



Public Works
Manly Hydraulics Laboratory

NSW COASTAL RAINFALL ANNUAL SUMMARY 2013-2014

Report MHL2293
December 2014



prepared for
NSW Office of Environment and Heritage



Office of
Environment
& Heritage

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NSW Coastal Rainfall Annual Summary 2013-2014

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December 2014

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Cover photograph: Cleveland Road Rainfall Station, Wollongong

Document Control

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Report No. MHL2293
PW Report No. 14049
ISBN 978 0 7347 4488 3
MHL File No. EDP8-2172
First published December 2014



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

Foreword

NSW Public Works Manly Hydraulics Laboratory (MHL) is a business group within NSW Public Works, a division of the Office of Finance and Services. The NSW rainfall database has been developed to support a number of NSW Office of Environment and Heritage (OEH) programs associated with coastal, floodplain and estuary management. The monitoring service is available to local government and other organisations, both in Australia and overseas.

This annual summary presents the results of rainfall monitoring obtained by the automatic rainfall recording stations along the coastal estuaries and rivers of New South Wales over the period 1 July 2013 to 30 June 2014, and catalogues data collected in NSW by NSW Public Works MHL.

This summary has been prepared to provide ready access to NSW Public Works MHL's rainfall database and its data analysis capabilities.

Requests for further information should be directed to:

Manager Environmental Data NSW Public Works Manly Hydraulics Laboratory 110b King Street Manly Vale NSW 2093	Email : data-request@mhl.nsw.gov.au WWW : http://www.mhl.nsw.gov.au/ Telephone : (02) 9949 0200 Facsimile : (02) 9948 6185
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Summary

This report contains:

- a brief description of the coastal rainfall monitoring program
- guidelines on how to use this report
- information on how to access the database
- a review of significant program developments and rainfall events in 2013-2014
- a list of all stations for which NSW Public Works MHL collected rainfall data in 2013-2014 ([Table 5.1](#))
- the annual data summaries for each site
- [Appendix A](#) which details the rainfall data available
- [Appendix B](#) outlining some of the data analysis suites and presentation formats available
- [Appendix C](#) a list of publications which may be of interest.

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1. Rainfall Monitoring Program

This report presents the twenty-ninth year of data collected by NSW Public Works Manly Hydraulics Laboratory (MHL). The network of automatic recorders and the associated analysis routines enable NSW Public Works MHL to provide an efficient service in providing rainfall data. As well as near real time rainfall information at over 120 stations in NSW, extracts from the historical database of rainfall data can be made available on request (refer to [Appendix A](#)).

The present program is based on a network of automatic rainfall recording stations installed at various coastal sites (see Section 5 [Station Location Maps](#)). The network consists of 73 permanent stations funded by NSW Office of Environment and Heritage (OEH), and over 50 short-term client-based project sites featuring distinctive, site-specific systems of rainfall monitoring and logging. The system utilises 0.2 mm, 0.5 mm and 1.0 mm tipping buckets and data loggers, shown in [Figure 1](#).

Rainfall data is transferred to the NSW Data Collection Warehouse, and to NSW Public Works MHL's data server using a variety of telemetry techniques including internet protocol (IP), landline telephone, cellular networks and Event-reporting Radio Telemetry System (ERTS). The incoming raw data is then immediately available to external users to view on-line as schematised in [Figure 2](#).

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

Data is backed up daily and archived to magnetic tape as a security measure at regular intervals. A complete mirrored backup database is also maintained at the NSW Data Collection Warehouse.

2. How to Use This Report

This report aims to streamline access to NSW Public Works MHL's services and to the rainfall 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. A list of rainfall data collected and stored on-line is included in [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](#) provides examples of data analysis and presentation formats available from NSW Public Works MHL. Available rainfall products include:

Tabulated Output

- daily totals
- intensity/duration tables
- time of tips of rain gauge or short period fixed time step data
- intensity-frequency-duration tables.

Graphical Plots

- hourly, daily, monthly and yearly hyetographs
- intensity-frequency-duration curves.

3. How to Access the Data

NSW Public Works 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 the NSW Public Works MHL web page (<http://www.mhl.nsw.gov.au>), by emailing data-request@mhl.nsw.gov.au, or via customised decision support tools that can be provided upon request.

The NSW Public Works MHL website has been updated in association with an updated database and data warehouse capability. The latest website was launched in March 2012 and includes updated functionality, data access and availability of rainfall time-series plots.

4. Significant Events and Developments 2013-2014

This section outlines events and developments which have influenced rainfall data monitoring during this reporting period.

The following stations were relocated during the fiscal year:

- South Boambee – relocated 25 m north of the original location due to access issues to the original site
- Kooroowi – relocated 800 m south-west from the existing site to ensure suitable surrounding clearance area
- Tiona – station to be decommissioned due to safety access issues
- Pacific Palms Wharf – new station installed approximately 2 km south from Tiona due to safety access issues at Tiona
- Barnsley – station relocated 150 m west from the original site at request of land owner
- Little Lake Entrance – new combined water level/rainfall station installed downstream from original site due to hydrometric monitoring issues.

Upgrades included new cabinet with instrumentation and TB3 rain gauge at Wyoming, Mount Sterland, Mardi Dam, Strickland Forest and Narara during the reporting period.

In the 2013-2014 fiscal year, the maximum recorded rainfall intensities for 11 durations between 5 minutes and 72 hours occurred at four different sites across the OEH rainfall network ([Table 4.1](#)). To determine the significance of a rainfall event, the intensities are compared against the Annual Exceedance Probability (AEP), where the AEP is the probability of an event occurring in any one year at a particular duration. An event with a 1% AEP (or the 100-year rainfall) is an event that has a 1% chance of being equalled or exceeded in any one year.

A summary of rainfall events during 2013-2014 on the NSW east coast is provided in [Table 4.2](#).

The maximum recorded rainfall for durations of 5 minutes to 72 hours at each station for 2013-2014 is presented in [Table 4.3](#).

Table 4.1 Maximum Recorded Intensities for all Stations 2013-2014

Duration	Station	Date	Rainfall (mm)	Rainfall (mm/hr)	AEP (%)
5min	Nabiac	25/04/2014	18.5	222.0	~2
10min	Nabiac	25/04/2014	34.0	204.0	~1
20min	Little Lake	15/11/2013	50.5	151.5	~2
30min	Little Lake	15/11/2013	71.0	142.0	~1
60min	Little Lake	15/11/2013	107.0	107.0	~1
3hrs	Rixons Pass	25/03/2014	126.5	42.2	~10
6hrs	Rixons Pass	25/03/2014	193.0	32.2	~5
12hrs	Rixons Pass	25/03/2014	249.0	20.8	~10
24hrs	Huonbrook	28/03/2014	278.0	11.6	~18
48hrs	Huonbrook	28/03/2014	294.5	6.1	~39
72hrs	Huonbrook	28/03/2014	319.5	4.4	~39

Table 4.2 lists significant rainfall events that occurred in the 2013-2014 fiscal year. 100 mm of rain falling in a 24-hour period has been deemed a suitable significant rain event by OEH.

Table 4.2 2013-2014 Summary of Rainfall Events

Month	Summary of Rainfall Events
July 2013	Daily rainfall exceeding 100 mm in 24 hours has occurred at Huonbrook
August 2013	No events exceeding 100 mm in 24 hours have occurred this month
September 2013	Daily rainfall exceeding 100 mm in 24 hours has occurred at nine sites in the Wollongong and South Coast region
October 2013	No events exceeding 100 mm in 24 hours have occurred this month
November 2013	Daily rainfall exceeding 100 mm in 24 hours has occurred at two Tweed region sites, five Great Lakes–Hunter region sites and six Macquarie–Tuggerah Lakes region sites
December 2013	No events exceeding 100 mm in 24 hours have occurred this month
January 2014	No events exceeding 100 mm in 24 hours have occurred this month
February 2014	Daily rainfall exceeding 100 mm in 24 hours has occurred at Mandalong and Wyee
March 2014	Daily rainfall exceeding 100 mm in 24 hours has occurred at five stations along the Tweed–Coffs Harbour region and 12 stations along the Wollongong–South Coast region
April 2014	No events exceeding 100 mm in 24 hours have occurred this month
May 2014	No events exceeding 100 mm in 24 hours have occurred this month
June 2014	No events exceeding 100 mm in 24 hours have occurred this month

4.1 Southern Oscillation Index

The Southern Oscillation Index (SOI) is a calculation of monthly or seasonal shifts in the air pressure between Darwin and Tahiti (source: Bureau of Meteorology). As well as being linked to the temperature of the Pacific Ocean and the strength of Pacific Trade winds, the SOI is also associated with rainfall and can be used to predict whether higher or lower than average rainfall may occur in northern and eastern Australia.

A La Niña episode occurs when there are ongoing positive SOI values, and increases the probability of higher than average rainfall in northern and eastern Australia. Sustained negative SOI values have been coined El Niño events, and are associated with a reduction in rainfall over northern and eastern Australia. Even low to moderate El Niño events can lead to severe droughts in Australia. The SOI for the period July 1995 to June 2014 is graphically represented in [Figure 3](#).

4.2 Data Provision

Rainfall data is provided to the public on behalf of the NSW Office of Environment and Heritage, via:

- OEH's and NSW Public Works MHL's public Internet home pages, providing near real-time access to a limited sample of data. Other methods of disseminating data include email correspondence and File Transfer Protocol (FTP).
- Data is being provided for presentation on the NSW Government Water Information website at <http://waterinfo.nsw.gov.au/>.
- NSW Public Works MHL provides OEH and NSW SES officers access to near-real time environmental data and our 'quality assured' historical database through a customised MHL Web Portal.
- NSW SES officers also receive automated notifications for flood warning projects in NSW.
- A Web-based data request system has been established where electronic requests can be submitted via NSW Public Works MHL's homepage at <http://mhl.nsw.gov.au> under the Data Request menu.

Statistics

- This year in excess of 165,000 public and customer Internet pages will be served by NSW Public Works MHL per month.
- NSW Public Works MHL has approximately 90,000 visitors to its website monthly.
- In excess of 1,997,500 individual webpage hits have been recorded in 2013-2014.
- Data access also continues to assist the Bureau of Meteorology, local government authorities, State Emergency Service, NSW Police, Sydney Catchment Authority, NSW Surf Life Saving Association, universities, the NSW court system, private consultancies, NSW Roads and Maritime Services and the Natural Resources Commission.
- A number of communities across Australia continue to receive environmental data from NSW Public Works MHL.

Table 4.3 2013-2014 Maximum Recorded Rainfall (mm)

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Cudgera	29/11/2013 9.0	13/11/2013 12.5	13/11/2013 23.5	13/11/2013 28.5	13/11/2013 33.5	28/03/2014 63.0	28/03/2014 94.0	28/03/2014 155.5	28/03/2014 187.0	28/03/2014 194.5	28/03/2014 207.5	911.0
Main Arm	11/12/2013 13.0	11/12/2013 20.0	11/12/2013 27.0	11/12/2013 28.0	28/03/2014 31.5	28/03/2014 72.5	28/03/2014 135.0	28/03/2014 207.5	28/03/2014 253.5	28/03/2014 262.5	29/03/2014 283.5	1138.0
Huonbrook	17/11/2013 7.0	17/11/2013 11.0	17/11/2013 15.5	28/03/2014 21.5	28/03/2014 39.0	28/03/2014 95.0	28/03/2014 148.0	28/03/2014 228.5	28/03/2014 278.0	28/03/2014 294.5	28/03/2014 319.5	1177.5
Myocum	11/12/2013 8.0	11/12/2013 10.5	11/12/2013 15.5	11/12/2013 19.0	28/03/2014 26.0	28/03/2014 56.5	28/03/2014 81.0	28/03/2014 124.0	28/03/2014 142.0	28/03/2014 145.0	30/03/2014 153.5	918.5
Lake Ainsworth²	2/07/2013 7.5	2/07/2013 11.5	2/07/2013 17.0	25/04/2014 18.0	28/03/2014 26.5	28/03/2014 44.0	28/03/2014 63.5	28/03/2014 96.0	28/03/2014 108.0	28/03/2014 110.0	28/03/2014 115.0	814.5
Wooli Caravan Park	1/05/2014 11.5	11/11/2013 20.0	11/11/2013 29.0	11/11/2013 32.5	11/11/2013 48.0	11/11/2013 61.5	11/11/2013 64.0	28/03/2014 77.0	12/11/2013 103.5	13/11/2013 132.5	13/11/2013 149.5	958.0
Perry Drive²	26/12/2013 11.0	10/11/2013 16.0	11/11/2013 22.5	11/11/2013 29.5	11/11/2013 37.5	11/11/2013 41.0	11/11/2013 48.0	28/04/2014 64.0	11/11/2013 69.0	12/11/2013 94.5	12/11/2013 103.5	1002.5
Shepards Lane	10/11/2013 9.0	10/11/2013 15.0	11/11/2013 21.0	11/11/2013 31.0	11/11/2013 40.0	11/11/2013 44.0	11/11/2013 49.0	12/11/2013 51.0	11/11/2013 68.5	12/11/2013 96.0	12/11/2013 102.5	1035.0
Red Hill	11/11/2013 9.0	11/11/2013 17.5	11/11/2013 25.5	11/11/2013 31.0	11/11/2013 39.0	11/11/2013 41.5	11/11/2013 48.0	28/04/2014 53.0	11/11/2013 64.0	12/11/2013 87.5	12/11/2013 98.5	960.5
Newports Creek	26/12/2013 16.0	26/12/2013 22.5	11/11/2013 28.5	11/11/2013 40.0	11/11/2013 63.0	11/11/2013 69.0	11/11/2013 73.0	12/11/2013 77.0	11/11/2013 81.5	12/11/2013 107.0	12/11/2013 121.0	1032.5
Middle Boambee	26/12/2013 13.0	26/12/2013 25.0	26/12/2013 29.5	11/11/2013 34.5	11/11/2013 43.0	11/11/2013 50.5	11/11/2013 54.0	28/04/2014 63.0	11/11/2013 78.5	12/11/2013 103.0	13/11/2013 113.5	1034.5
South Boambee²	10/11/2013 11.0	11/11/2013 20.0	11/11/2013 25.5	11/11/2013 28.0	11/11/2013 32.0	27/04/2014 45.0	28/04/2014 58.0	28/04/2014 70.0	28/04/2014 73.0	12/11/2013 83.0	12/11/2013 97.5	932.5
North Bonville	26/12/2013 12.5	26/12/2013 23.0	11/11/2013 25.5	11/11/2013 35.0	11/11/2013 41.0	16/11/2013 60.0	16/11/2013 64.5	16/11/2013 64.5	11/11/2013 80.5	12/11/2013 93.0	12/11/2013 107.5	1133.0
Kooroowi²	13/11/2013 9.0	13/11/2013 13.5	21/03/2014 17.5	21/03/2014 22.5	21/03/2014 23.5	13/11/2013 38.0	13/11/2013 38.5	13/11/2013 38.5	13/11/2013 52.5	13/11/2013 61.5	13/11/2013 94.5	660.0

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Stuarts Island Downstream	25/11/2013 9.5	25/11/2013 14.0	24/03/2014 20.5	24/03/2014 23.0	16/02/2014 24.5	18/10/2013 40.0	18/10/2013 48.5	18/10/2013 51.0	18/10/2013 51.5	26/03/2014 57.0	28/03/2014 73.0	651.0
Utungun	29/11/2013 15.0	2/06/2014 19.5	2/06/2014 23.5	2/06/2014 23.5	10/11/2013 29.5	17/02/2014 36.0	17/02/2014 46.0	10/11/2013 61.5	11/11/2013 72.5	12/11/2013 105.5	13/11/2013 113.5	695.0
Aldavilla Downstream	12/11/2013 10.0	12/11/2013 16.0	12/11/2013 22.0	12/11/2013 22.0	12/11/2013 26.0	12/11/2013 37.0	12/11/2013 37.0	12/11/2013 46.0	12/11/2013 54.0	12/11/2013 66.0	13/11/2013 73.0	578.0
Green Valley²	28/02/2014 7.0	28/02/2014 10.5	25/03/2014 14.0	25/03/2014 20.0	25/03/2014 22.0	25/03/2014 25.0	18/10/2013 35.0	18/10/2013 38.0	2/03/2014 52.0	2/03/2014 73.0	28/03/2014 97.5	529.0
Telegraph Point	10/11/2013 6.0	10/11/2013 11.0	10/11/2013 18.0	10/11/2013 23.5	10/11/2013 37.5	11/11/2013 48.0	11/11/2013 59.5	11/11/2013 67.0	11/11/2013 70.0	12/11/2013 102.5	13/11/2013 117.0	702.0
Logans Crossing	25/11/2013 9.0	25/11/2013 13.0	2/06/2014 19.5	2/06/2014 25.5	2/06/2014 28.5	10/11/2013 46.0	10/11/2013 68.5	10/11/2013 86.0	2/03/2014 101.5	2/03/2014 124.5	3/03/2014 126.5	755.0
Mount George	15/11/2013 9.5	15/11/2013 17.0	15/11/2013 23.0	15/11/2013 27.5	15/11/2013 28.0	25/04/2014 40.0	25/04/2014 42.0	1/03/2014 44.0	16/11/2013 58.0	2/03/2014 75.0	2/03/2014 81.5	722.0
Nabiac	25/04/2014 18.5	25/04/2014 34.0	25/04/2014 46.0	25/04/2014 51.5	25/04/2014 59.0	25/04/2014 83.0	25/04/2014 83.0	25/04/2014 83.0	25/04/2014 83.0	25/04/2014 83.0	27/04/2014 88.0	610.0
Tuncurry	16/02/2014 9.0	25/04/2014 14.0	25/04/2014 26.0	25/04/2014 37.0	25/04/2014 54.0	25/04/2014 57.0	25/04/2014 57.0	11/11/2013 67.0	11/11/2013 86.0	12/11/2013 93.5	12/11/2013 98.0	702.5
Tiona	29/10/2013 6.5	29/10/2013 11.5	29/10/2013 14.5	29/10/2013 17.5	29/10/2013 28.5	29/10/2013 38.5	29/10/2013 40.0	2/03/2014 49.0	11/11/2013 52.5	11/11/2013 68.5	2/03/2014 91.5	712.5
Pacific Palms Wharf	16/02/2014 9.5	16/02/2014 15.0	6/06/2014 22.0	25/04/2014 27.0	25/04/2014 35.0	11/11/2013 50.5	11/11/2013 74.0	11/11/2013 83.5	11/11/2013 89.0	11/11/2013 146.0	12/11/2013 164.0	944.0
Tarbuck Bay	23/11/2013 10.0	23/11/2013 17.5	23/11/2013 21.0	23/11/2013 21.5	2/03/2014 24.0	28/02/2014 40.0	28/02/2014 59.0	18/11/2013 67.5	18/11/2013 103.5	18/11/2013 121.0	2/03/2014 149.5	1144.5
Bulahdelah	25/04/2014 10.5	25/04/2014 17.0	25/04/2014 31.0	25/04/2014 35.5	25/04/2014 39.0	18/11/2013 43.5	18/11/2013 72.0	18/11/2013 123.5	18/11/2013 132.0	18/11/2013 140.0	18/11/2013 145.0	880.5
Gostwyck	16/11/2013 6.0	11/11/2013 10.0	11/11/2013 17.0	25/04/2014 22.5	28/02/2014 33.5	18/11/2013 58.0	18/11/2013 105.5	18/11/2013 170.0	18/11/2013 215.0	18/11/2013 237.5	18/11/2013 260.5	801.0
Seaham	7/01/1900 7.5	10/01/1900 10.0	14/01/1900 14.0	19/01/1900 19.0	24/01/1900 24.5	17/02/1900 48.5	24/03/1900 84.5	8/05/1900 129.5	28/06/1900 180.5	11/07/1900 193.5	13/07/1900 195.5	663.5
Belmore Bridge	29/10/2013 9.5	29/10/2013 14.0	29/10/2013 19.5	29/10/2013 20.5	29/10/2013 21.5	28/02/2014 39.0	18/11/2013 65.0	18/11/2013 102.5	18/11/2013 135.5	18/11/2013 149.5	18/11/2013 152.5	651.5

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Hexham Bridge	19/02/2014 8.5	19/02/2014 13.0	29/10/2013 15.5	19/02/2014 19.5	17/11/2013 24.5	18/11/2013 45.5	18/11/2013 79.5	18/11/2013 118.5	18/11/2013 156.5	18/11/2013 168.5	19/11/2013 170.0	736.0
Barnsley	25/04/2014 12.5	25/04/2014 22.5	25/04/2014 31.5	25/04/2014 46.0	25/04/2014 69.0	25/04/2014 82.5	25/04/2014 89.0	25/04/2014 90.0	18/11/2013 114.5	18/11/2013 131.5	18/11/2013 141.0	846.5
Martinsville²	16/11/2013 8.0	16/11/2013 10.5	15/11/2013 10.5	27/02/2014 13.0	27/02/2014 18.5	28/02/2014 38.5	28/02/2014 56.5	28/02/2014 83.0	18/11/2013 107.5	18/11/2013 135.0	18/11/2013 153.0	616.5
Mandalong	25/04/2014 11.0	25/04/2014 21.0	25/04/2014 31.0	25/04/2014 36.5	15/11/2013 48.0	28/02/2014 88.0	28/02/2014 150.5	28/02/2014 192.0	28/02/2014 202.0	1/03/2014 209.0	2/03/2014 213.0	1077.5
Wyee	24/03/2014 9.0	24/03/2014 15.5	25/04/2014 25.0	25/04/2014 30.0	25/04/2014 38.0	28/02/2014 65.0	28/02/2014 113.5	28/02/2014 149.0	28/02/2014 163.5	18/11/2013 172.5	18/11/2013 186.0	964.5
Whitemans Ridge	16/11/2013 10.0	16/11/2013 16.5	16/11/2013 25.5	16/11/2013 35.0	16/11/2013 41.0	16/11/2013 44.5	16/11/2013 45.0	18/11/2013 58.0	18/11/2013 87.0	18/11/2013 98.5	18/11/2013 145.0	831.5
Yarramalong	28/03/2014 7.0	28/03/2014 14.0	28/03/2014 27.0	28/03/2014 38.5	28/03/2014 48.5	28/03/2014 62.5	28/03/2014 72.0	28/03/2014 72.0	18/11/2013 76.5	18/11/2013 92.0	18/11/2013 100.0	722.5
Kulnura	30/03/2014 5.5	30/03/2014 10.5	30/03/2014 17.5	30/03/2014 22.5	30/03/2014 28.0	30/03/2014 31.0	30/03/2014 31.0	18/11/2013 37.0	18/11/2013 67.0	18/11/2013 87.5	18/11/2013 90.5	723.5
Toukley	25/04/2014 9.5	25/04/2014 17.0	25/04/2014 28.0	25/04/2014 33.0	25/04/2014 35.0	25/04/2014 35.5	28/02/2014 53.5	28/02/2014 62.0	28/02/2014 65.0	1/03/2014 93.5	1/03/2014 97.5	772.0
Hamlyn Terrace	25/04/2014 10.5	25/04/2014 19.5	25/04/2014 33.5	25/04/2014 45.0	25/04/2014 51.0	25/04/2014 56.5	28/02/2014 74.0	28/02/2014 95.5	18/11/2013 134.5	18/11/2013 152.5	18/11/2013 190.0	1090.0
Mardi Dam	15/11/2013 8.5	15/11/2013 16.5	15/11/2013 22.0	15/11/2013 25.5	15/11/2013 26.0	16/11/2013 50.5	16/11/2013 53.0	18/11/2013 58.0	18/11/2013 93.5	18/11/2013 108.5	18/11/2013 164.0	856.5
Sterland	16/03/2014 4.5	28/03/2014 7.0	28/03/2014 12.5	28/03/2014 19.0	28/03/2014 29.5	28/03/2014 48.0	28/03/2014 57.0	28/03/2014 57.0	18/11/2013 90.0	18/11/2013 99.0	18/11/2013 128.5	836.0
Kangy Angy	30/03/2014 7.5	15/11/2013 13.0	15/11/2013 17.5	15/11/2013 21.0	15/11/2013 41.0	16/11/2013 55.5	16/11/2013 56.5	18/11/2013 61.0	18/11/2013 94.5	18/11/2013 111.0	18/11/2013 168.0	889.5
Berkeley Vale	15/11/2013 12.0	15/11/2013 23.5	15/11/2013 44.5	15/11/2013 61.5	15/11/2013 78.5	16/11/2013 95.5	16/11/2013 96.5	16/11/2013 96.5	18/11/2013 99.5	17/11/2013 161.0	18/11/2013 213.0	953.5
Bateau Bay	16/03/2014 7.5	17/11/2013 9.0	17/11/2013 16.5	17/11/2013 21.5	17/11/2013 37.0	17/11/2013 62.0	17/11/2013 79.0	17/11/2013 100.0	18/11/2013 139.5	18/11/2013 159.5	18/11/2013 198.0	1010.0

