods Drain Offshoot at McLeods Drain Offshoot	McLeods Drain Offshoot	NA	21-Mar-96	31-Sep-96	780
Cudgen Lake at Cudgen Lake	Cudgen Lake	NA	14-Dec-92	05-Nov-93	674
Cudgen Creek at Cudgen Lake West	Cudgen Lake West	NA	08-Oct-93	05-Nov-93	674
Cudgen Creek at Cudgen Creek	Cudgen Creek	NA	15-Dec-92	05-Nov-93	674
Simpsons Creek at Belongil	Belongil	NA	06-Dec-94	17-Dec-96	
Richmond River at Shaws Bay	Shaws Bay	NA	11-Mar-99	12-Apr-00	755, 849
Marshalls Creek at Capricornia Canal	Capricornia Canal	NA	24-Mar-97	31-Mar-11	1051
Marshalls Creek at New Brighton	New Brighton	NA	17-Mar-97	24-Apr-98	1000
Brunswick River at Pacific Highway Bridge	Pacific Highway Bridge	NA	18-Mar-97	18-Mar-99	1000
Simpsons Creek at Simpsons Creek	Simpsons Creek	NA	03-Apr-98	18-Mar-99	1000
Tuckean Broadwater at Tuckean	Tuckean	NA	30-Oct-95	29-Oct-96	850
Richmond River at Empire Vale Creek	Empire Vale Creek	NA	08-May-98	12-Oct-99	1032
Roberts creek at Roberts Creek	Roberts Creek	NA	20-May-94	24-May-96	784
Clarence River at Tarrent Bridge	Tarrent Bridge	NA	04-Mar-99	11-Apr-00	1065
Andersons Inlet at Middle Island MM1	Middle Island MM1	NA	06-Apr-01	15-Dec-06	986
Andersons Inlet at Middle Island MM2	Middle Island MM2	NA	19-Mar-96	03-Feb-99	986
Andersons Inlet at Double Island	Double Island	NA	19-Mar-96	03-Feb-99	986
Macleay River at Andersons Inlet	Andersons Inlet	NA	06-Apr-01	27-Sep-01	1151
Maria River at Connection Creek	Connection Creek	NA	22-Sep-94	26-Oct-95	760
Hastings River at Lake Innes	Lake Innes	NA	19-Aug-93	07-Sep-94	760
Scotts Creek at Scotts Creek	Scotts Creek	NA	20-Oct-98	22-Oct-99	1029
Wallis Lake at Peach Tree Point	Peach Tree Point	NA	30-Jul-97	09-Mar-99	987
Wallis Lake at Wallamba	Wallamba	NA	30-Jul-97	25-Aug-98	987
Wallis Lake at Booti Island	Booti Island	NA	31-Jul-97	25-Aug-98	987
Wallis Lake at Darawakh Creek	Darawakh Creek	NA	26-Aug-98	08-Mar-99	987
Smiths Lake at Smiths Lake	Smiths Lake	NA	04-May-95	16-May-96	771
Myall Lake at Mayers Point	Mayers Point	NA	10-Jul-96	04-Mar-98	906