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Lisarow	15/11/2013 18.0	15/11/2013 28.5	15/11/2013 43.5	15/11/2013 56.0	15/11/2013 63.0	25/04/2014 70.0	25/04/2014 72.0	25/04/2014 73.0	18/11/2013 75.0	17/11/2013 118.0	18/11/2013 164.5	962.5
Strickland	30/03/2014 10.5	30/03/2014 16.5	15/11/2013 24.5	15/11/2013 30.5	15/11/2013 39.5	16/11/2013 41.0	19/02/2014 45.5	18/11/2013 47.5	18/11/2013 67.5	18/11/2013 89.5	18/11/2013 132.0	872.0
Narara	30/03/2014 11.0	30/03/2014 19.0	30/03/2014 30.0	30/03/2014 35.5	19/02/2014 41.0	19/02/2014 46.5	19/02/2014 53.0	19/02/2014 53.0	18/11/2013 62.0	18/11/2013 82.5	18/11/2013 97.5	893.5
Mount Elliot	15/11/2013 14.5	15/11/2013 26.0	25/04/2014 43.0	25/04/2014 63.0	25/04/2014 79.0	25/04/2014 87.0	25/04/2014 91.5	25/04/2014 95.5	25/04/2014 95.5	17/11/2013 130.0	18/11/2013 175.5	986.5
Wyoming	30/03/2014 12.5	30/03/2014 23.0	30/03/2014 37.0	30/03/2014 44.5	30/03/2014 47.5	30/03/2014 49.5	19/02/2014 53.0	19/02/2014 53.0	18/11/2013 61.0	18/11/2013 80.5	18/11/2013 99.0	933.5
Kincumber	19/02/2014 12.5	15/11/2013 19.5	15/11/2013 34.5	15/11/2013 48.5	15/11/2013 61.5	16/11/2013 72.0	16/11/2013 72.5	16/11/2013 72.5	16/11/2013 77.0	17/11/2013 128.0	18/11/2013 159.0	1009.0
Webbs Creek	4/12/2013 7.0	4/12/2013 10.2	19/02/2014 10.4	16/02/2014 11.4	13/03/2014 17.6	19/02/2014 21.2	16/02/2014 30.4	16/02/2014 40.4	17/02/2014 48.6	17/02/2014 55.8	17/02/2014 56.8	560.6
Colo Junction	30/03/2014 13.4	30/03/2014 17.8	22/11/2013 21.4	22/11/2013 24.8	22/11/2013 27.2	22/11/2013 28.0	22/11/2013 28.0	22/11/2013 32.2	17/02/2014 36.8	12/11/2013 49.4	18/11/2013 59.6	534.6
Sackville D/S	22/11/2013 9.0	22/11/2013 16.6	22/11/2013 26.4	22/11/2013 29.4	22/11/2013 30.2	22/11/2013 30.2	22/11/2013 30.4	22/11/2013 35.8	22/11/2013 37.8	12/11/2013 41.0	18/11/2013 45.6	429.2
Kelso Creek	24/03/2014 6.5	24/03/2014 11.5	24/03/2014 20.5	24/03/2014 31.0	24/03/2014 51.0	24/03/2014 76.5	24/03/2014 83.5	24/03/2014 83.5	25/03/2014 84.0	24/03/2014 84.0	27/03/2014 93.5	509.0
Rixons Pass²	24/03/2014 9.5	24/03/2014 18.5	24/03/2014 32.0	24/03/2014 40.0	24/03/2014 67.5	25/03/2014 126.5	25/03/2014 193.0	25/03/2014 249.0	25/03/2014 264.5	26/03/2014 269.5	27/03/2014 304.5	1085.5
Russell Vale	24/03/2014 14.0	24/03/2014 19.5	24/03/2014 25.5	25/03/2014 33.5	25/03/2014 60.0	25/03/2014 93.5	25/03/2014 148.0	25/03/2014 196.5	25/03/2014 214.0	26/03/2014 218.5	27/03/2014 250.5	1093.0
Mount Pleasant	24/03/2014 9.0	24/03/2014 15.5	24/03/2014 24.5	24/03/2014 38.0	24/03/2014 56.0	25/03/2014 97.0	25/03/2014 149.0	25/03/2014 189.0	25/03/2014 205.5	26/03/2014 215.5	27/03/2014 256.5	1309.5
Mount Kembla	15/11/2013 13.5	15/11/2013 20.5	15/11/2013 31.0	15/11/2013 37.0	15/11/2013 50.0	25/03/2014 71.5	25/03/2014 115.0	25/03/2014 165.5	25/03/2014 185.0	26/03/2014 199.5	27/03/2014 236.5	1177.5
Dombarton Loop	15/11/2013 11.5	15/11/2013 22.5	15/11/2013 29.0	15/11/2013 34.0	15/11/2013 41.5	25/03/2014 83.0	25/03/2014 142.5	25/03/2014 199.5	25/03/2014 217.0	26/03/2014 227.5	27/03/2014 263.0	1331.5

Station	Duration											Total yearly rainfall
	5 min	10 min	20 min	30 min	60 min	3 hrs	6 hrs	12 hrs	24 hrs	48 hrs	72 hrs	
Wongawilli	3/04/2014 9.5	15/11/2013 17.5	15/11/2013 25.5	15/11/2013 29.0	15/11/2013 53.5	15/11/2013 76.0	15/11/2013 94.0	25/03/2014 137.5	25/03/2014 153.5	26/03/2014 168.5	27/03/2014 194.0	1050.5
Port Kembla	15/11/2013 10.5	15/11/2013 18.0	15/11/2013 29.0	15/11/2013 36.0	15/11/2013 49.0	15/11/2013 57.0	24/03/2014 74.0	25/03/2014 123.5	25/03/2014 148.5	26/03/2014 159.5	27/03/2014 181.0	978.5
Darkes Road	25/03/2014 9.5	25/03/2014 15.5	25/03/2014 22.5	15/11/2013 31.5	15/11/2013 56.5	15/11/2013 83.0	17/09/2013 86.0	25/03/2014 135.5	25/03/2014 157.0	26/03/2014 168.5	27/03/2014 200.5	1007.5
Cleveland Road	25/03/2014 10.0	25/03/2014 15.5	25/03/2014 23.5	25/03/2014 27.0	24/03/2014 34.0	24/03/2014 57.0	24/03/2014 78.0	25/03/2014 137.5	25/03/2014 158.0	26/03/2014 174.0	27/03/2014 203.0	925.0
Huntley Colliery²	15/11/2013 11.5	15/11/2013 17.0	15/11/2013 23.5	15/11/2013 25.5	3/04/2014 37.0	16/09/2013 69.0	17/09/2013 110.5	17/09/2013 137.5	17/09/2013 141.5	17/09/2013 142.0	17/09/2013 152.0	767.5
Upper Calderwood	3/04/2014 7.5	3/04/2014 13.0	3/04/2014 21.5	25/03/2014 23.5	16/09/2013 31.5	17/09/2013 75.5	17/09/2013 125.5	17/09/2013 160.5	17/09/2013 169.0	17/09/2013 170.0	27/03/2014 185.0	954.0
Little Lake	15/11/2013 13.5	15/11/2013 26.0	15/11/2013 50.5	15/11/2013 71.0	15/11/2013 107.0	15/11/2013 121.5	16/11/2013 123.5	16/11/2013 125.0	25/03/2014 141.5	26/03/2014 156.0	18/11/2013 175.5	892.5
North Macquarie	24/03/2014 7.0	24/03/2014 12.5	24/03/2014 19.0	24/03/2014 24.0	24/03/2014 30.0	24/03/2014 46.0	17/09/2013 73.5	17/09/2013 94.5	17/09/2013 98.0	26/03/2014 135.0	27/03/2014 167.5	833.5
Clover Hill	20/03/2014 11.0	20/03/2014 20.0	20/03/2014 32.0	20/03/2014 38.5	16/09/2013 48.5	16/09/2013 113.0	17/09/2013 190.5	17/09/2013 244.0	17/09/2013 255.5	17/09/2013 256.5	17/09/2013 260.5	1160.0
Nurrewin	20/03/2014 10.5	20/03/2014 17.5	20/03/2014 30.0	20/03/2014 35.0	16/09/2013 43.0	16/09/2013 95.5	17/09/2013 165.0	17/09/2013 212.5	17/09/2013 222.5	17/09/2013 224.0	17/09/2013 227.5	1072.5
Yellow Rock Road	24/03/2014 7.5	24/03/2014 14.5	24/03/2014 22.5	24/03/2014 28.5	24/03/2014 36.0	24/03/2014 57.0	24/03/2014 72.5	25/03/2014 105.0	25/03/2014 121.0	26/03/2014 173.5	27/03/2014 214.5	1087.5
Barlows Bay	4/06/2014 9.5	4/06/2014 18.0	4/06/2014 23.5	4/06/2014 23.5	12/11/2013 26.5	12/11/2013 58.0	12/11/2013 79.5	12/11/2013 86.5	27/03/2014 121.5	27/03/2014 227.0	27/03/2014 230.0	893.0
Regatta Point	7/03/2014 11.5	7/03/2014 21.0	7/03/2014 35.0	7/03/2014 43.5	7/03/2014 69.0	7/03/2014 75.5	8/03/2014 77.5	8/03/2014 78.0	27/03/2014 89.5	27/03/2014 155.0	27/03/2014 157.5	902.0

¹ Dates listed refer to the time that the recorded maximum rainfall ends

² Some measure of data loss occurred at these sites. See individual plots for further details

5. Rainfall Monitoring Summary

This section documents locality maps and quality assured rainfall monitoring summaries for each station. Tables 5.1 and 5.2 provide indexes to the figures presented.

Table 5.1 Index of Figures

	Figure
Typical Pluviometer Station	1
Data Transfer Schematic	2
Southern Oscillation Index, June 1995-June 2014	3

Region	Short Name	Station No.	MGA	Easting	Northing	Figure
Station Locality Map	Tweed River and Brunswick River Regions					4
Tweed	Cudgera	558046	56	549668	6859164	5
Brunswick	Main Arm	558053	56	542469	6847276	6
Brunswick	Huonbrook	558049	56	538665	6840760	7
Brunswick	Myocum	558036	56	550528	6837390	8
Station Locality Map	Richmond River Region					9
Richmond	Lake Ainsworth	203455	56	557863	6816160	10
Station Locality Map	Bellinger River Region (North)					11
Bellinger	Wooli Caravan Park	205463	56	524551	6697797	12
Station Locality Map	Bellinger River Region					13
Bellinger	Perry Drive	559019	56	510149	6650415	14
Bellinger	Shepards Lane	559017	56	508200	6650890	15
Bellinger	Red Hill	559016	56	506655	6649689	16
Bellinger	Newports Creek	559051	56	505893	6646681	17
Bellinger	Middle Boambee	559048	56	504720	6645291	18
Bellinger	South Boambee	559049	56	504826	6643617	19
Bellinger	North Bonville	559050	56	500593	6641143	20
Bellinger	Kooroowi	205440	56	482562	6629162	21
Station Locality Map	Nambucca River Region					22
Nambucca	Stuarts Island Downstream	205466	56	499502	6608568	23
Nambucca	Utungun	205414	56	485797	6600327	24
Station Locality Map	Macleay River and Hasting River Regions					25
Macleay	Aldavilla Downstream	206459	56	479318	6561231	26
Hastings	Green Valley	207406	56	486422	6540269	27
Hastings	Telegraph Point	207415	56	481049	6534532	28

Region	Short Name	Station No.	MGA	Easting	Northing	Figure
Station Locality Map	Camden Haven Region					29
Camden Haven	Logans Crossing	207428	56	470912	6502301	30
Manning	Mount George	208440	56	419224	6472247	31
Station Locality Map	Karuah River Region					32
Karuah	Nabiac	209404	56	436821	6446458	33
Karuah	Tuncurry	209401	56	450591	6442284	34
Karuah	Tiona	209403	56	454412	6425971	35
Karuah	Pacific Palms Wharf	209406	56	455509	6422730	36
Karuah	Tarback Bay	209465	56	451230	6418348	37
Karuah	Bulahdelah	209460	56	425463	6413372	38
Station Locality Map	Hunter River (North) Region					39
Hunter	Gostwyck	210402	56	369104	6396070	40
Hunter	Seaham	210462	56	381105	6385316	41
Hunter	Belmore Bridge	210458	56	364435	6377790	42
Hunter	Hexham Bridge	210448	56	376768	6367608	43
Station Locality Map	Macquarie-Tuggerah Lakes (North) Region					44
Macquarie-Tuggerah Lakes	Barnsley	561067	56	367910	6355832	45
Macquarie-Tuggerah Lakes	Martinsville	561083	56	351245	6341595	46
Macquarie-Tuggerah Lakes	Mandalong	561081	56	355224	6335165	47
Macquarie-Tuggerah Lakes	Wyee	561097	56	358609	6328268	48
Station Locality Map	Macquarie-Tuggerah Lakes (South) and Hawkesbury River Regions					49
Macquarie-Tuggerah Lakes	Whitemans Ridge	561026	56	343664	6324896	50
Macquarie-Tuggerah Lakes	Yarramalong (S)	561137	56	338871	6322384	51
Macquarie-Tuggerah Lakes	Kulnura	561078	56	333767	6321516	52
Macquarie-Tuggerah Lakes	Toukley	211401	56	362602	6318536	53
Macquarie-Tuggerah Lakes	Hamlyn Terrace	561133	56	357399	6319854	54
Macquarie-Tuggerah Lakes	Mardi Dam	561082	56	351036	6314557	55
Macquarie-Tuggerah Lakes	Sterland	567138	56	342434	6315398	56
Macquarie-Tuggerah Lakes	Kangy Angy	561132	56	350168	6310609	57
Macquarie-Tuggerah Lakes	Berkeley Vale	561134	56	353191	6309376	58
Macquarie-Tuggerah Lakes	Bateau Bay	561069	56	358100	6305651	59
Macquarie-Tuggerah Lakes	Lisarow	561079	56	348927	6305252	60
Hawkesbury	Strickland	561136	56	345370	6305548	61
Hawkesbury	Narara	561085	56	344531	6303941	62
Hawkesbury	Mount Elliot	561084	56	350645	6302922	63
Hawkesbury	Wyoming	561098	56	346487	6302051	64
Hawkesbury	Kincumber	561077	56	350391	6294474	65
Station Locality Map	Hawkesbury River (Mid) Region					66
Hawkesbury	Webbs Creek	212408	56	312346	6303935	67
Hawkesbury	Colo Junction	212407	56	303218	6298170	68
Hawkesbury	Sackville Downstream	212438	56	302831	6291440	69

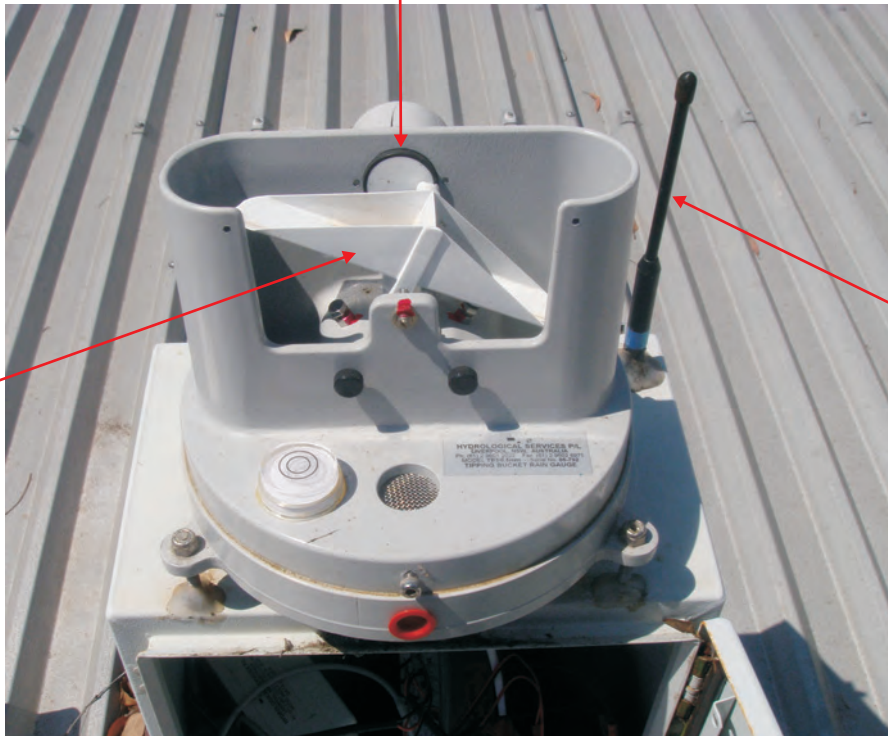
Region	Short Name	Station No.	MGA	Easting	Northing	Figure
Station Locality Map	Sydney Coastal Region					70
Sydney Coastal	Kelso Creek	213430	56	313763	6241029	71
Station Locality Map	Wollongong Coastal Region					72
Wollongong Coastal	Rixons Pass	568317	56	305280	6196896	73
Wollongong Coastal	Russell Vale	568318	56	306378	6196138	74
Wollongong Coastal	Mount Pleasant	568229	56	303305	6191991	75
Wollongong Coastal	Mount Kembla	568314	56	299550	6186447	76
Wollongong Coastal	Dombarton Loop	568307	56	294718	6185611	77
Wollongong Coastal	Wongawilli	568320	56	293261	6182391	78
Wollongong Coastal	Port Kembla	568316	56	306636	6182721	79
Wollongong Coastal	Darkes Road	568309	56	297450	6182478	80
Wollongong Coastal	Cleveland Road	568308	56	295799	6179730	81
Wollongong Coastal	Huntley Colliery	568311	56	290680	6178916	82
Wollongong Coastal	Upper Calderwood	568319	56	288750	6175161	83
Wollongong Coastal	Little Lake	214466	56	304089	6173338	84
Wollongong Coastal	Nurrewin	568228	56	284569	6173438	85
Wollongong Coastal	Clover Hill	568310	56	284232	6172390	86
Wollongong Coastal	North Macquarie	568315	56	291440	6171495	87
Wollongong Coastal	Yellow Rock Road	568321	56	292886	6167651	88
Station Locality Map	South Coast (Mid) Region					89
South Coast	Barlows Bay	218415	56	239467	5988955	90
South Coast	Regatta Point	219405	56	236890	5971052	91

(S) – Indicates station is standalone (non-telemetered)

Table 5.2 Index of Appendix B Figures

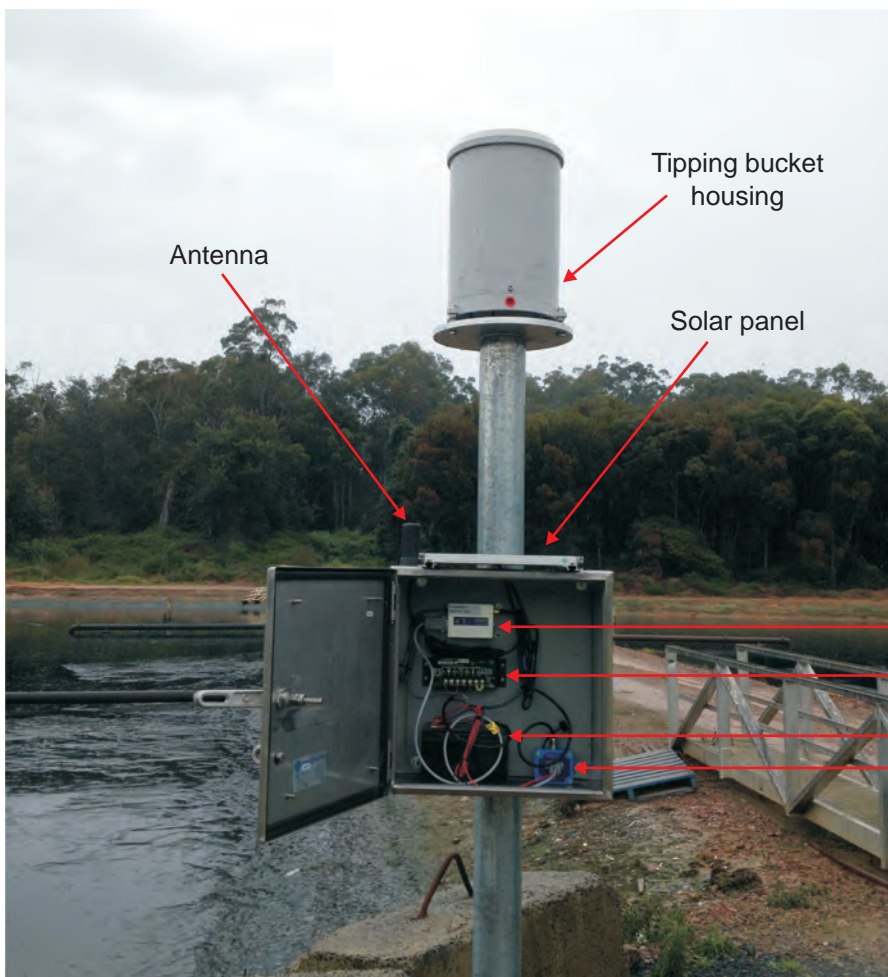
Sample Rainfall Data Outputs	Figure
Daily and Monthly Rainfall Plots, North Bonville	B1
Intensity-Frequency-Duration, North Bonville, 21 January-21 March 2013	B2
Rain Gauge Tip Times, North Bonville	B3