Station Longname	Station Name	Station Number	Start Date	End Date	Additional MHL Report Number Reference
Myall River at Monkey Jacket	Monkey Jacket	NA	09-Jul-96	04-Mar-98	906
Lake Wollumboola at Lake Wollumboola	Lake Wollumboola Floating	NA	07-Dec-00	19-Jun-01	1145
Tuross Lake at Trunketabella	Trunketabella	NA	04-May-94	11-Mar-98	921
Wallaga Lake at Meads Bay	Meads Bay	NA	03-Feb-99	10-Feb-00	1048
Hexham Swamp at Ironbark Creek Downstream	Ironbark Creek Downstream	NA	08-Aug-02	30-Jun-09	
Hexham Swamp at Ironbark Creek Upstream	Ironbark Creek Upstream	NA	09-Aug-02	27-Oct-04	
Hexham Swamp at Morris Jetty	Morris Jetty	NA	07-Aug-02	30-Jun-09	
Hunter River at Fishery Creek	Fishery Creek	NA	08-Aug-02	07-Mar-03	
Hunter River at Fishery Creek 2	Fishery Creek	NA	11-Jun-03	29-Aug-03	
Hexham Swamp at Shortland Wetland Centre	Shortland Wetland Centre	NA	10-Mar-99	04-Jul-00	1058
Hexham Swamp at SWC Canoe Trail	SWC Canoe Trail	NA	07-Aug-02	09-Jan-03	1221
Lake Macquarie at Swansea Channel Site 4	Swansea Channel Site 4	NA	28-Mar-96	14-Jun-96	770