Reed switch registers bucket tips



Tipping bucket

Communication antenna



Antenna

Tipping bucket housing

Solar panel

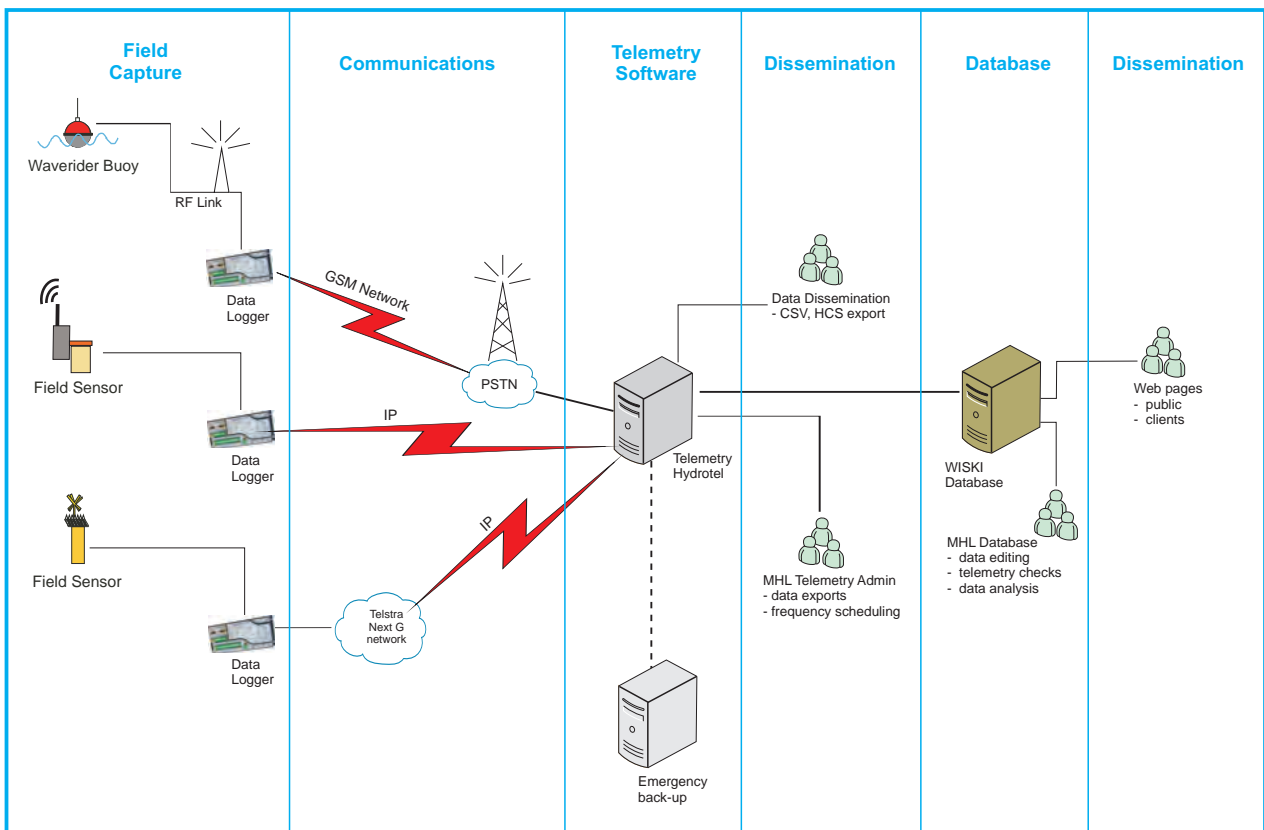
Modem

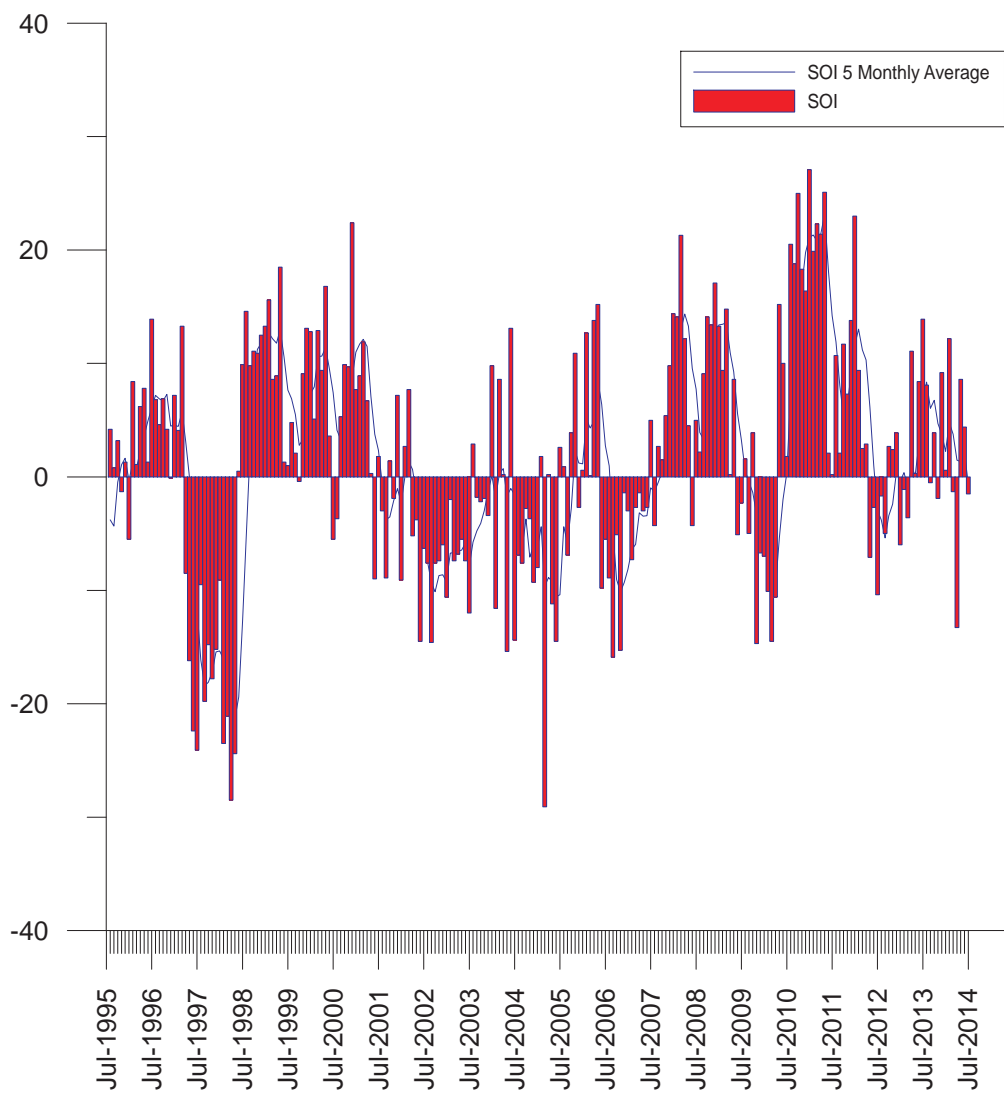
Solar regulator

Battery

ML1-Minilog







Source: Bureau of Meteorology (<http://www.bom.gov.au/climate/current/soi2.shtml>)





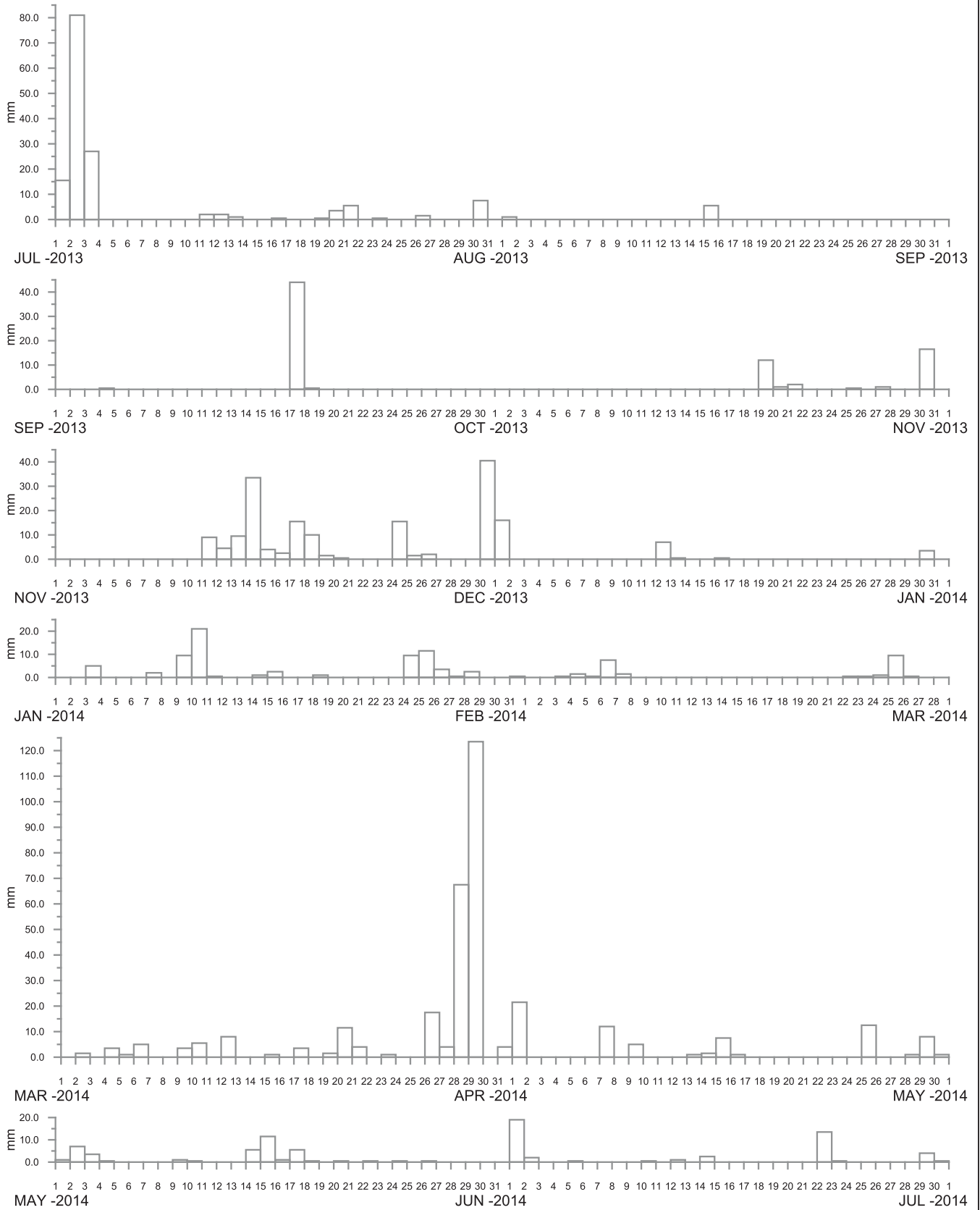
Public Works
Manly Hydraulics Laboratory

RAINFALL STATION LOCATIONS TWEED RIVER AND BRUNSWICK RIVER REGIONS

MHL
Report 2293

Figure
4

DRAWING 2293-04.cdr



----- DATA LOSS



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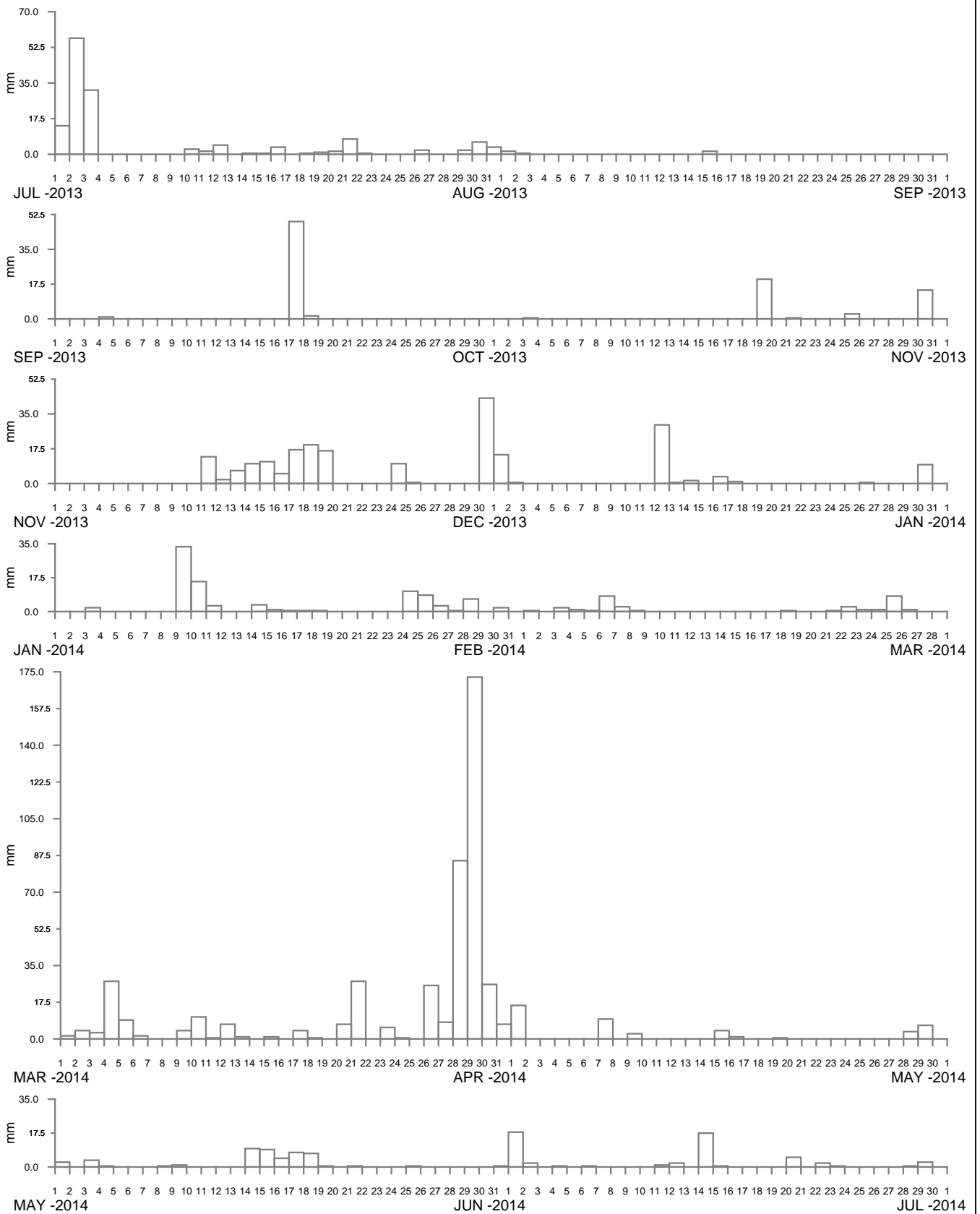
CUDGERA AT CABBAGE GUM ROAD
2013-2014

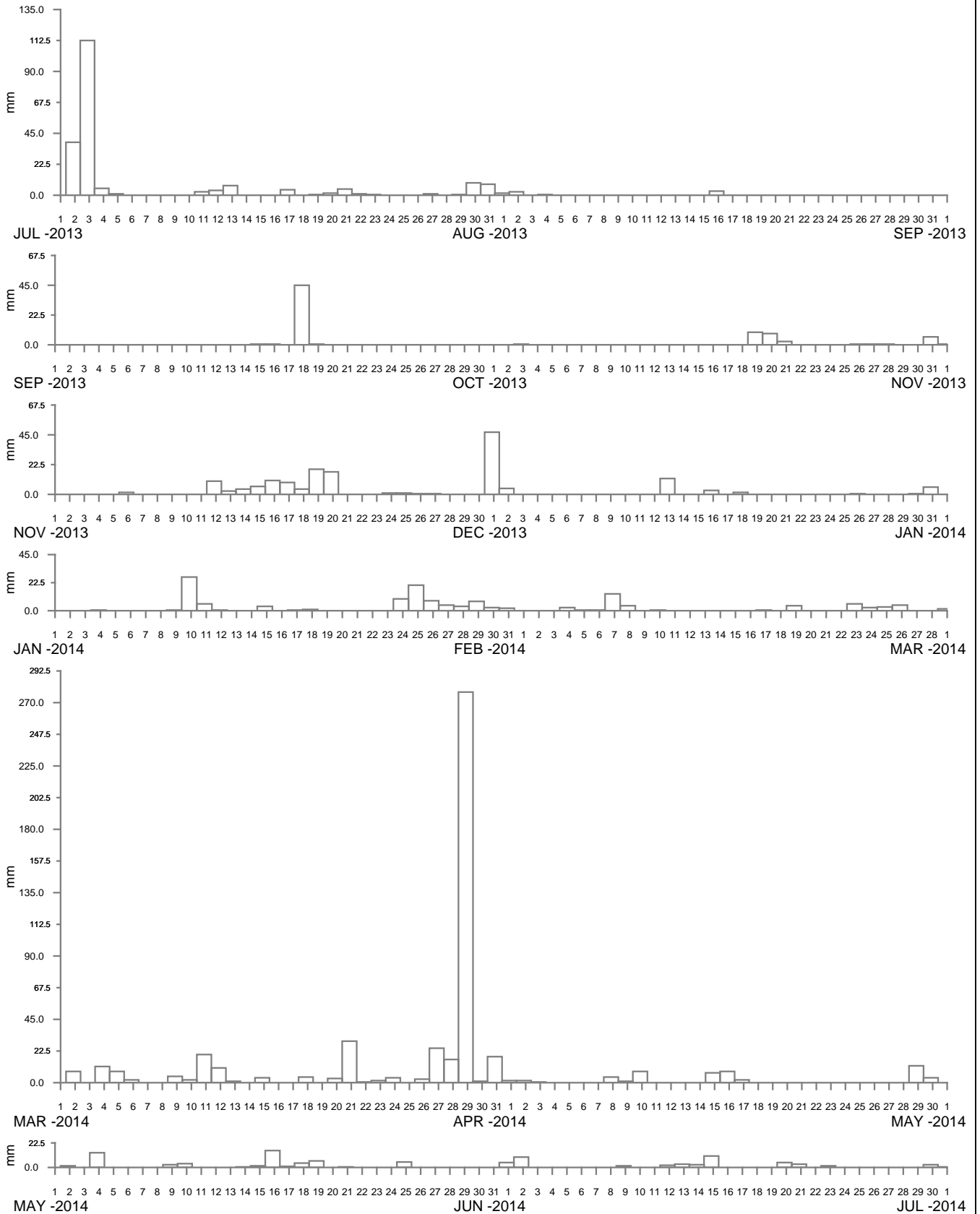
MHL
Report 2293

Figure

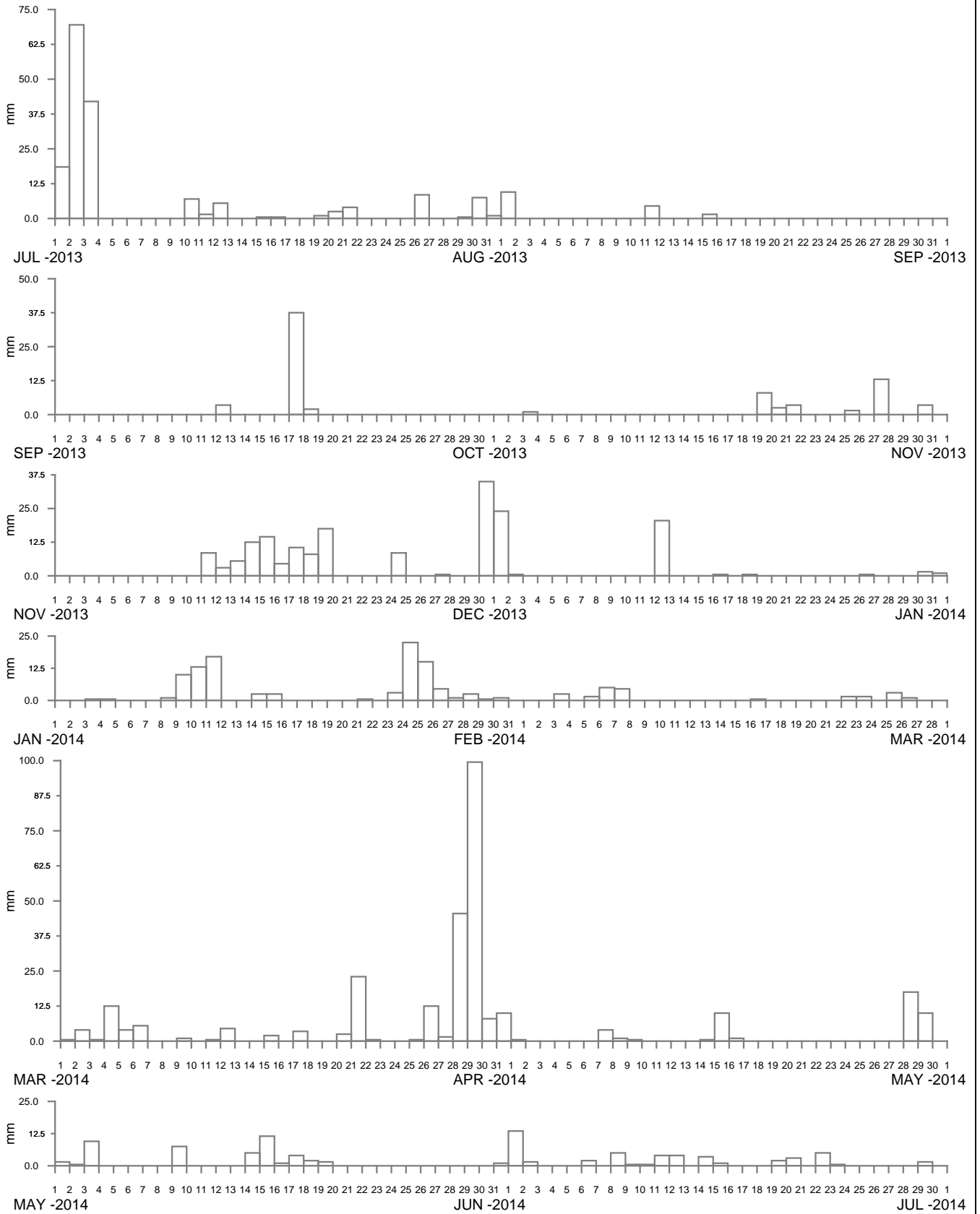
5

DRAWING 2293-5





----- DATA LOSS





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RAINFALL STATION LOCATIONS RICHMOND RIVER REGION

MHL
Report 2293

Figure
9

DRAWING 2293-09.cdr



Woolgi Caravan Park

DATA UNKNOWN

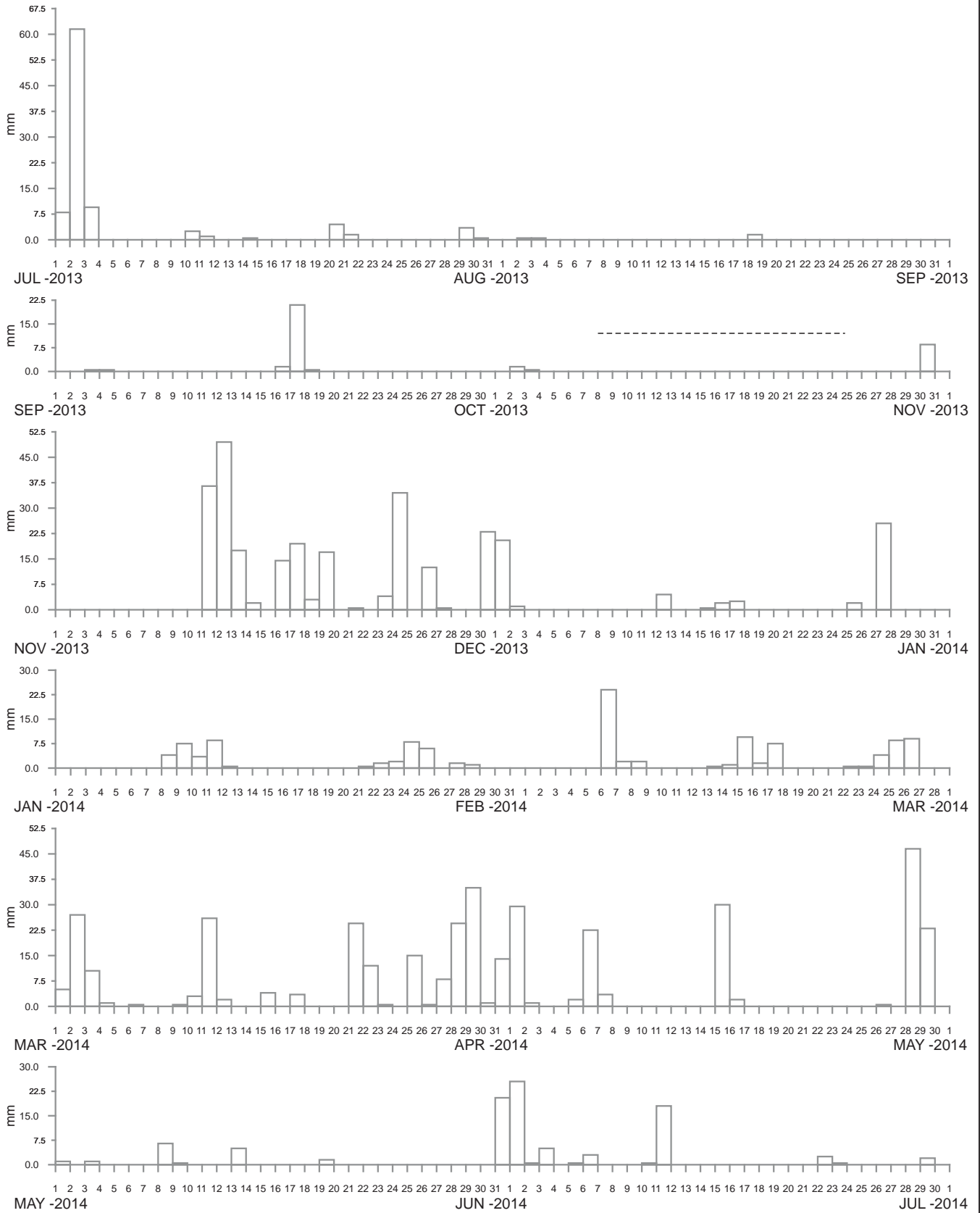


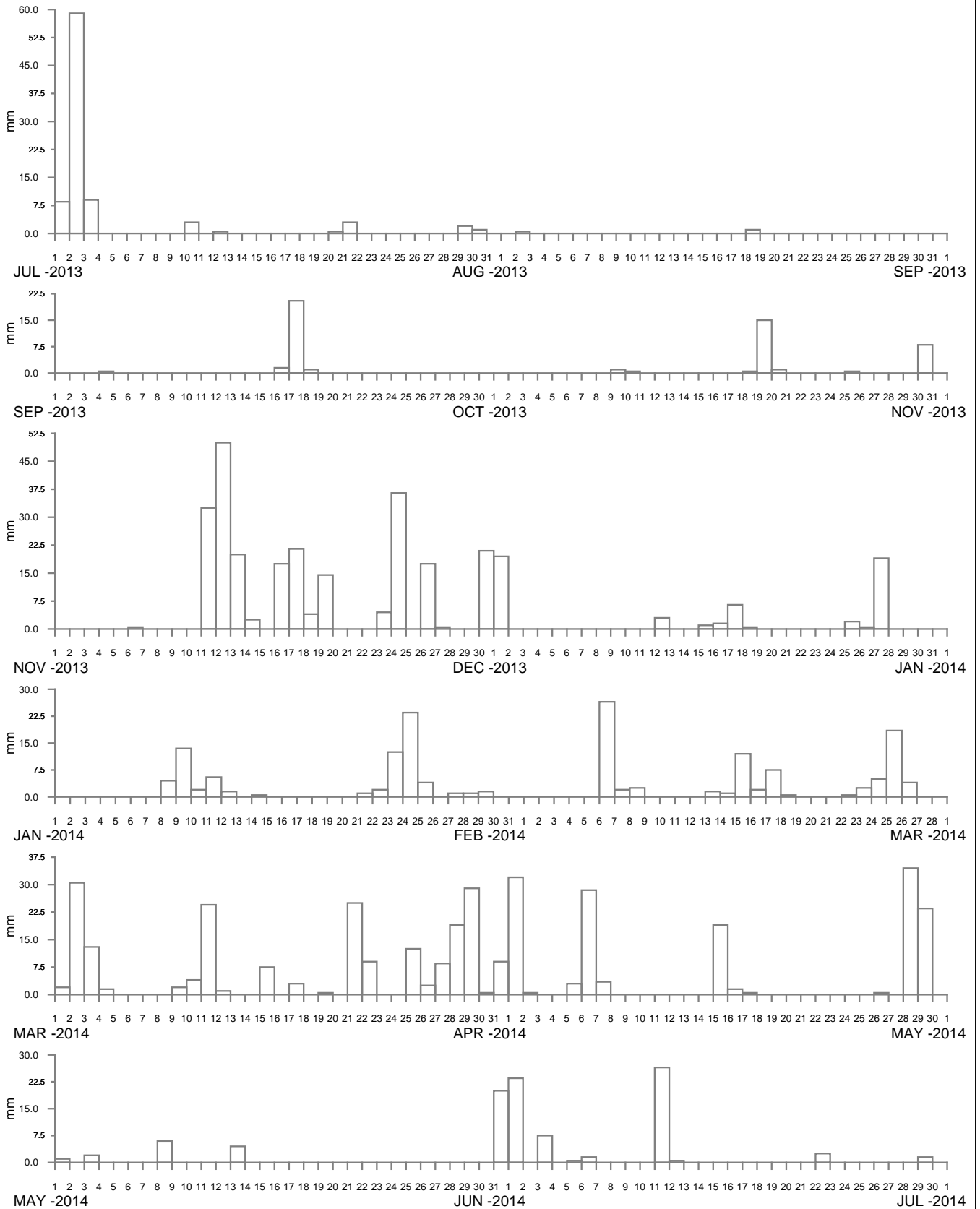
Public Works
Manly Hydraulics Laboratory

**RAINFALL STATION LOCATIONS
BELLINGER RIVER REGION**

MHL
Report 2293
**Figure
13**

DRAWING 2293-13.cdr





----- DATA LOSS



Public Works
Manly Hydraulics Laboratory

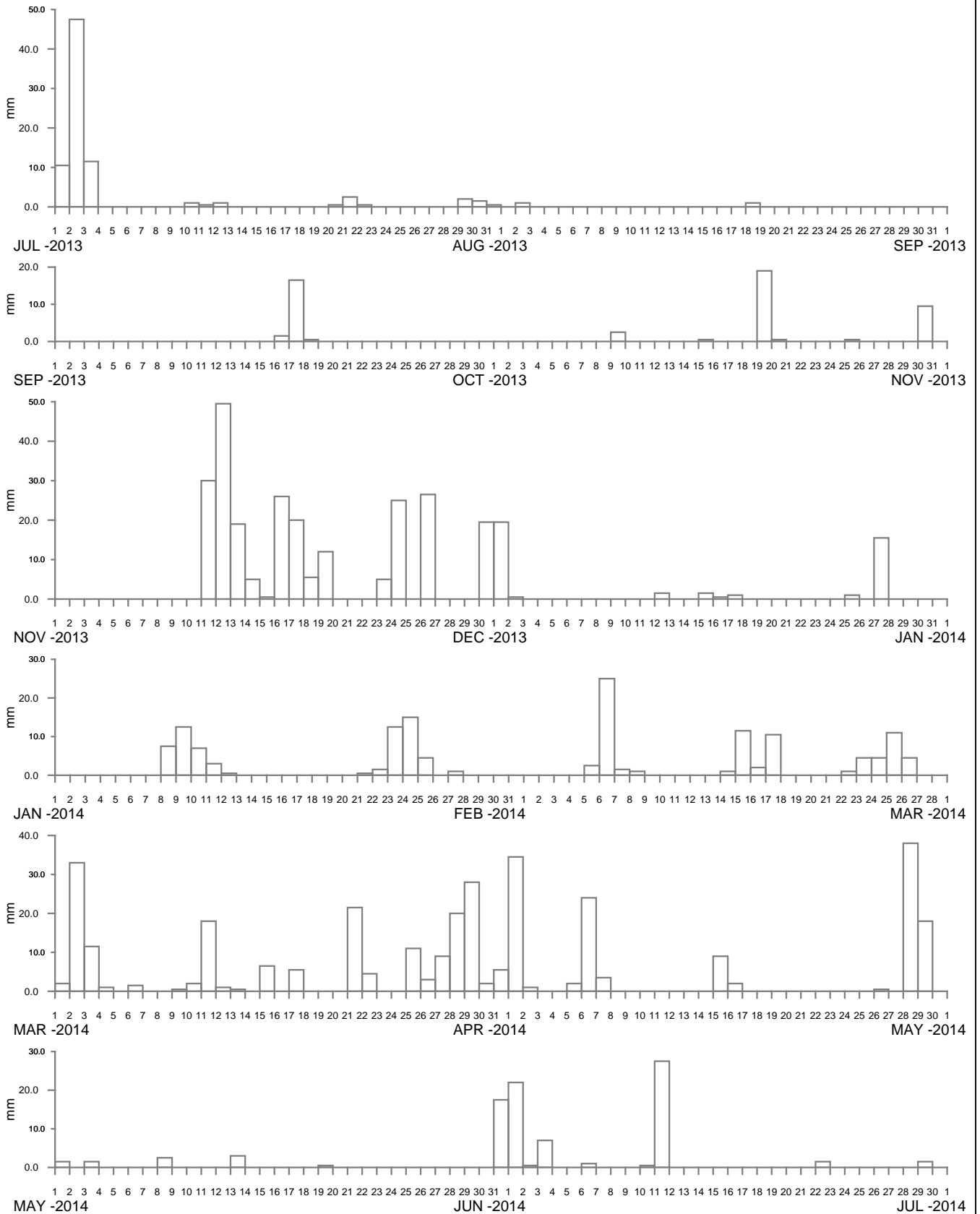
COFFS HARBOUR AT SHEPARDS LANE
2013-2014

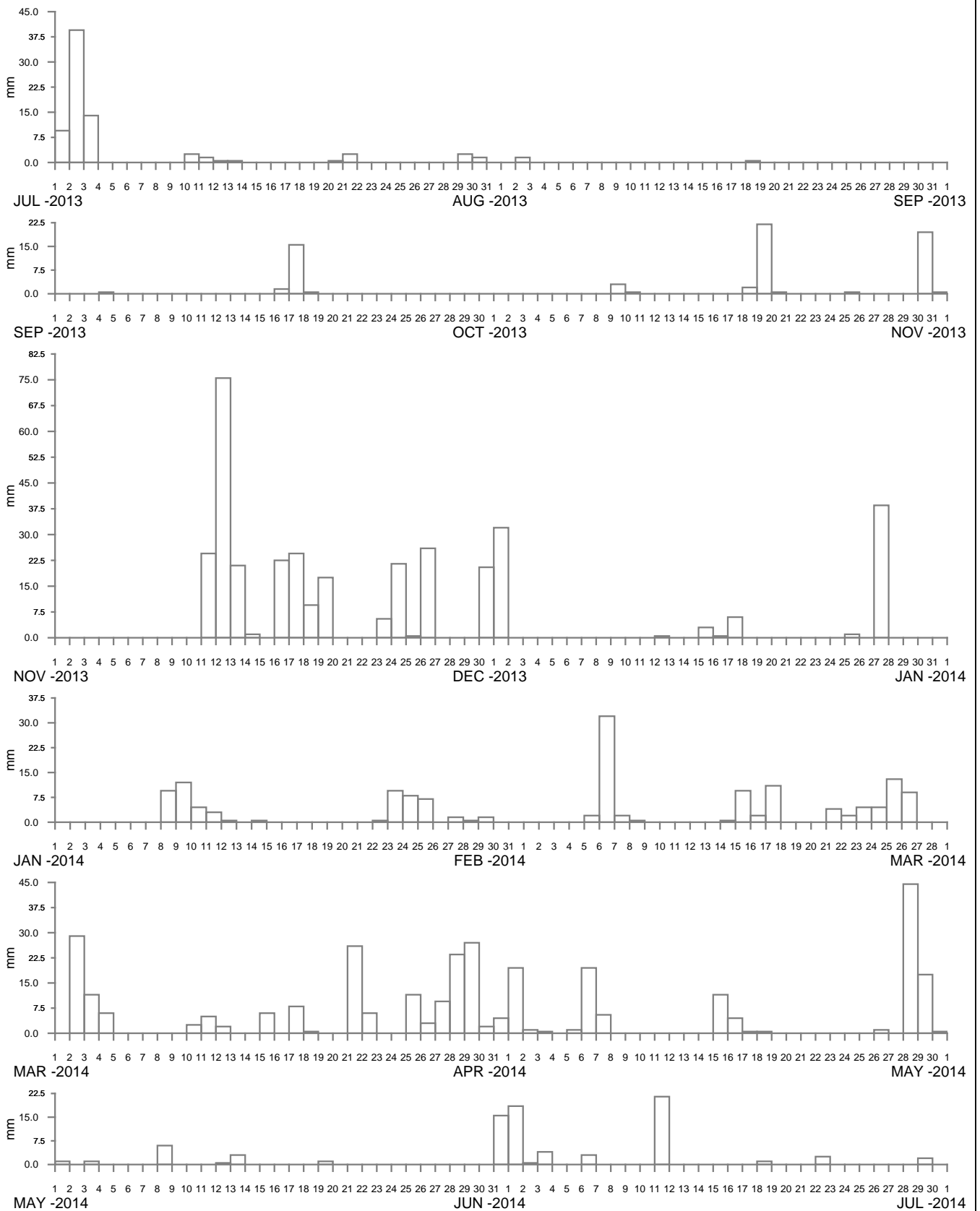
MHL
Report 2293

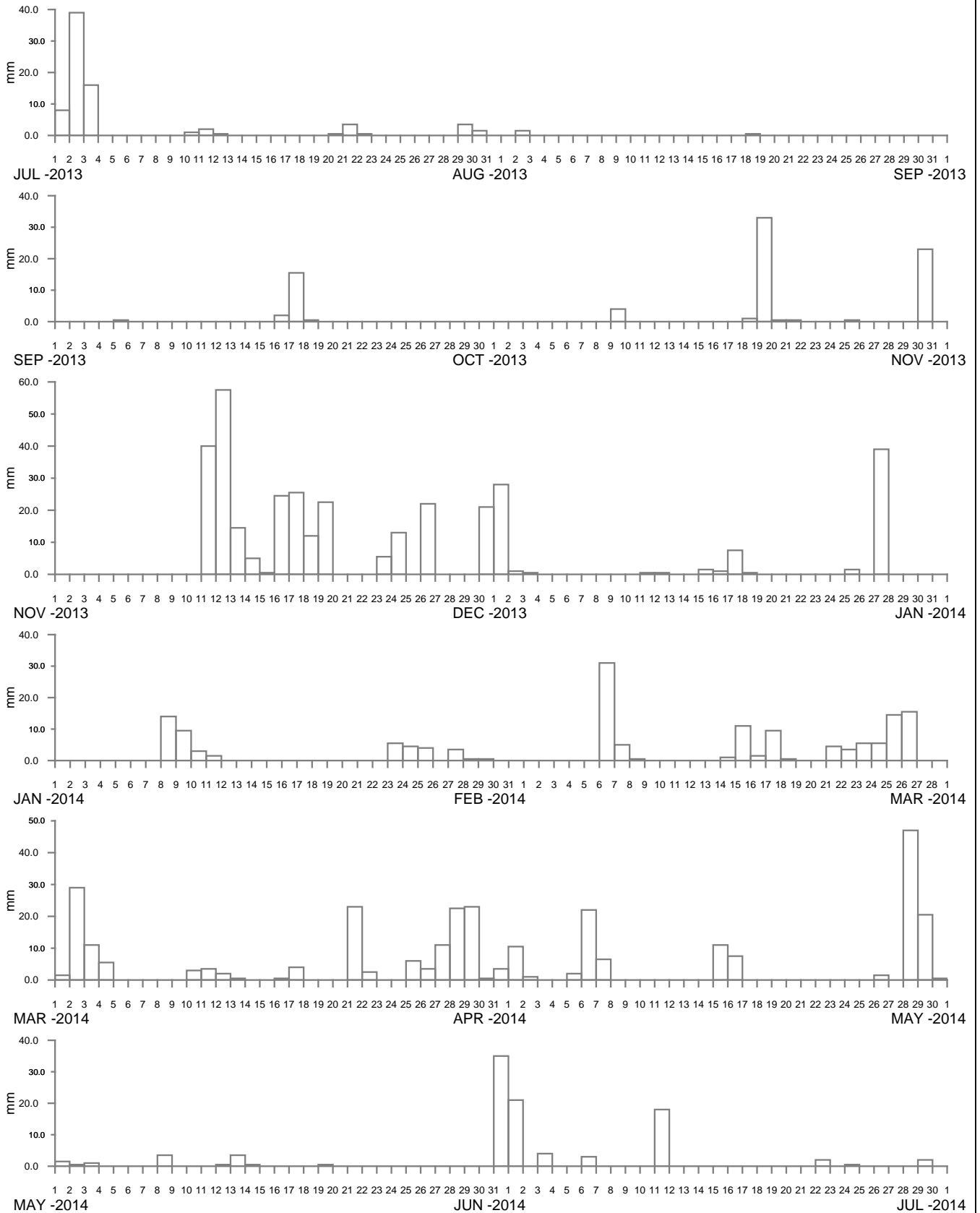
Figure

15

DRAWING 2293-15







----- DATA LOSS



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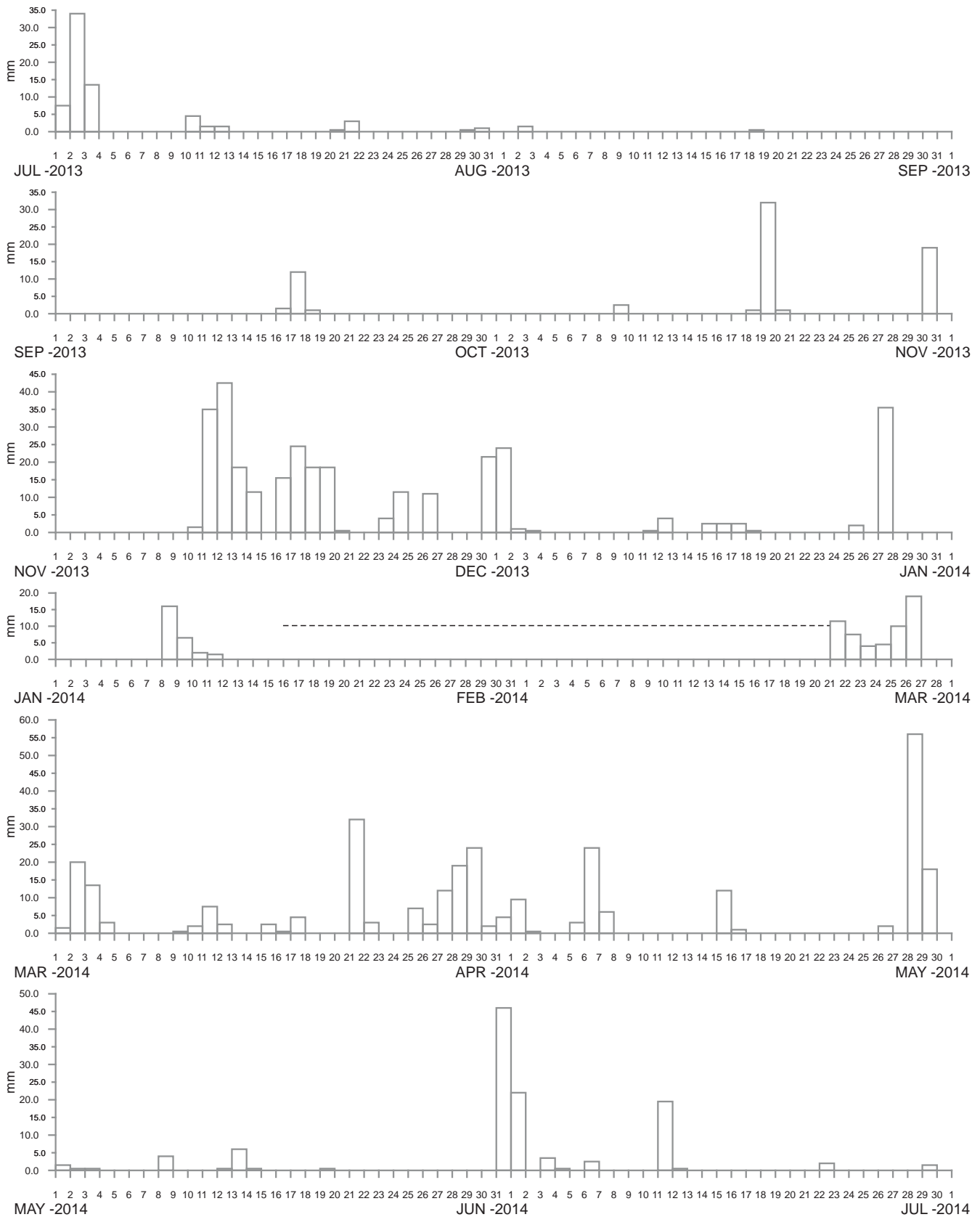
MIDDLE BOAMBEE AT CEDARVALE ROAD
2013-2014