Lake Macquarie at Swansea Channel Site 5	Swansea Channel Site 5	NA	15-Apr-96	10-May-96	770
Orphan site at Berowra Water Quality	Berowra Creek Water Quality	NA	26-May-95	29-Nov-95	745
Berowra Creek at Berowra Waters Marina	Berowra Waters Marina	NA	22-Aug-01	23-Nov-01	
Narrabeen Lagoon at Pittwater Road Bridge	Pittwater Road Bridge	NA	23-Feb-96	15-Nov-05	
Manly Lagoon at Riverview Parade	Riverview Parade	NA	02-Feb-96	05-Jan-07	
Manly Lagoon at Manly Dam	Manly Dam	NA	29-Jan-96	22-Aug-01	
Shoalhaven River at Wharf Road	Wharf Road	NA	06-Mar-95	07-Apr-95	
Shoalhaven River at DPI Waterra Bridge	DPI Waterra Point	NA	07-Mar-95	07-Apr-95	
Clyde River at Clyde Site 7	Clyde River Site 7	NA	25-Sep-96	08-Oct-96	792
Clyde River at Clyde Site 16	Clyde River Site 16	NA	25-Sep-96	08-Oct-96	
Wonboyn River Upstream of Wonboyn Lake	Wonboyn River	NA	21-Aug-97	06-Sep-98	

Appendix B

Sample Outputs

NSW GOVERNMENT

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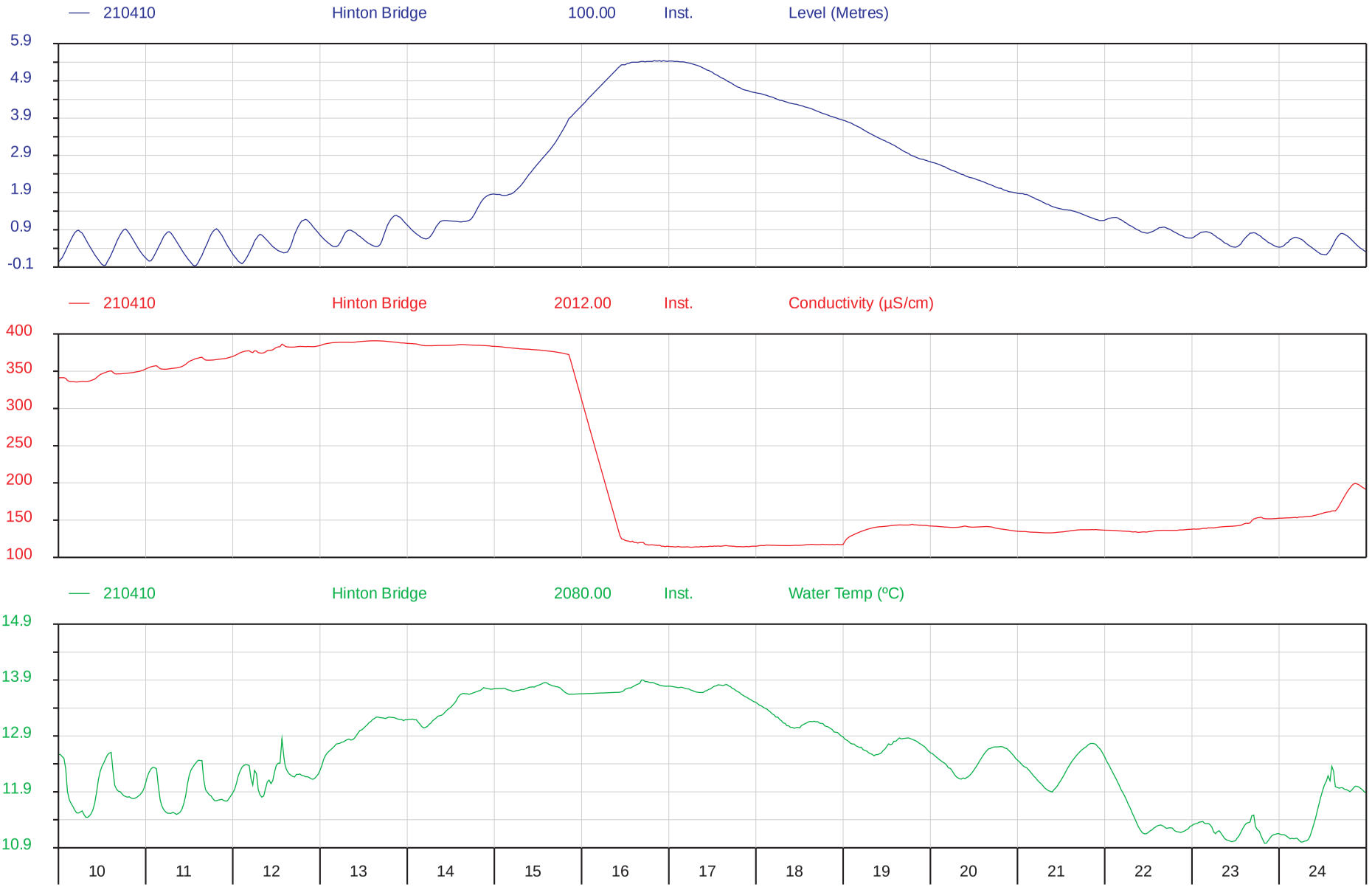
SAMPLE DATA PLOTS