MHL
Report 2293

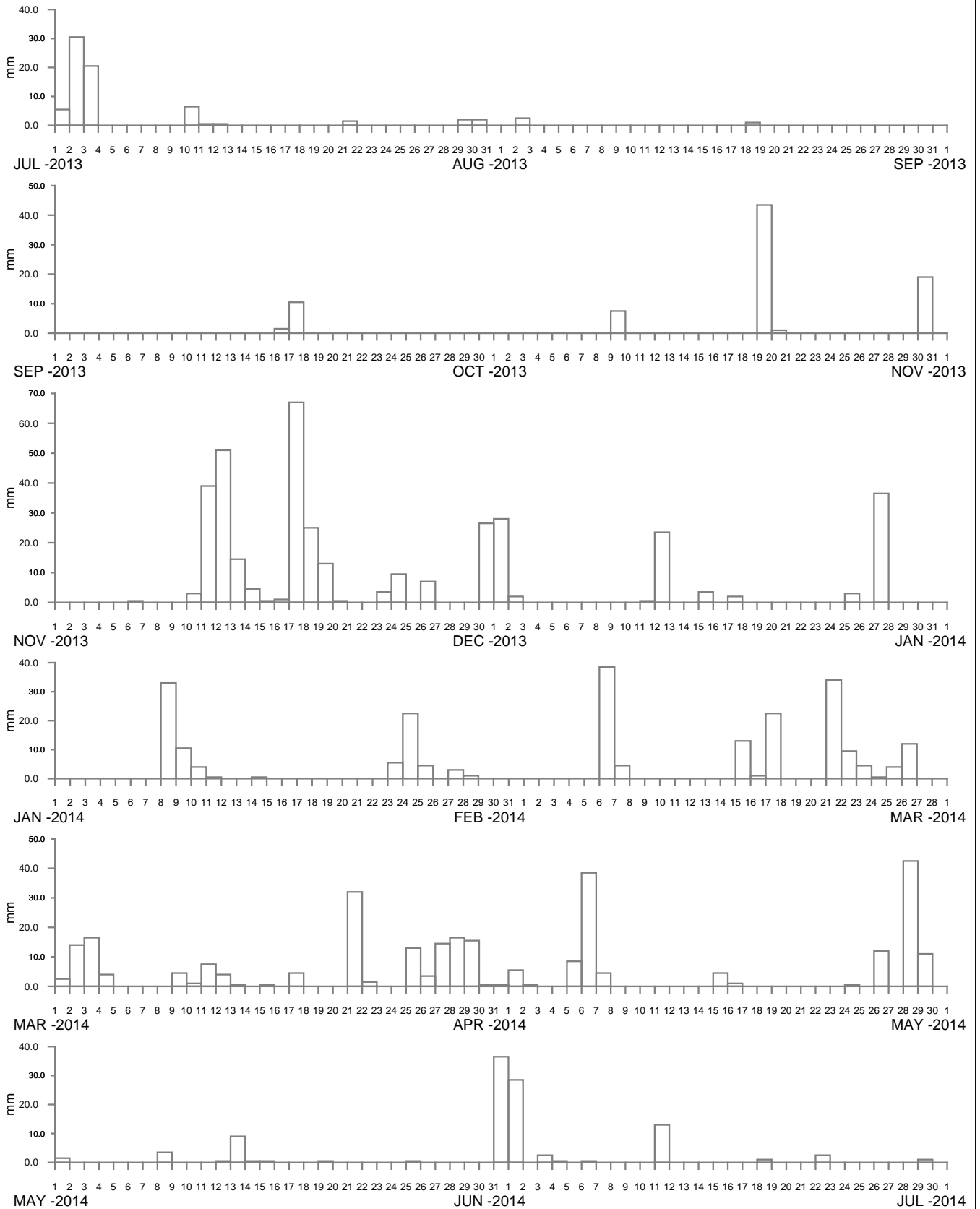
Figure

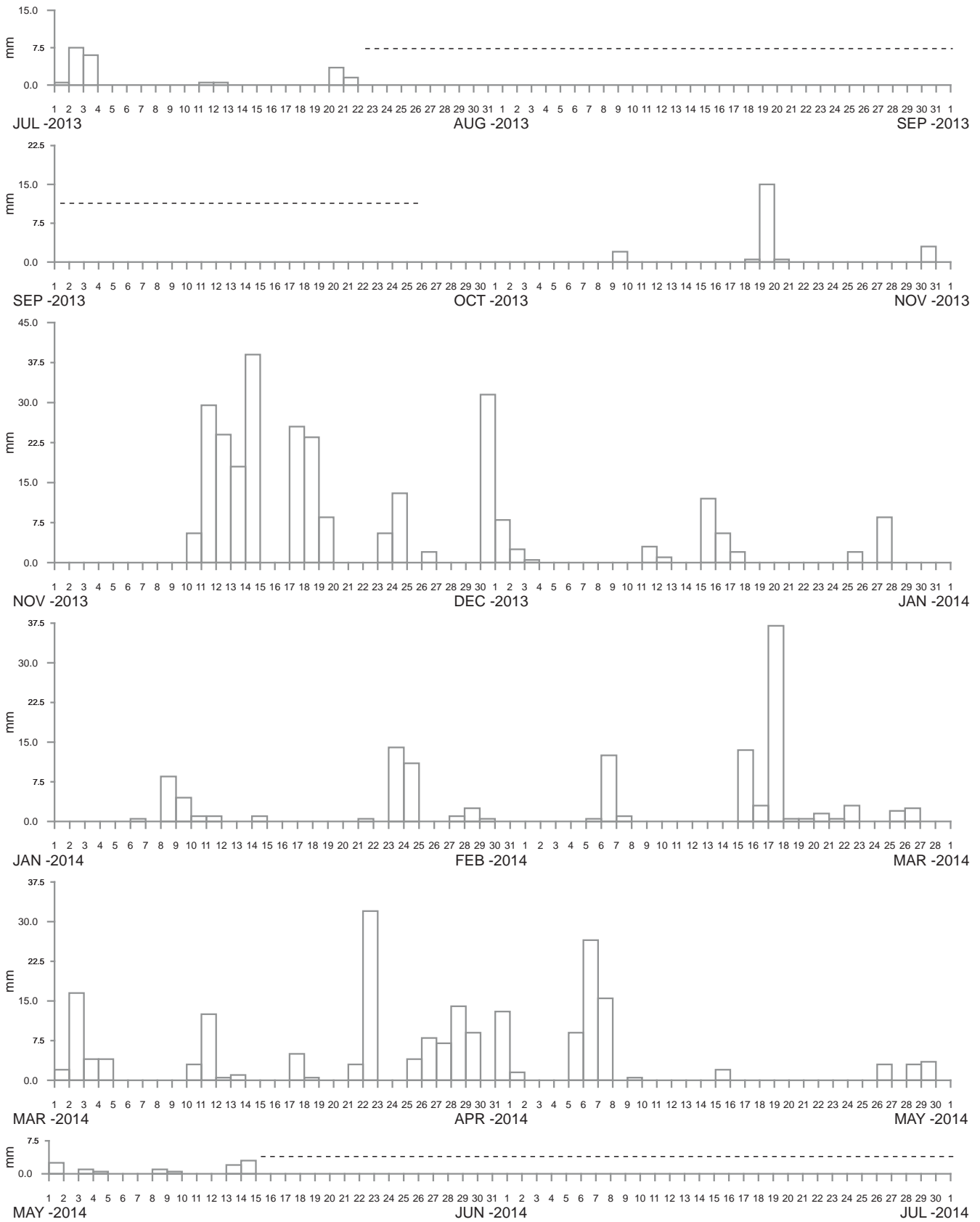
18

DRAWING 2293-18



----- DATA LOSS





----- DATA LOSS



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KALANG RIVER AT KOOROOWI
2013-2014

MHL
Report 2293

Figure
21

DRAWING 2293-21



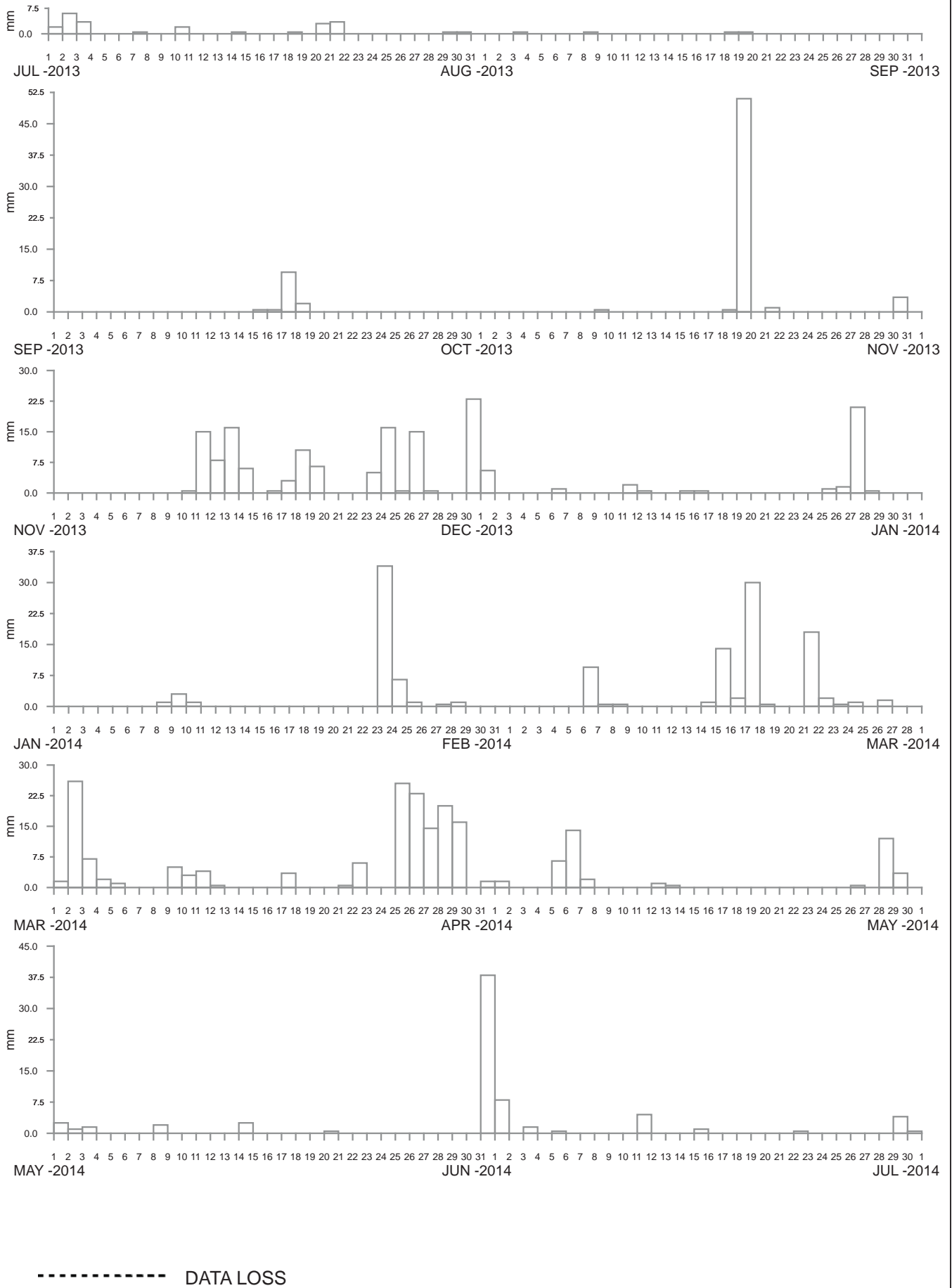
Public Works
Manly Hydraulics Laboratory

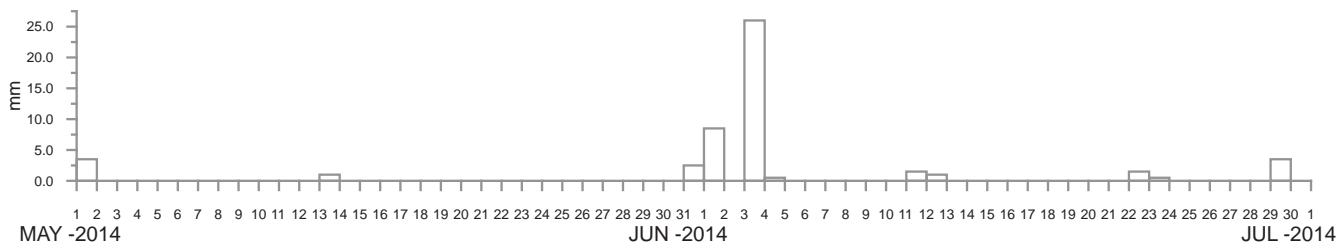
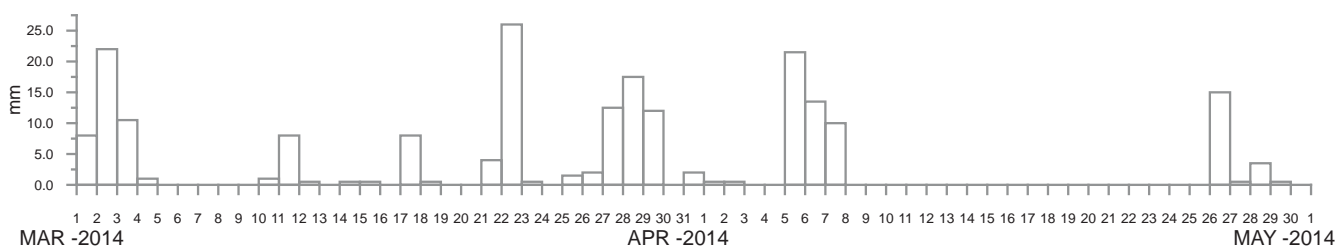
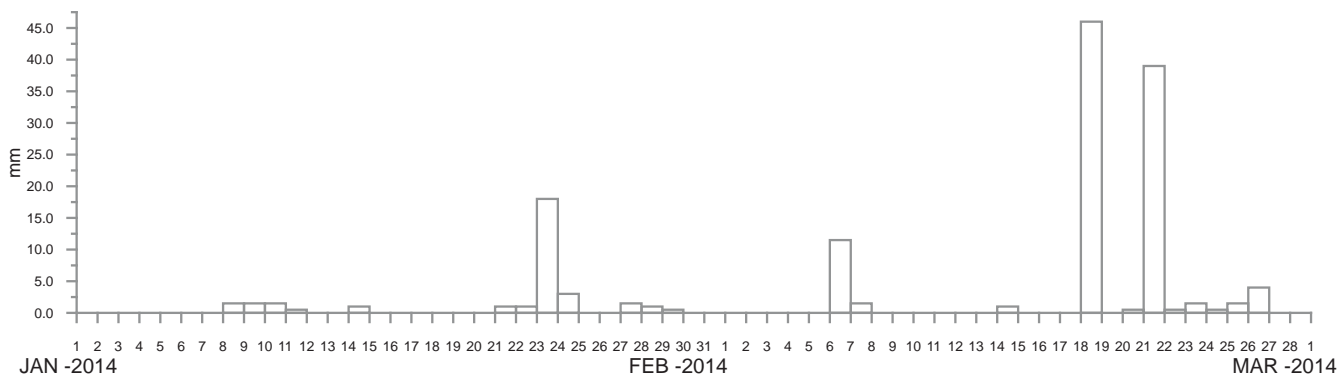
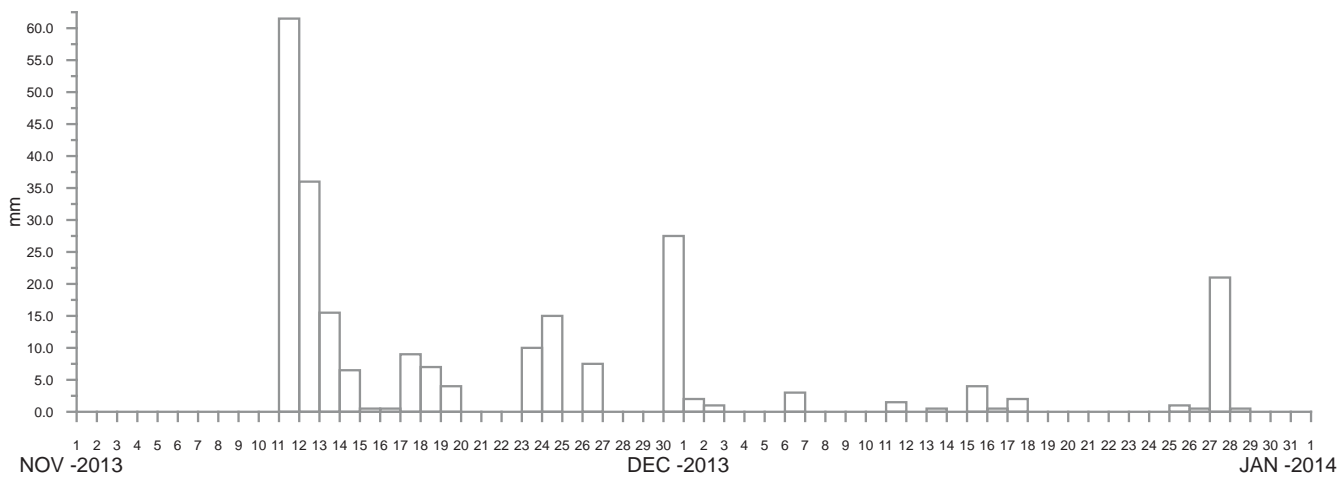
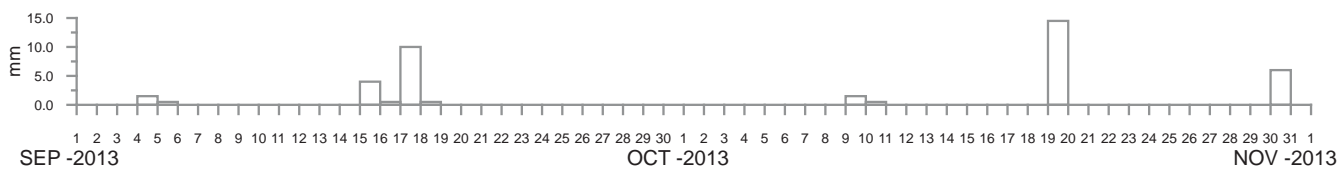
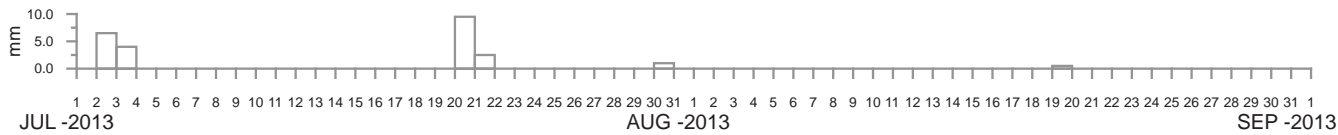
RAINFALL STATION LOCATIONS NAMBUCCA RIVER REGION

MHL
Report 2293

Figure
22

DRAWING 2293-22.cdr





----- DATA LOSS



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NAMBUCCA RIVER AT UTUNGUN
2013-2014

MHL
Report 2293

Figure
24

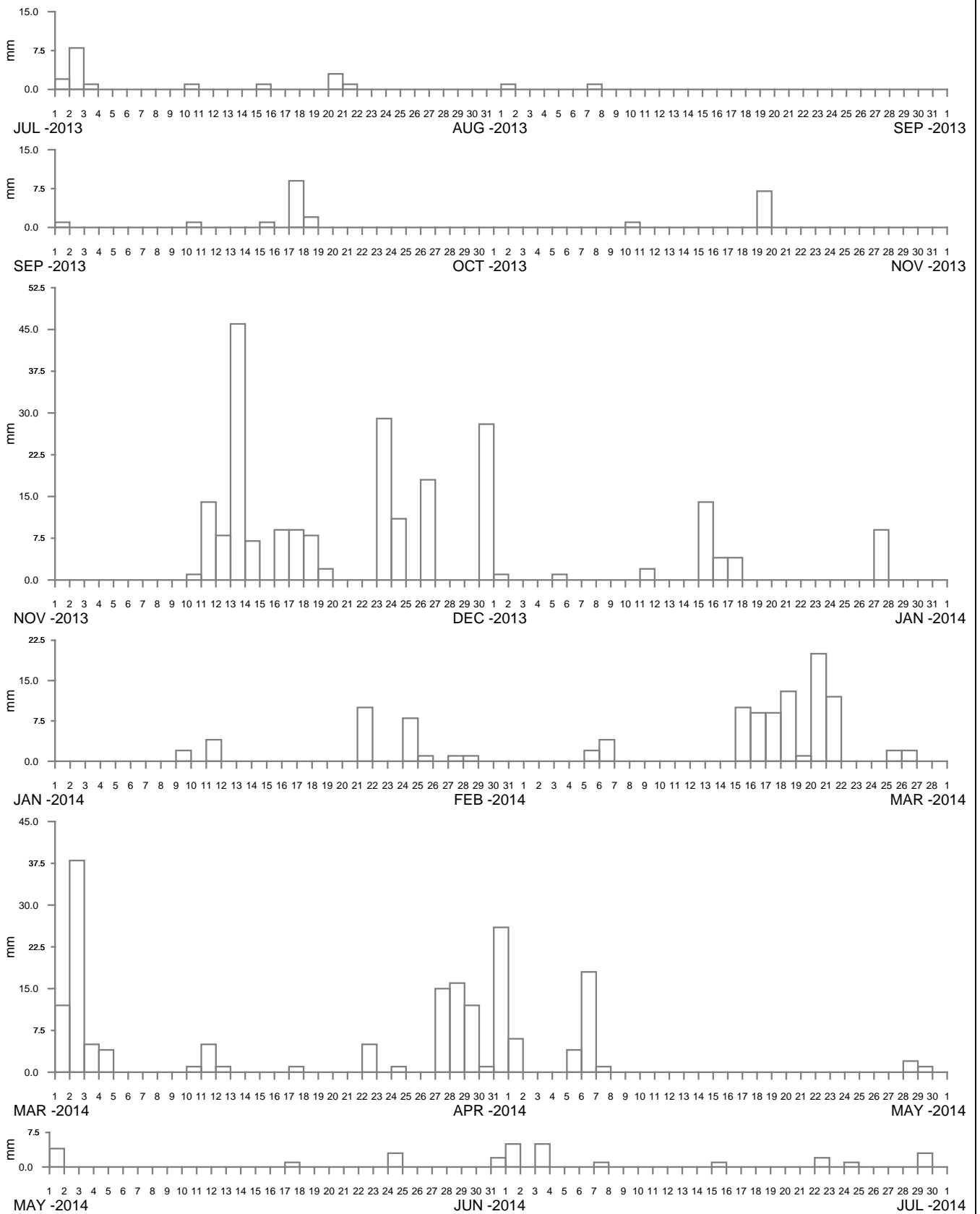
DRAWING 2293-24



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**RAINFALL STATION LOCATIONS
MACLEAY RIVER AND HASTINGS RIVER REGIONS**

MHL
Report 2293
Figure
25
DRAWING 2293-25.cdr



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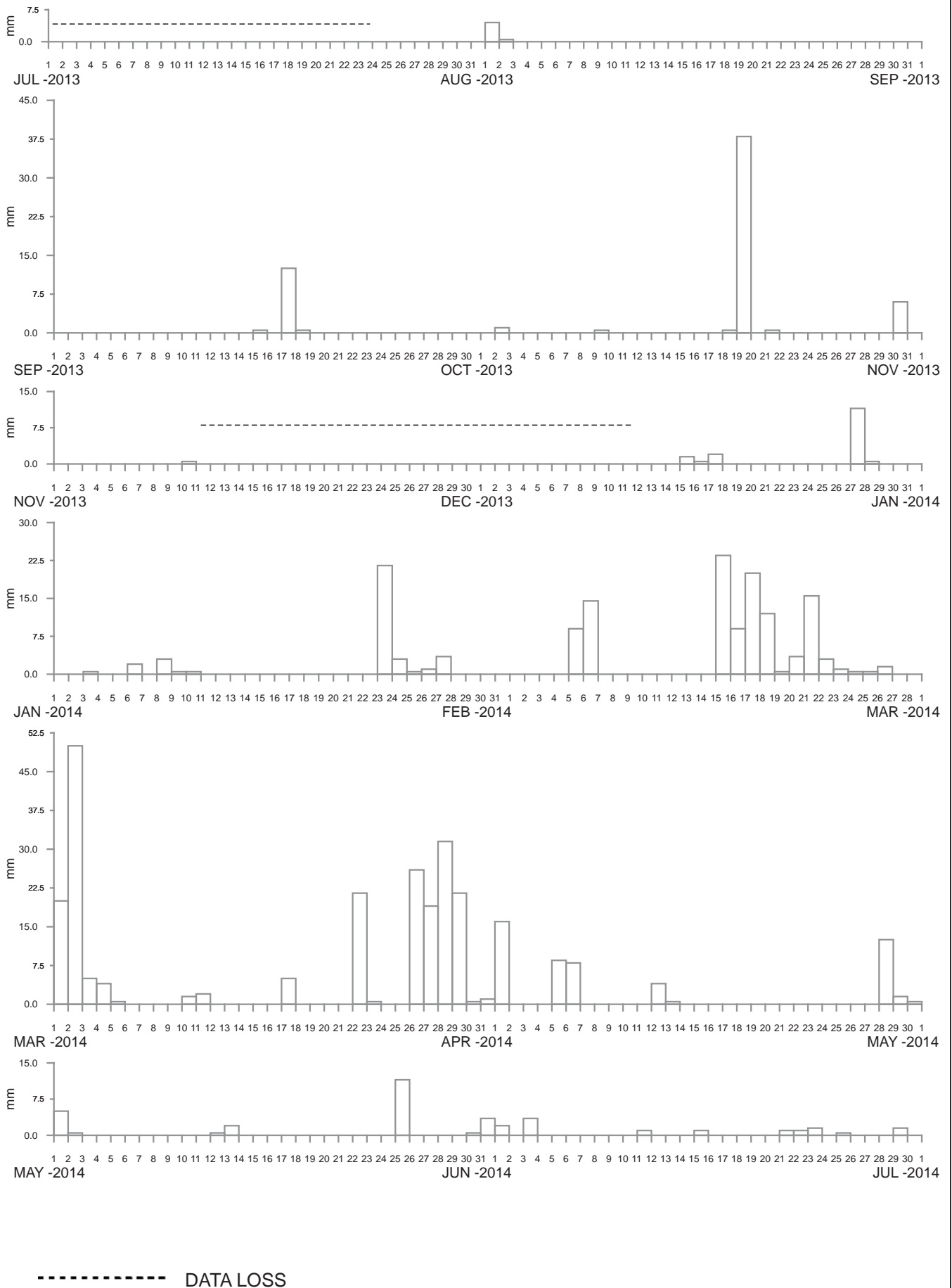
MACLEAY RIVER AT ALDAVILLA DOWNSTREAM
2013-2014