Period	15 Day	Plot Start	00:00_10/06/2011
Interval	30 Minute	Plot End	00:00_25/06/2011

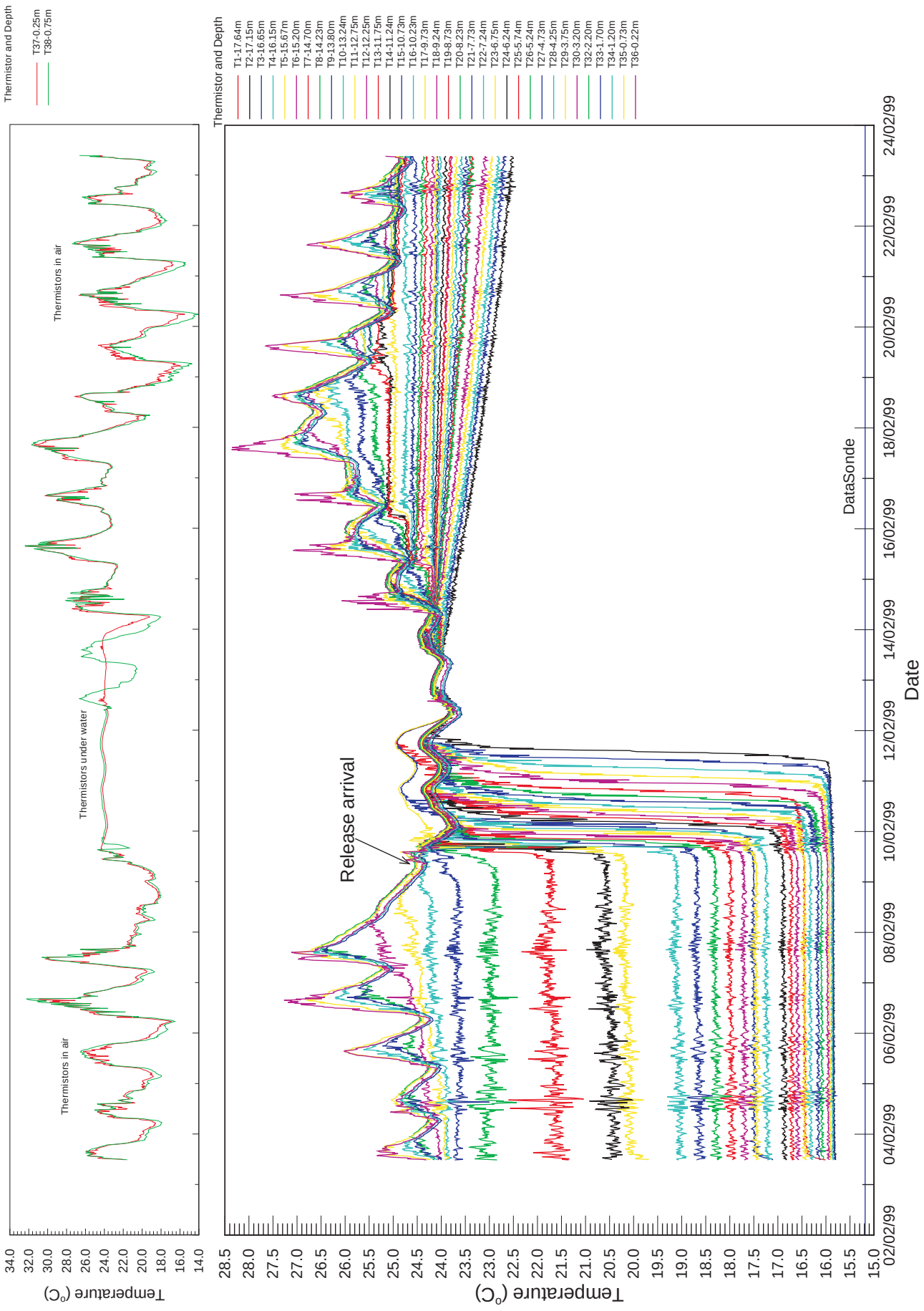


MHL Report 2387

Figure B1

DRAWING 2387-B.cdr

Station Name, Port Stephens (Live),,
Station Number,209471,,
Latitude,+152:10:56.06,,
Longitude,-32:42:53.57,,
Datum,PSHD,,
,,,
date,time,value,value.status
5/07/2011,0:00:00,1.61325,6 (Good)
5/07/2011,0:15:00,1.56495,6 (Good)
5/07/2011,0:30:00,1.47403,6 (Good)
5/07/2011,0:45:00,1.39316,6 (Good)
5/07/2011,1:00:00,1.3186,6 (Good)
5/07/2011,1:15:00,1.22369,6 (Good)
5/07/2011,1:30:00,1.10246,6 (Good)
5/07/2011,1:45:00,1.03073,6 (Good)
5/07/2011,2:00:00,0.949726,6 (Good)
5/07/2011,2:15:00,0.84358,6 (Good)
5/07/2011,2:30:00,0.756913,6 (Good)
5/07/2011,2:45:00,0.658031,6 (Good)
5/07/2011,3:00:00,0.573691,6 (Good)
5/07/2011,3:15:00,0.504744,6 (Good)
5/07/2011,3:30:00,0.423529,6 (Good)
5/07/2011,3:45:00,0.361451,6 (Good)
5/07/2011,4:00:00,0.317804,6 (Good)
5/07/2011,4:15:00,0.276461,6 (Good)
5/07/2011,4:30:00,0.214138,6 (Good)
5/07/2011,4:45:00,0.196576,6 (Good)
5/07/2011,5:00:00,0.182245,6 (Good)
5/07/2011,5:15:00,0.190659,6 (Good)
5/07/2011,5:30:00,0.205091,6 (Good)
5/07/2011,5:45:00,0.22192,6 (Good)
5/07/2011,6:00:00,0.237748,6 (Good)
5/07/2011,6:15:00,0.291828,6 (Good)
5/07/2011,6:30:00,0.337178,6 (Good)
5/07/2011,6:45:00,0.395157,6 (Good)
5/07/2011,7:00:00,0.441683,6 (Good)
5/07/2011,7:15:00,0.495641,6 (Good)