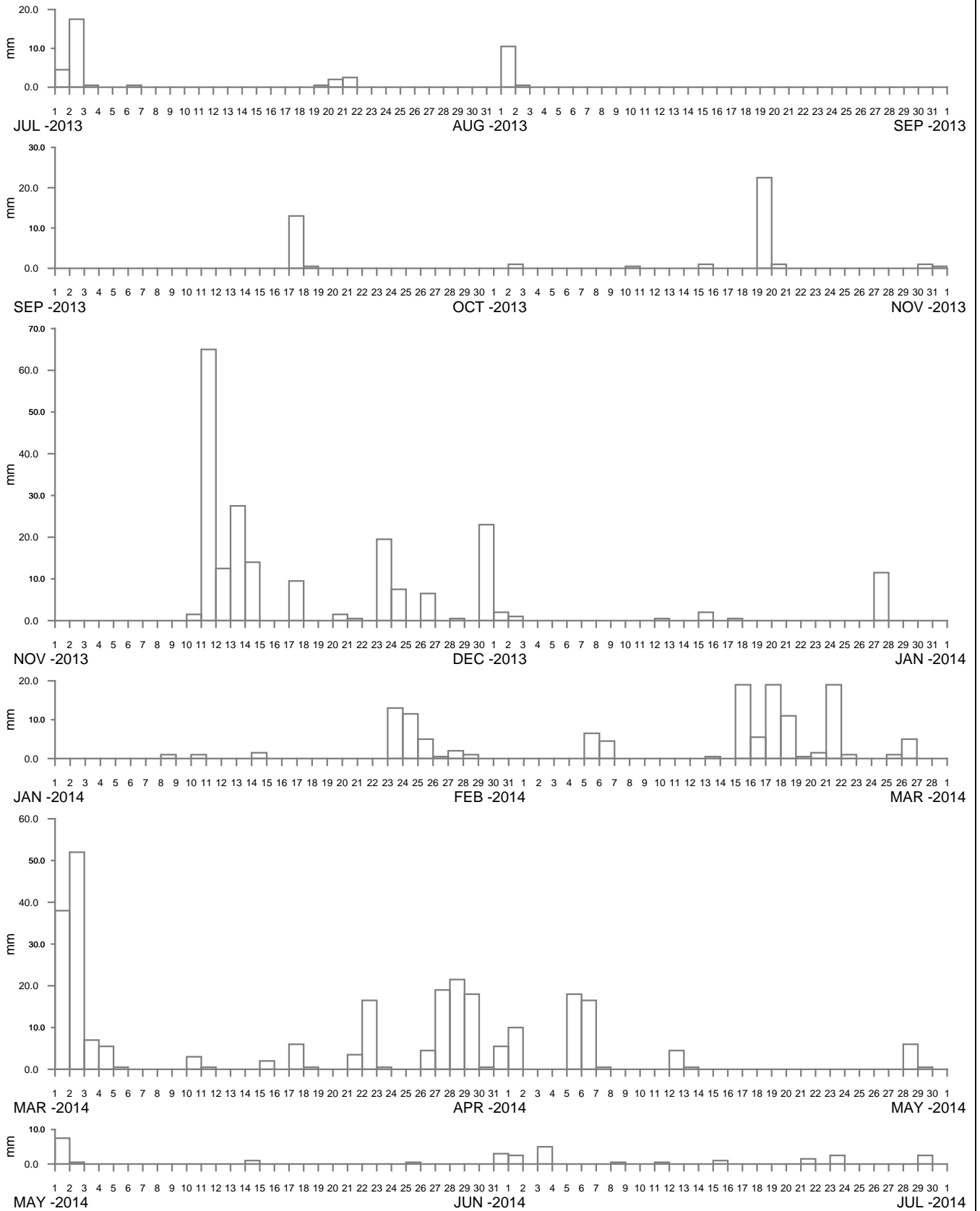
MHL
Report 2293

Figure

26

DRAWING 2293-26





----- DATA LOSS



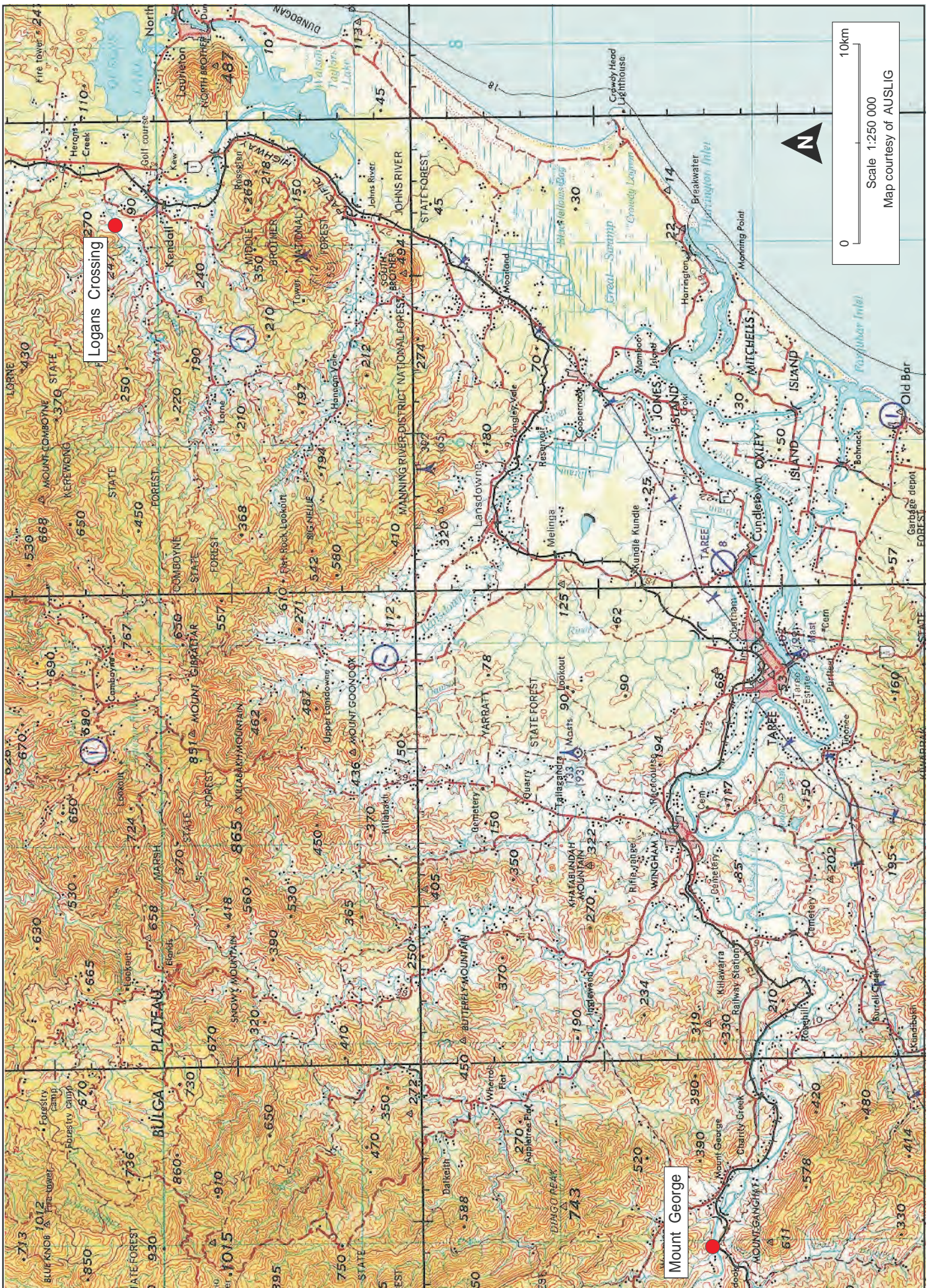
Public Works
Manly Hydraulics Laboratory

WILSONS RIVER AT TELEGRAPH POINT
2013-2014

MHL
Report 2293

Figure
28

DRAWING 2293-28

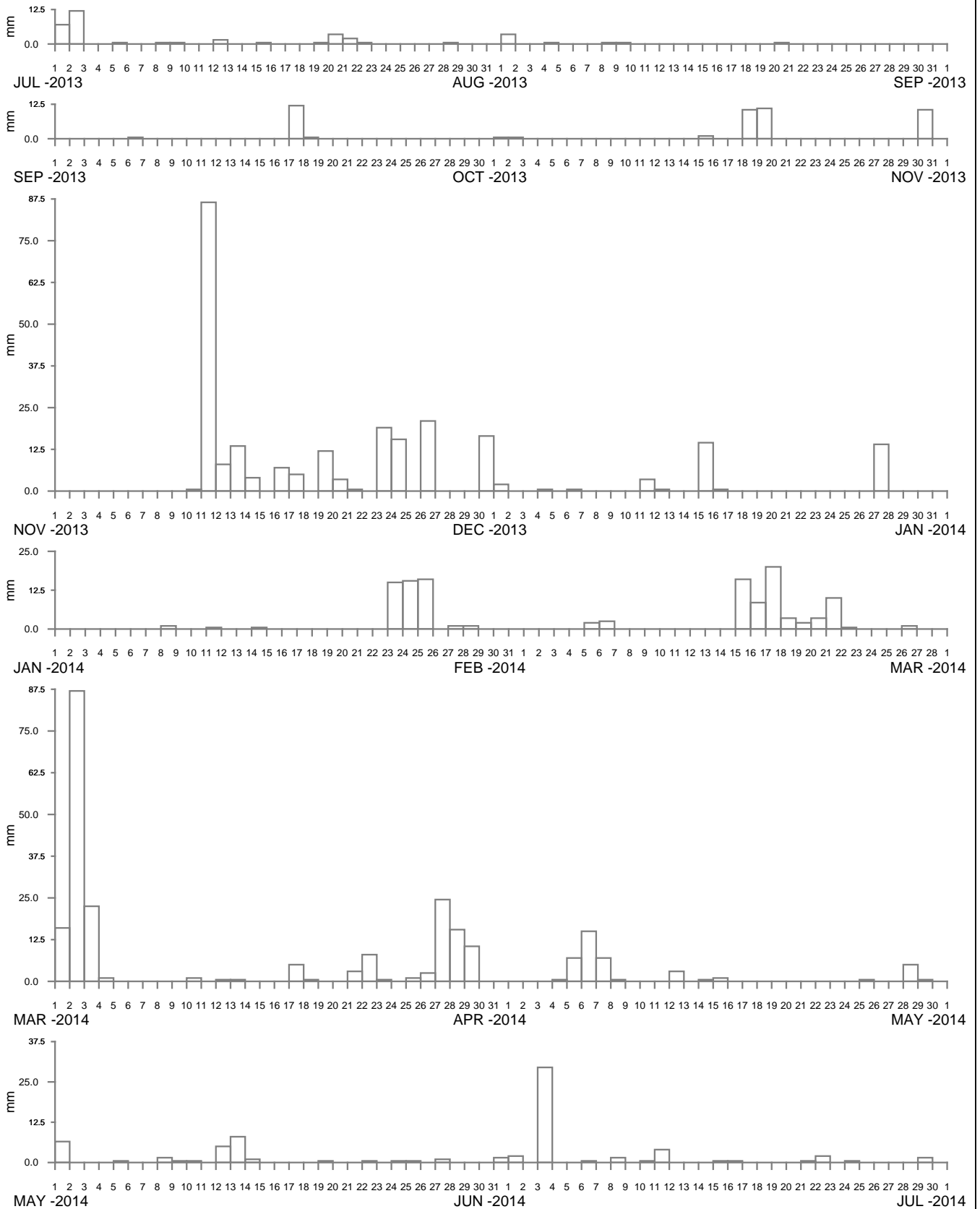


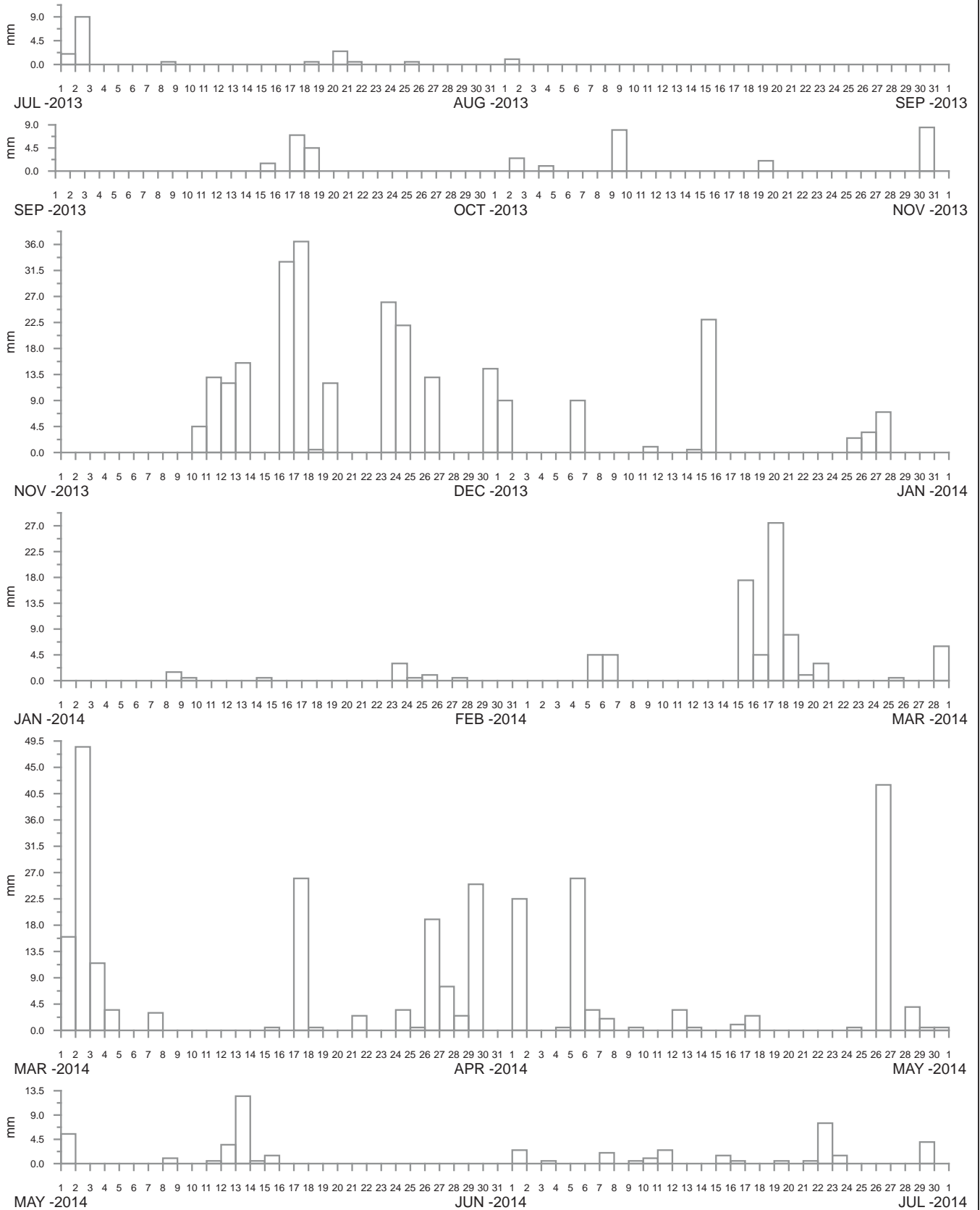
Public Works
Manly Hydraulics Laboratory

**RAINFALL STATION LOCATIONS
CAMDEN HAVEN REGION**

MHL
Report 2293
Figure
29

DRAWING 2293-29.cdr





----- DATA LOSS



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MANNING RIVER AT MT GEORGE
2013-2014

MHL
Report 2293

Figure

31

DRAWING 2293-31



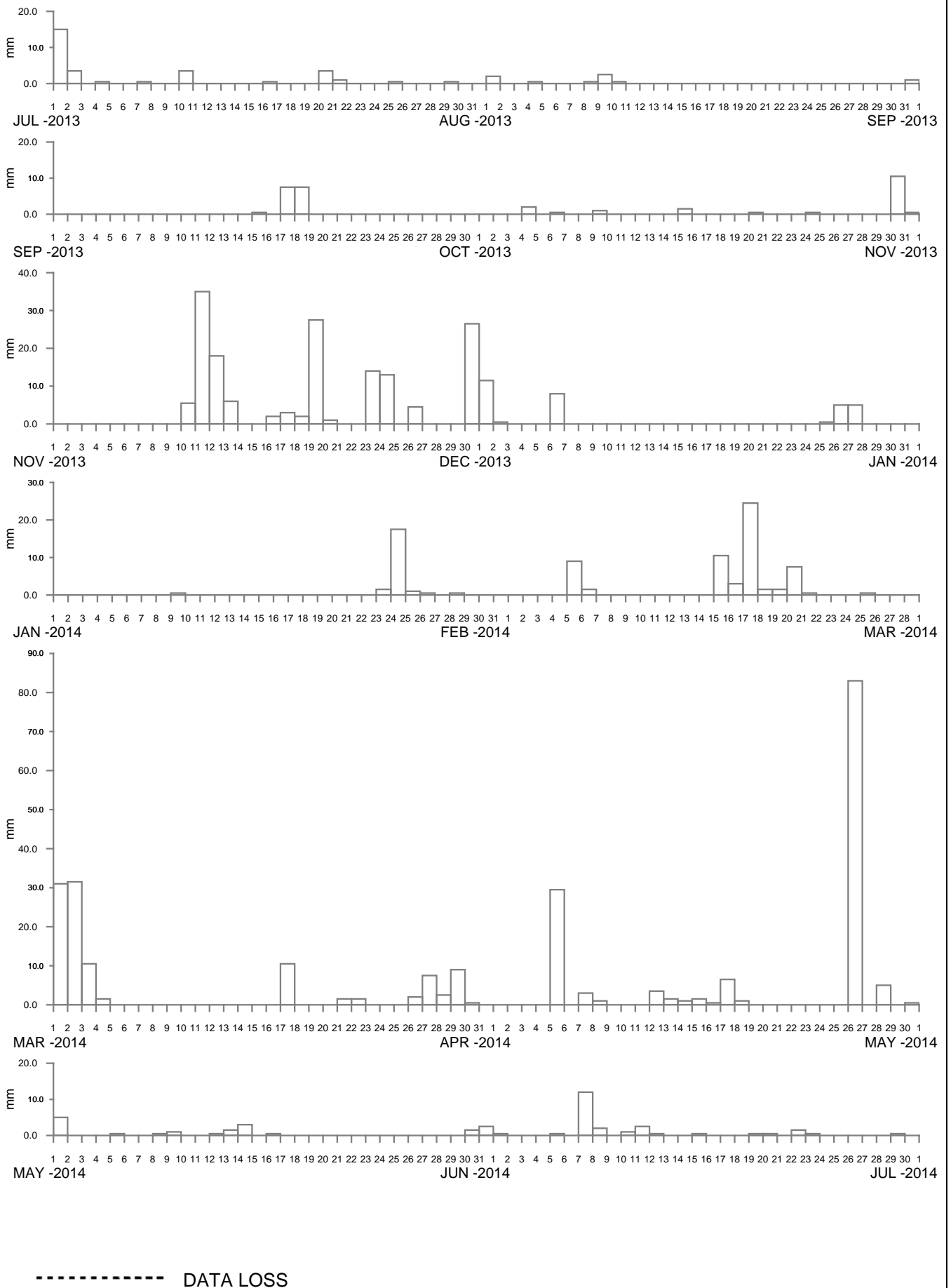
Public Works
Manly Hydraulics Laboratory

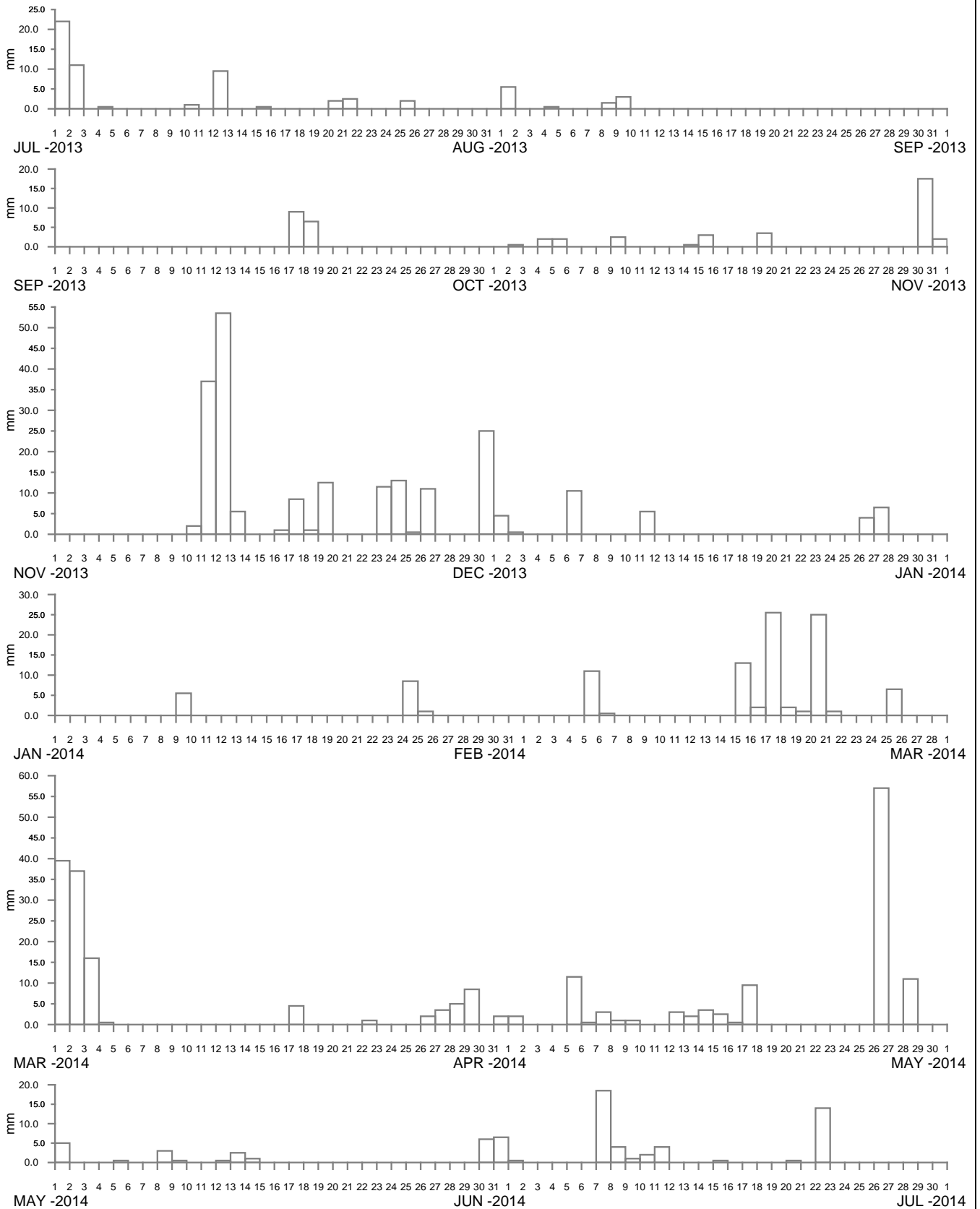
RAINFALL STATION LOCATIONS KARUAH RIVER REGION

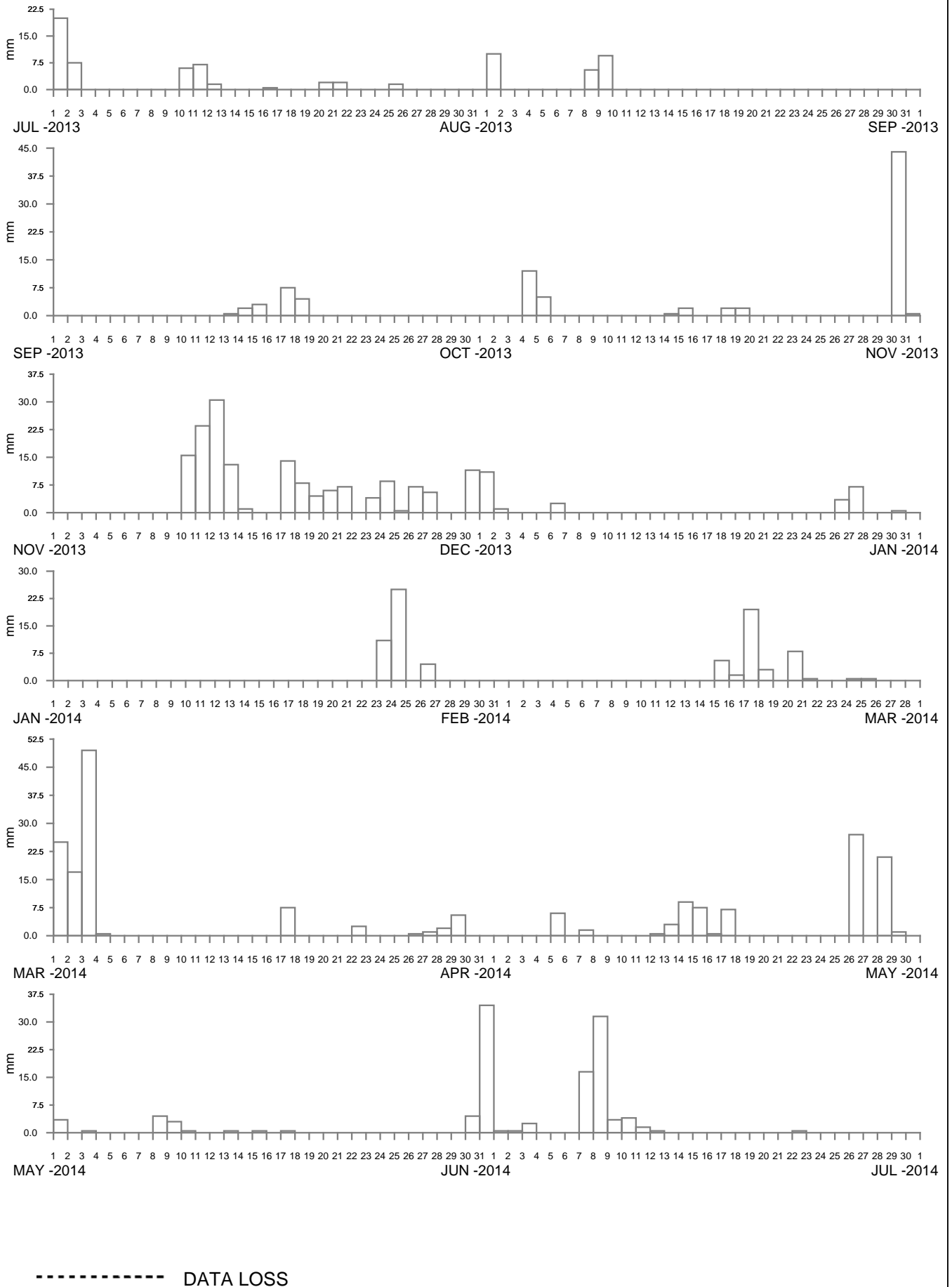
MHL
Report 2293

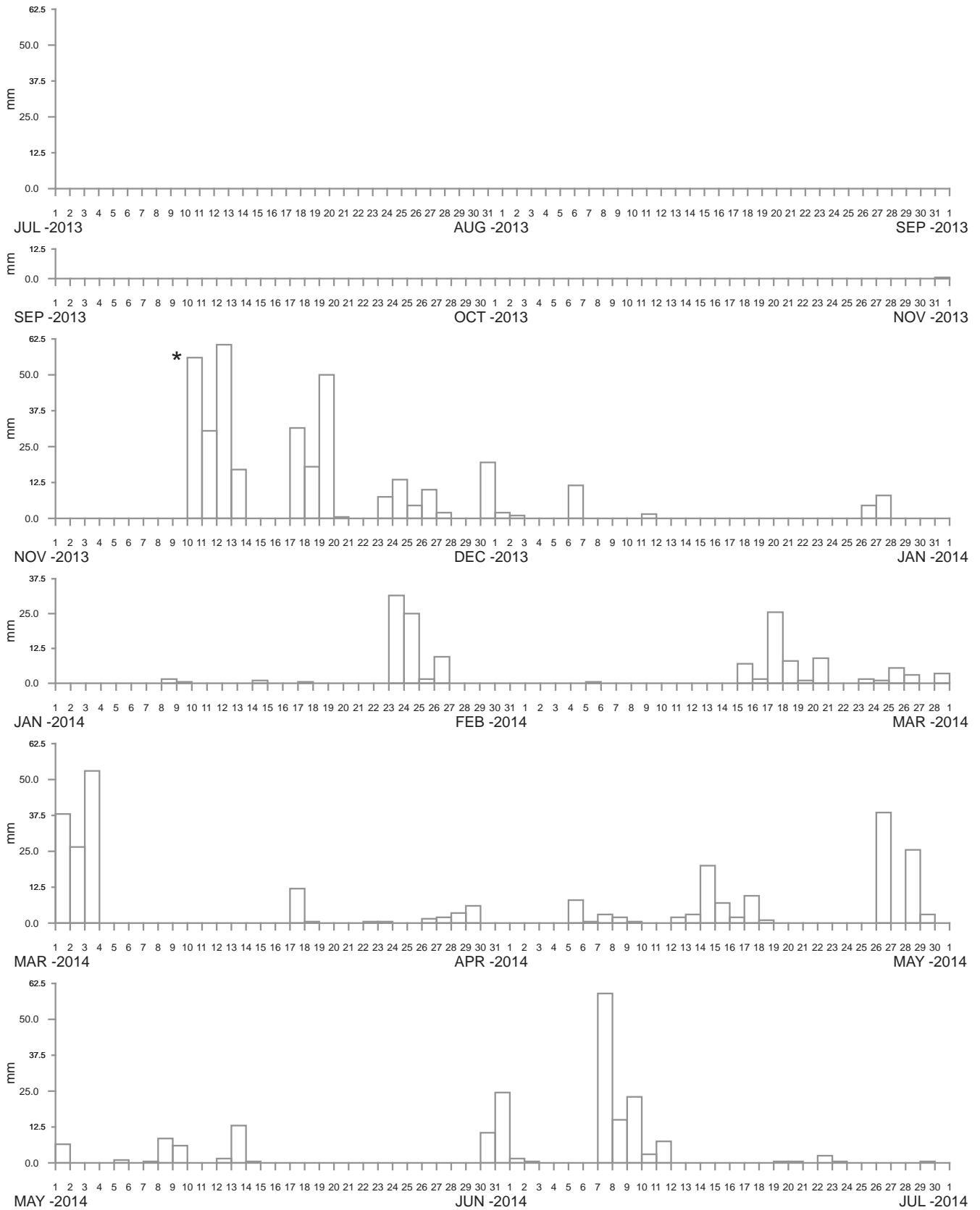
Figure
32

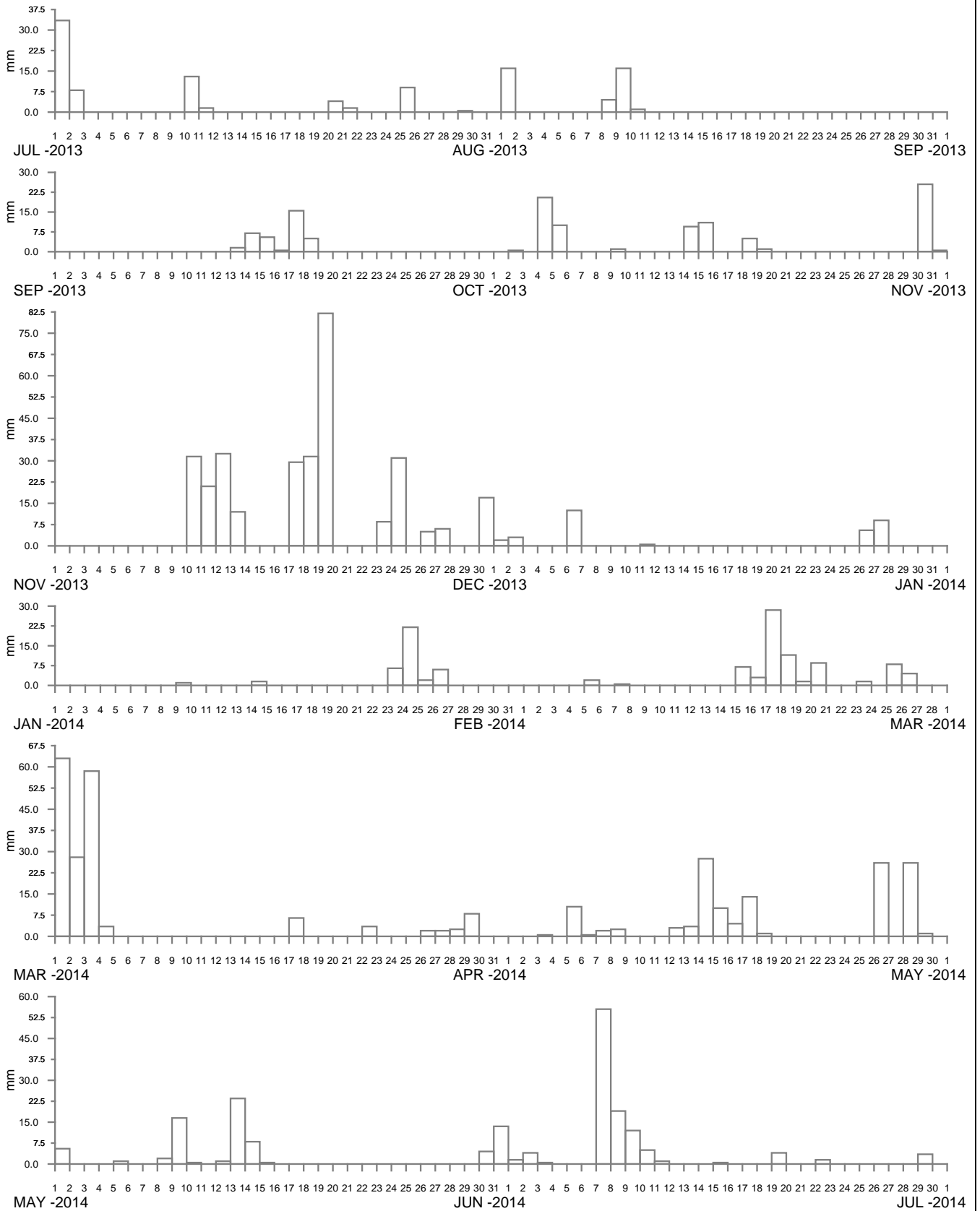
DRAWING 2293-32.cdr











----- DATA LOSS



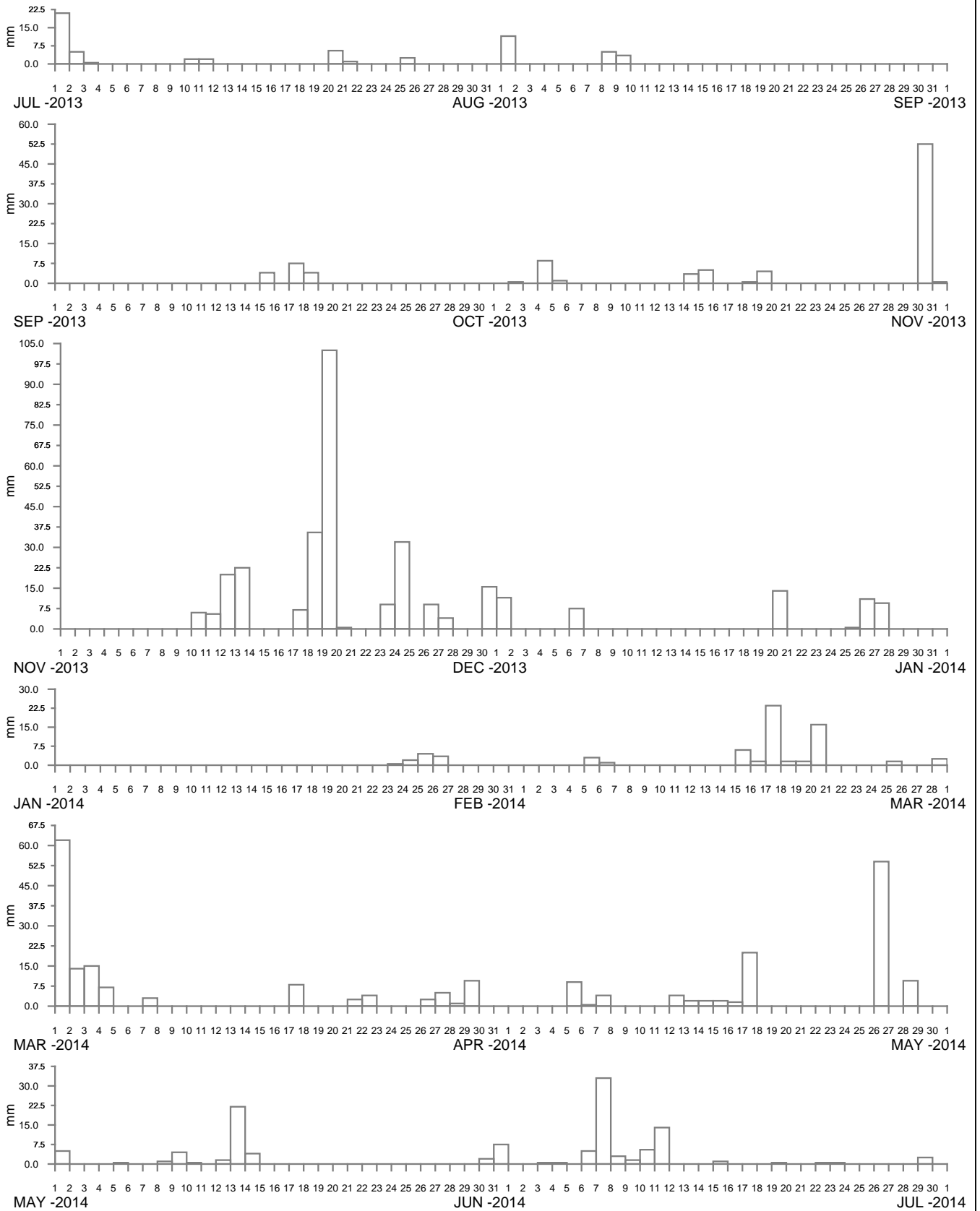
Public Works
Manly Hydraulics Laboratory

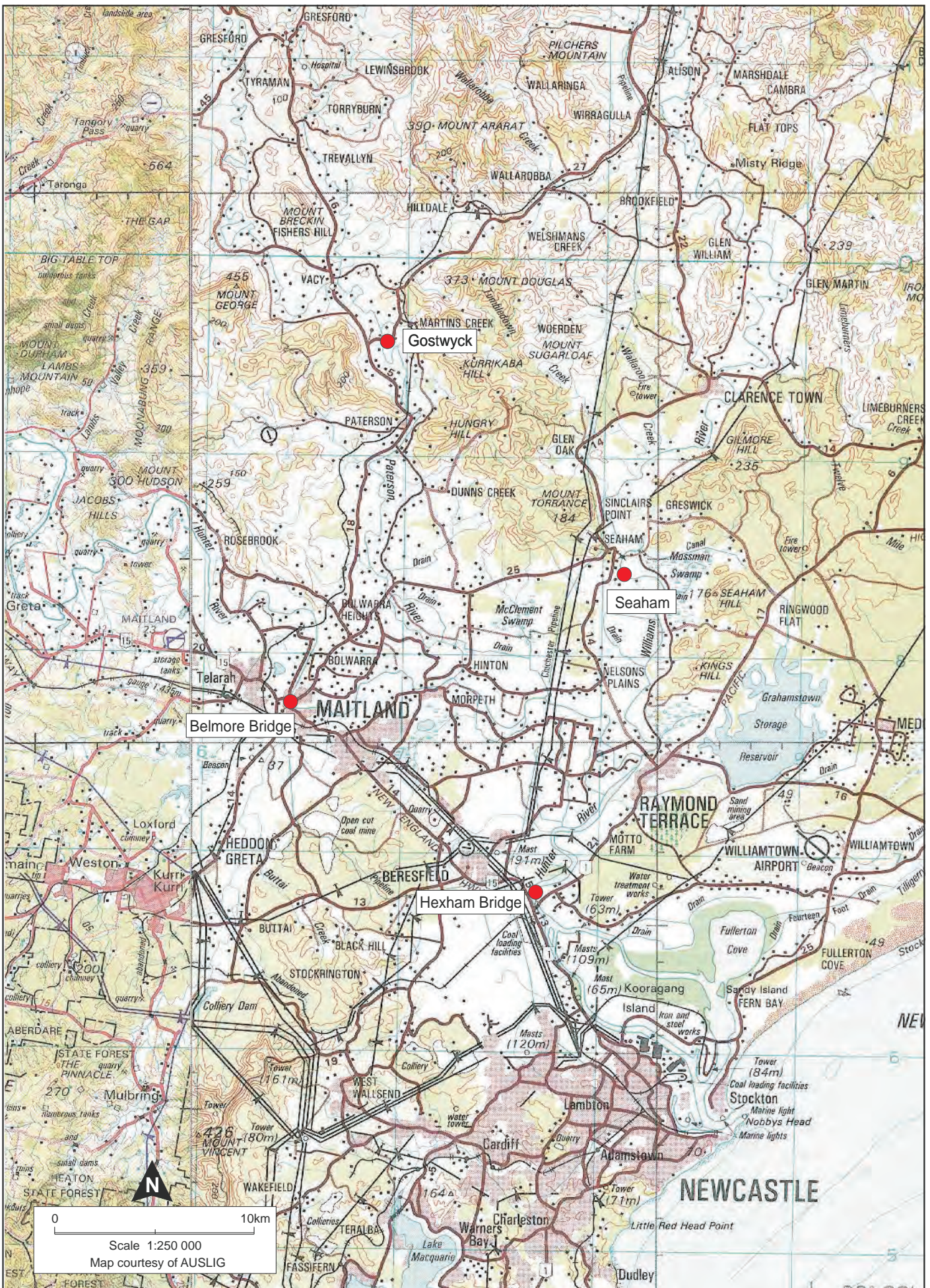
SMITHS LAKE AT TARBUCK BAY
2013-2014

MHL
Report 2293

Figure
37

DRAWING 2293-37



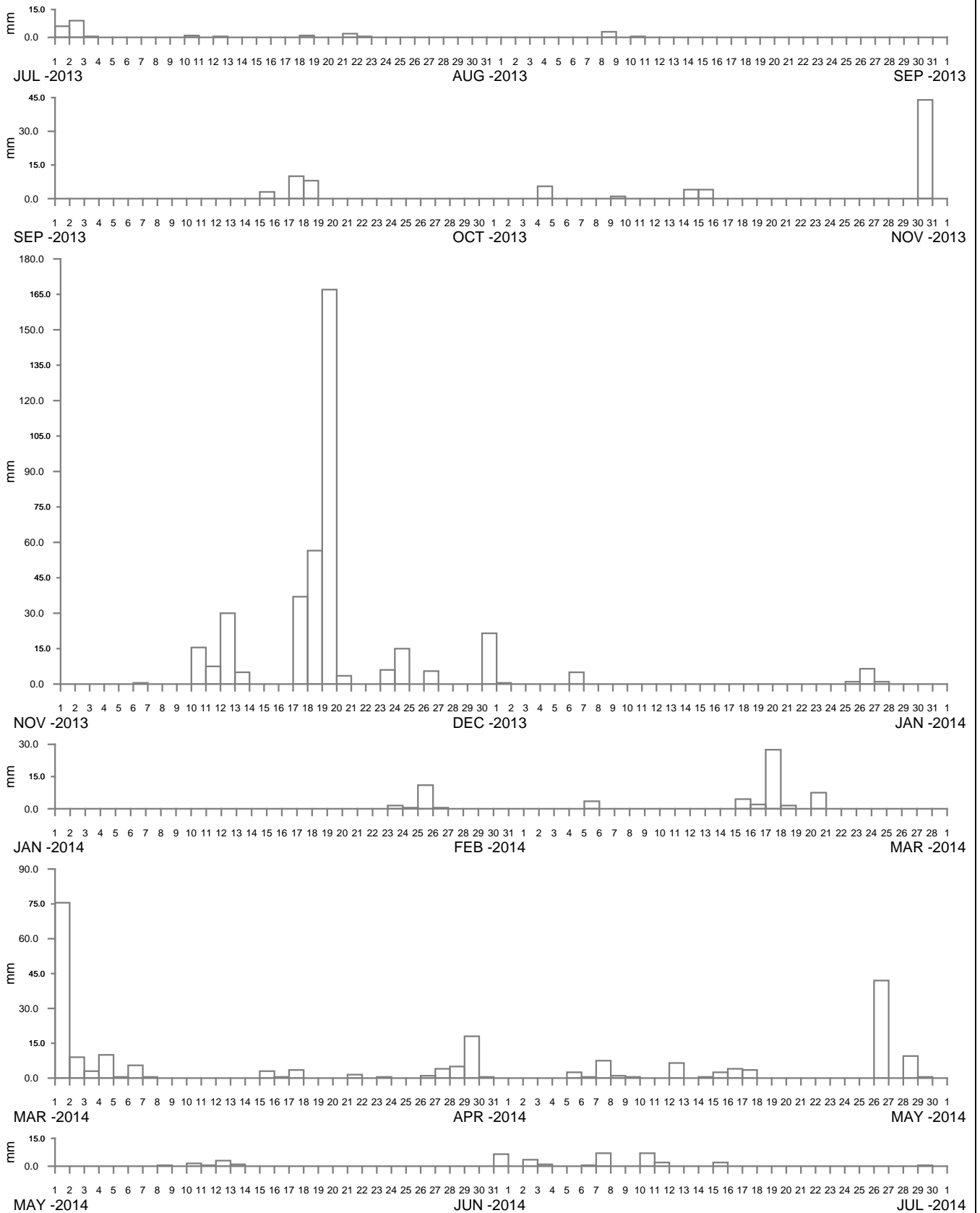


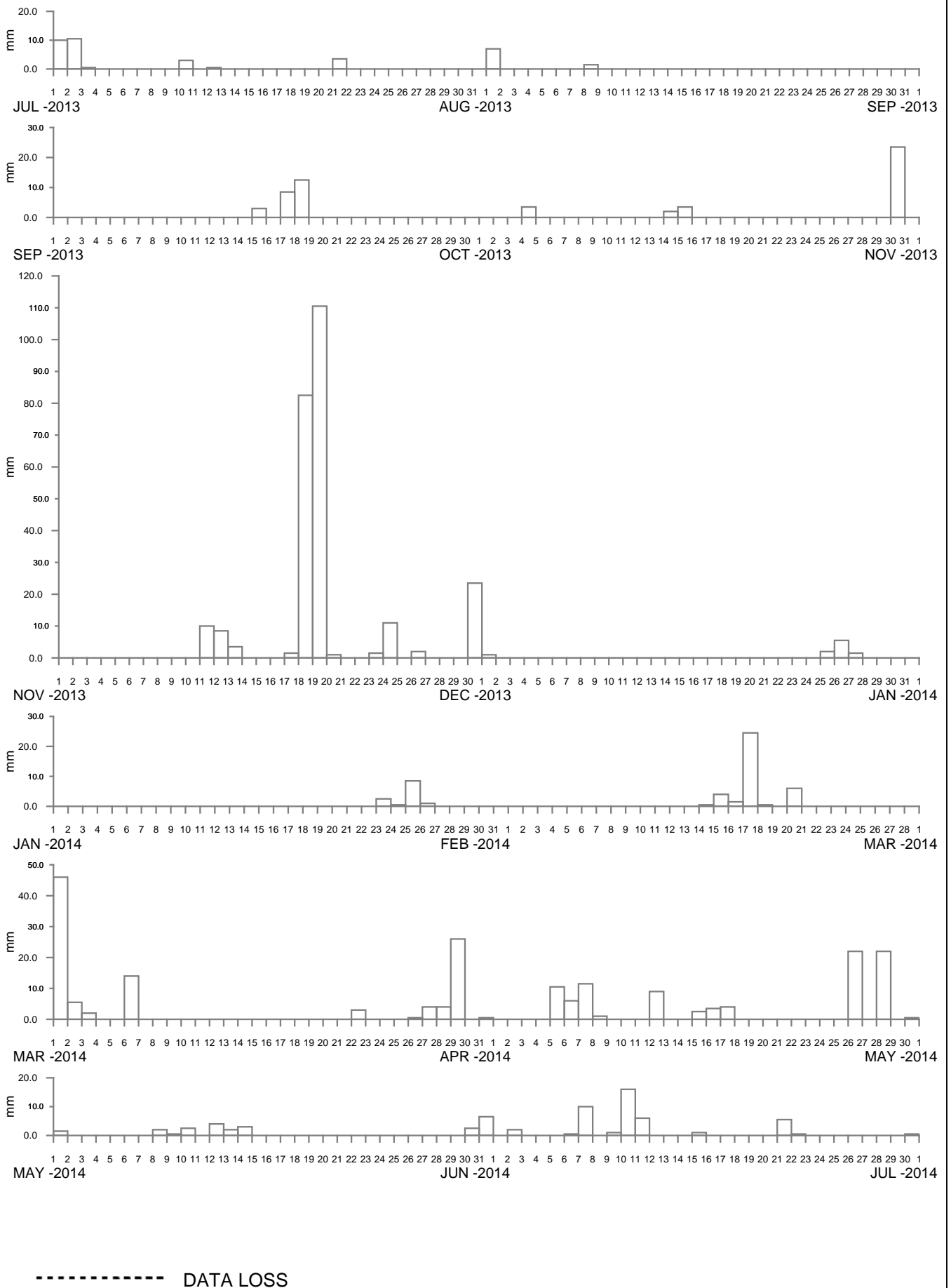
Public Works
Manly Hydraulics Laboratory