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SAMPLE THERMISTOR CHAIN DATA
TEMPERATURE DISTRIBUTION TIME SERIES

MHL Report 2387

Figure B3

DRAWING 2387-B.cdr

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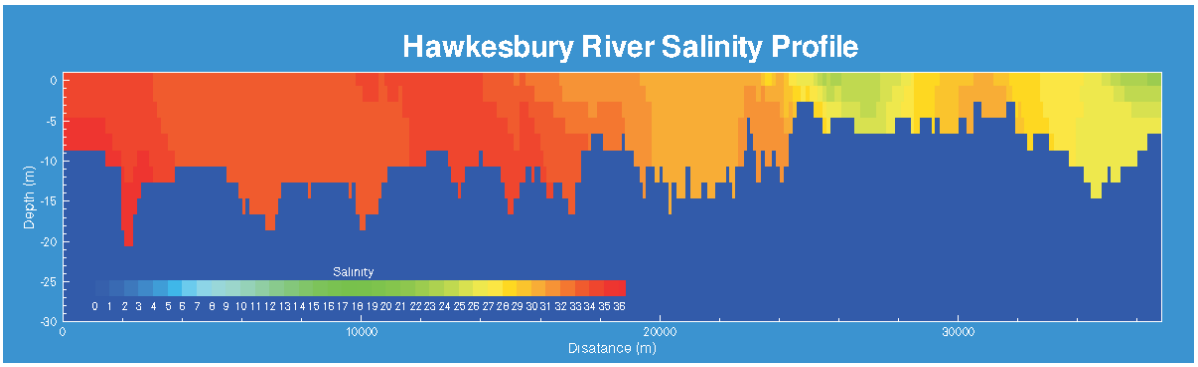
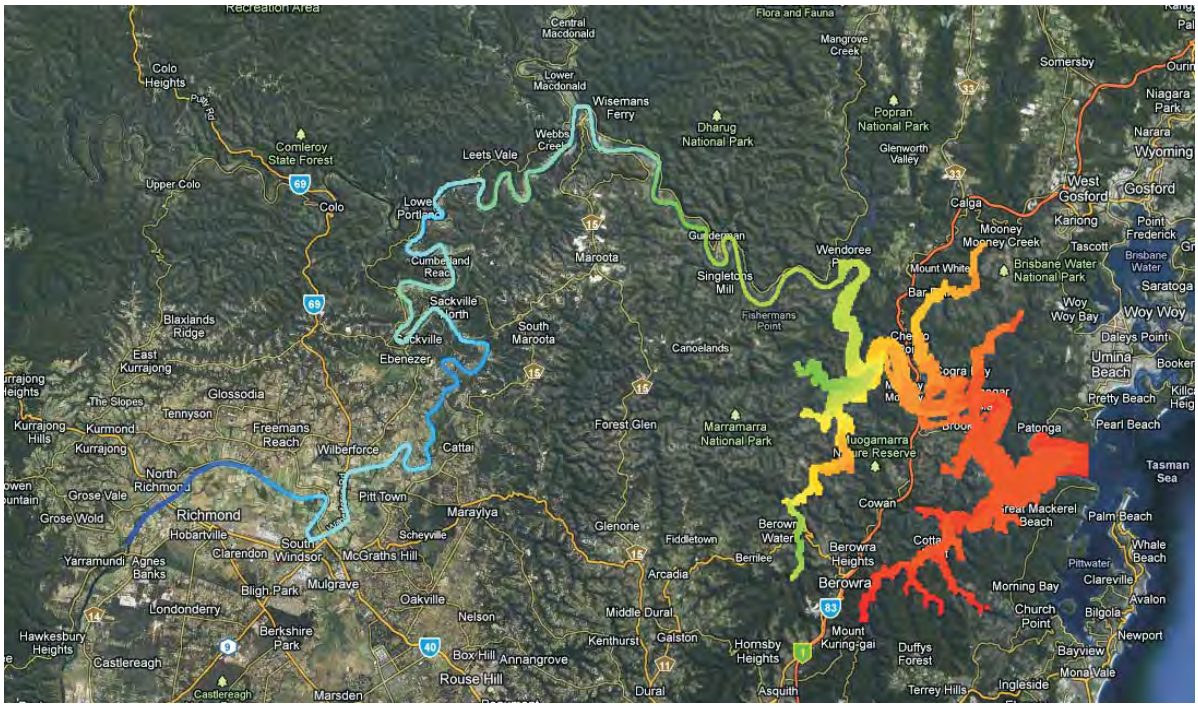
SAMPLE FLOW, WEATHER DATA AND TEMPERATURE CONTOURS

MHL Report 2387

Figure B4

DRAWING 2387-B.cdr


Hawkesbury River Salinity Profile
Depth (m)
0
-5
-10
-15
-20
-25
-30
Salinity
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
0
10000
20000
30000
Disatance (m)


Recreation Area
Central Macdonald
Flora and Fauna
Mangrove Creek
Somersby
Colo Heights
Lower Macdonald
Wisemans Ferry
Popran National Park
Niagara Park
Webbs Creek
Dharug National Park
Glenworth Valley
Narara
Wyoming
Comleroy State Forest
Leets Vale
West Gosford
Gosford
Upper Colo
Colo
Lower Portland
Calga
Karlong
Point Frederick
Mooney Mooney Creek
Tascott
Gunderman
Maroota
Wendoree
Mount White
Brisbane Water National Park
Brisbane Water
Saratoga
Cumberland Reac
Singletons Mill
Sackville North
Blaxlands Ridge
South Maroota
Fishermans Point
Woy Woy Bay
Woy Woy
Sackville
Ebenezer
Canoelands
Daleys Point
Umina Beach
East Kurrajong
Glossodia
The Slopes
Tennyson
Pretty Beach
Kurrajong Hills
Kurmond
Freemans Reach
Wilberforce
Forest Glen
Marramarra National Park
Patonga
Pearl Beach
Kurrajong
Cattai
Tasman Sea
North Richmond
Grose Vale
Pitt Town
Cowan
Grose Wold
Richmond
Maraylya
Hobartville
Scheyville
Glenorie
Fiddletown
Berowra Water
Palm Beach
Whale Beach
Yarramundi
Agnes Banks
South Windsor
Clarendon
McGraths Hill
Berrilee
Berowra Heights
Pittwater
Arcadia
Berowra
Clareville
Bligh Park
Mulgrave
Morning Bay
Avalon
Londonderry
Oakville
Nelson
Middle Dural
Church Point
Bilgola
Berkshire Park
Kenthurst
Galston
Mount Kuring-gai
Newport
Hawkesbury Heights
Castlereagh
Box Hill
Annangrove
Hornsby Heights
Duffys Forest
Bayview
Rouse Hill
Dural
Asquith
Terrey Hills
Ingleside
Mona Vale
Marsden

Appendix C

Other Publications of Interest

Appendix C Other Publications of Interest

Data Reports

MHL Annual Ocean Tide Levels Summaries available:

MHL Report Nos. 515 (86-87), 544 (87-88), 563 (88-89), 585 (89-90), 602 (90-91), 628 (91-92), 658 (92-93), 697 (93-94), 732 (94-95), 777 (95-96), 876 (96-97), 947 (97-98), 1013 (98-99), 1069 (99-00, 1129 (00-01), 1205 (01-02), 1277 (02-03), 1347 (03-04), 1423 (04-05), 1512 (05-06), 1764 (06-07), 1848 (07-08), 1933 (08-09), 2010 (09-10), 2089 (10-11), 2158 (11-12), 2219 (12-13) , 2292 (13-14).

MHL Annual Estuary and River Water Levels Summaries available:

MHL Report Nos. 555 (87-88), 564 (88-89), 582 (89-90), 601 (90-91), 625 (91-92), 659 (92-93), 698 (93-94), 731 (94-95), 778 (95-96), 875 (96-97), 947 (97-98), 1014 (98-99), 1070 (99-00), 1130 (00-01), 1206 (01-02), 1276 (02-03), 1346 (03-04), 1422 (04-05), 1511 (05-06), 1763 (06-07), 1847 (07-08), 1932 (08-09), 2009 (09-10), 2088 (10-11), 2157 (11-12), 2218 (12-13), 2291 (13-14).

MHL Annual Coastal Rainfall Summaries available:

MHL Report Nos. 610 (90-91), .624 (91-92), 660 (92-93), 699 (93-94), 730 (94-95), 776 (95-96), 874 (96-97), 946 (97-98), 1015 (98-99), 1071 (99-00), 1131 (00-01), 1207 (01-02), 1278 (02-03), 1348 (03-04), 1424 (04-05), 1513 (05-06), 1765 (06-07), 1849 (07-08), 1934 (08-09), 2011 (09-10), 2090 (10-11), 2159 (11-12), 2220 (12-13) , 2293 (13-14).

MHL Annual Wave Climate and Coastal Air Pressure Summaries available:

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Public Works
Manly Hydraulics Laboratory

110B King Street
Manly Vale NSW 2093
T 02 9949 0200
F 02 9948 6185
TTY 1300 301 181
www.mhl.nsw.gov.au