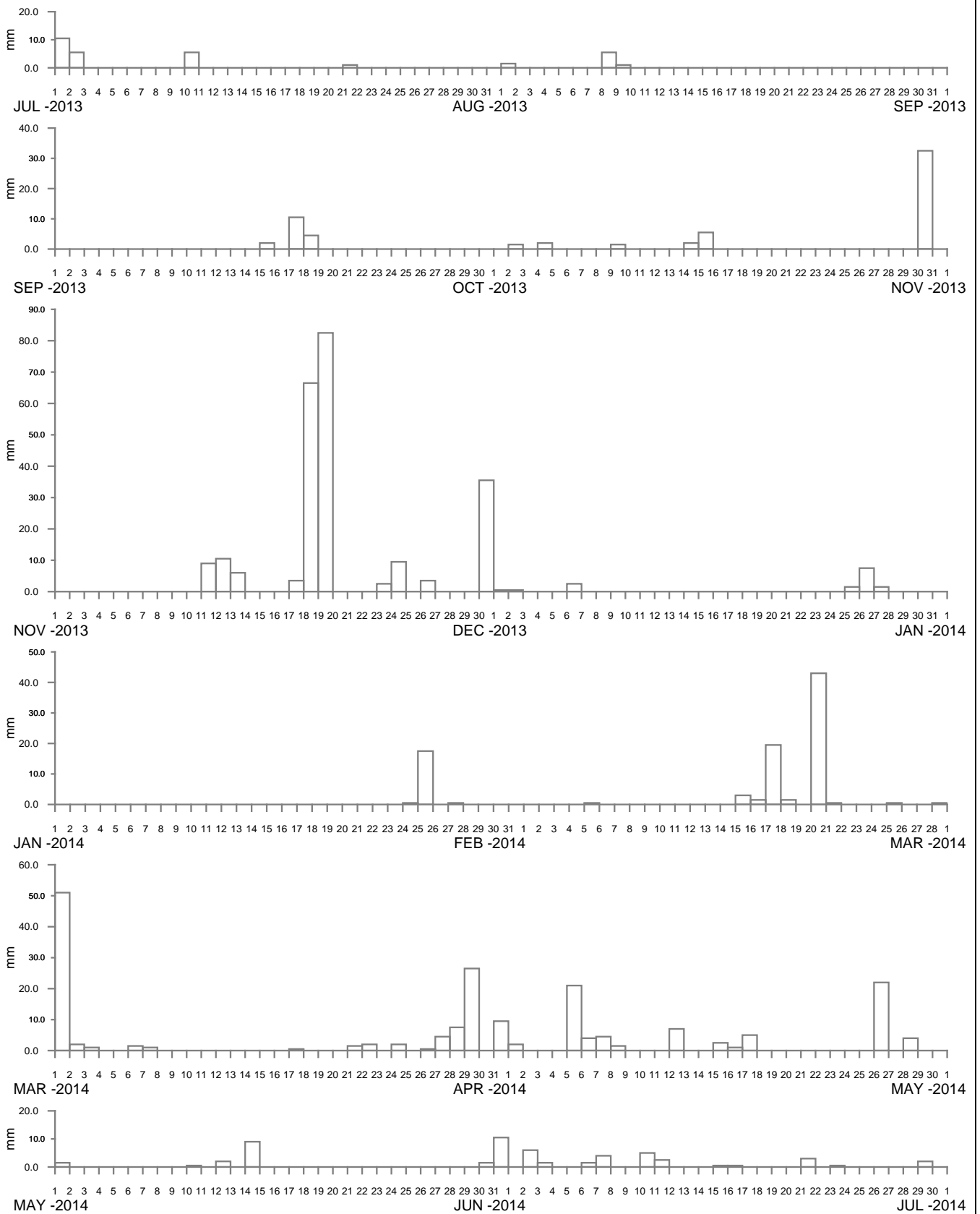
**RAINFALL STATION LOCATIONS
HUNTER RIVER (NORTH) REGION**

MHL
Report 2293
Figure
39

DRAWING 2293-39.cdr







----- DATA LOSS



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Manly Hydraulics Laboratory

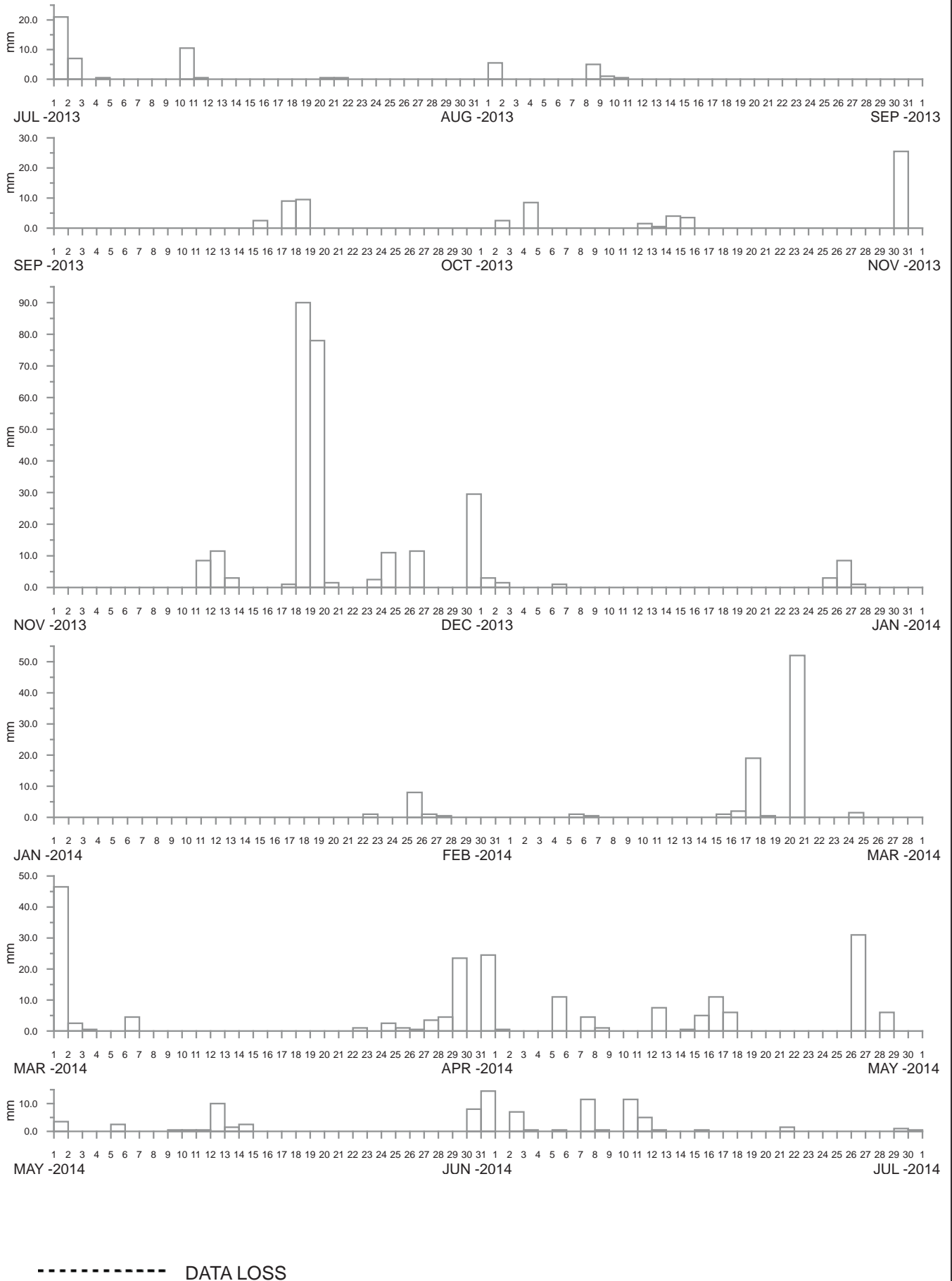
HUNTER RIVER AT BELMORE BRIDGE
2013-2014

MHL
Report 2293

Figure

42

DRAWING 2293-42





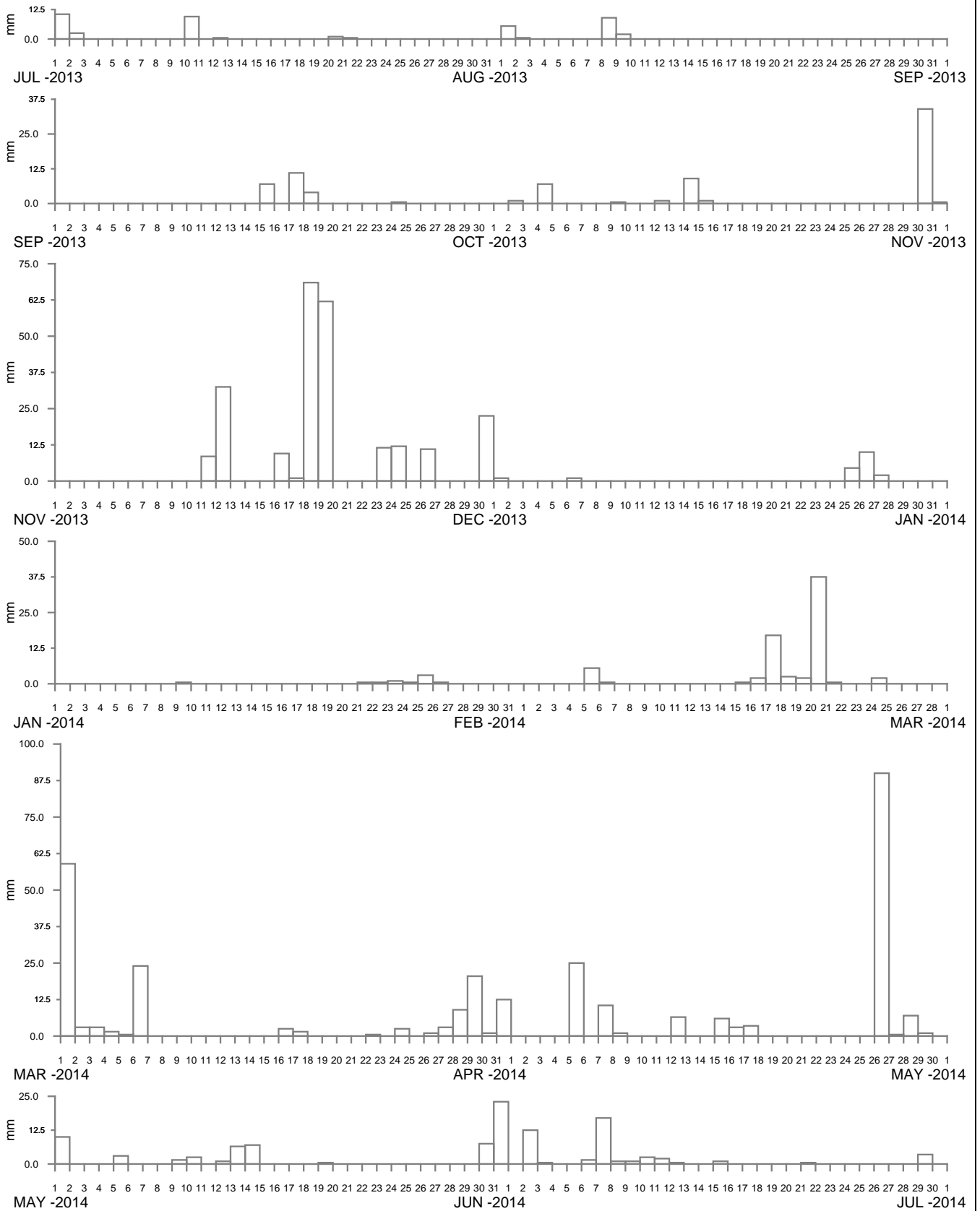
0 10km
 Scale 1:250 000
 Map courtesy of AUSLIG



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**RAINFALL STATION LOCATIONS
 MACQUARIE-TUGGERAH LAKES (NORTH) REGION**

MHL
 Report 2293
 Figure
 44
 DRAWING 2293-44.cdr



----- DATA LOSS



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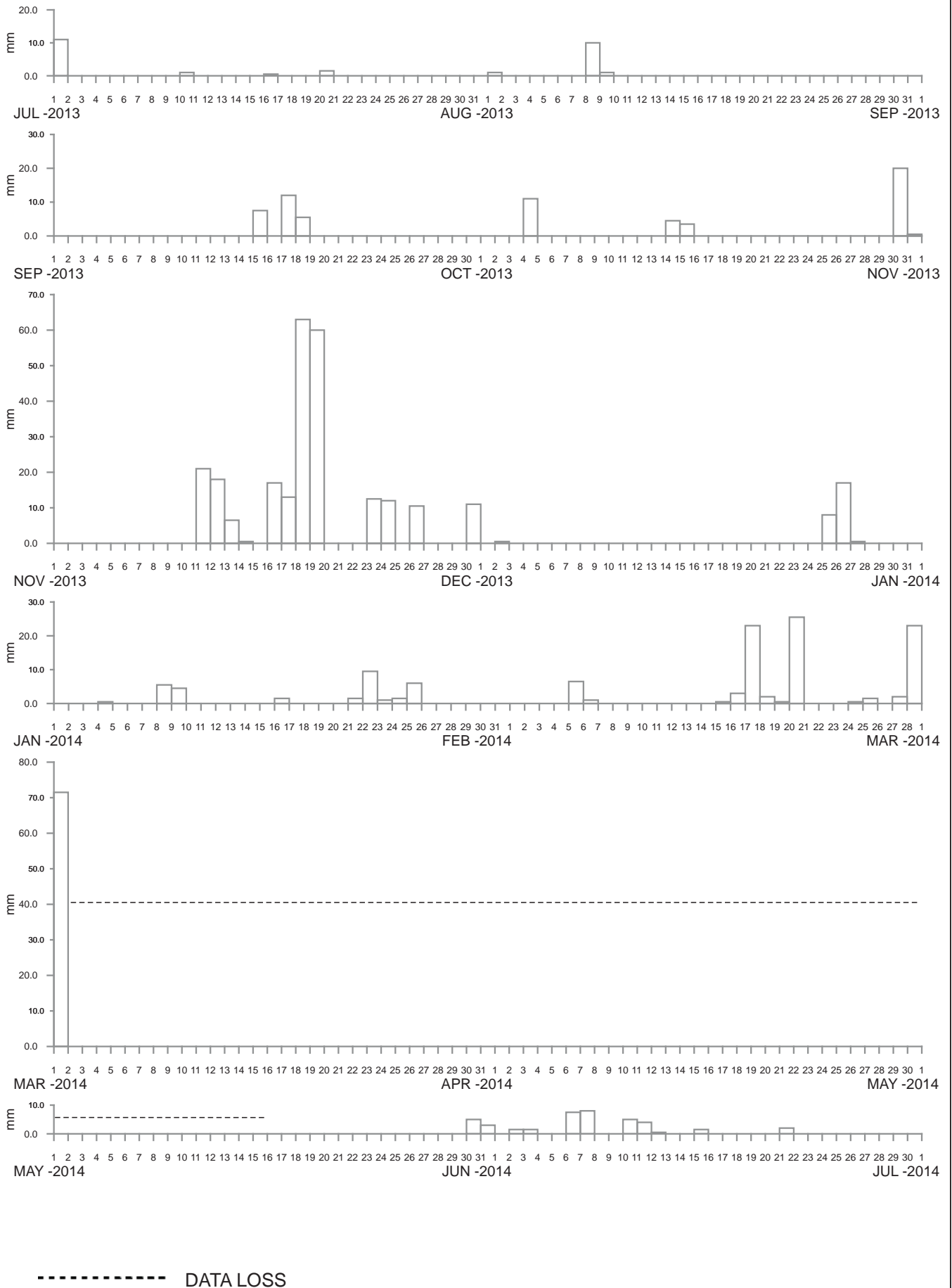
BARNESLEY AT JOHNSON AVENUE
2013-2014

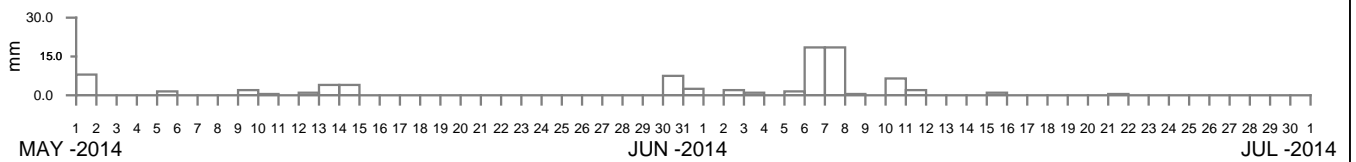
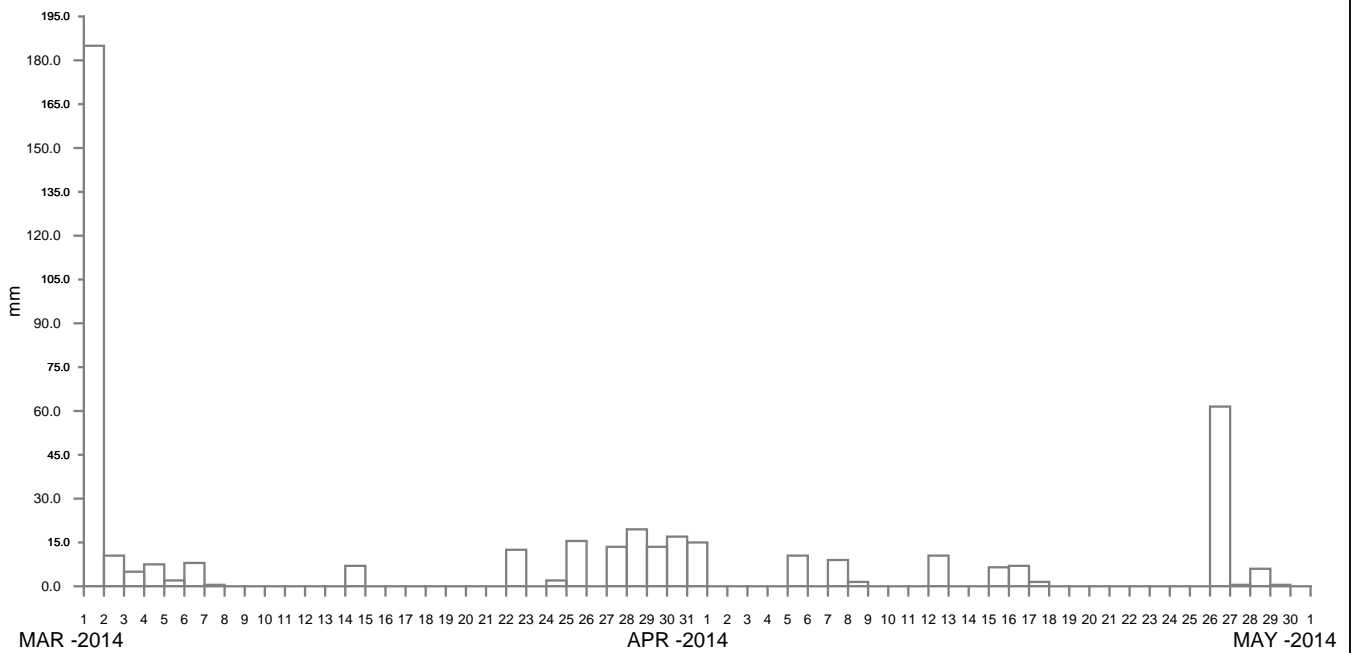
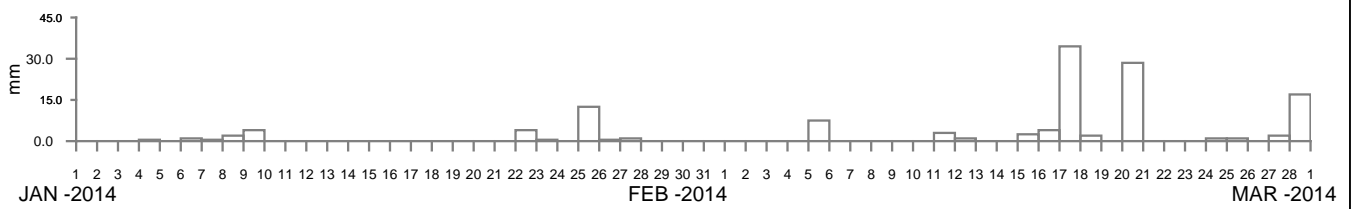
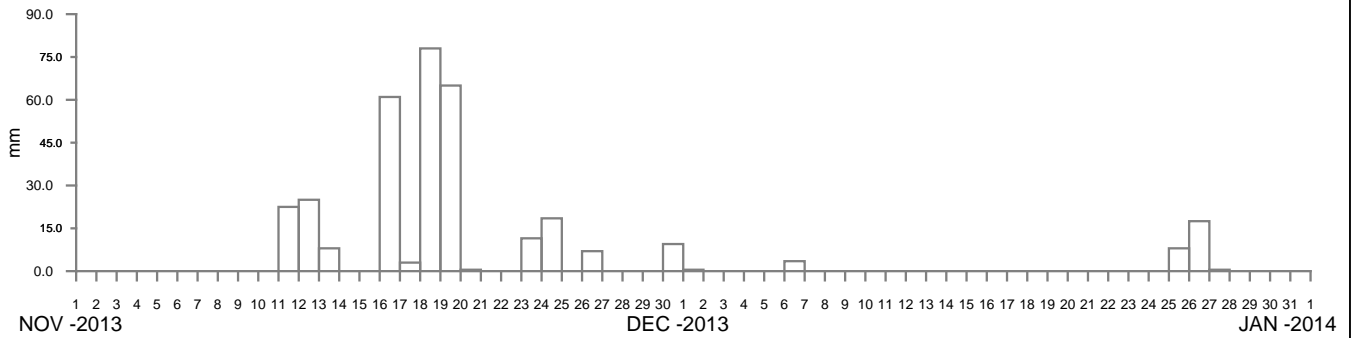
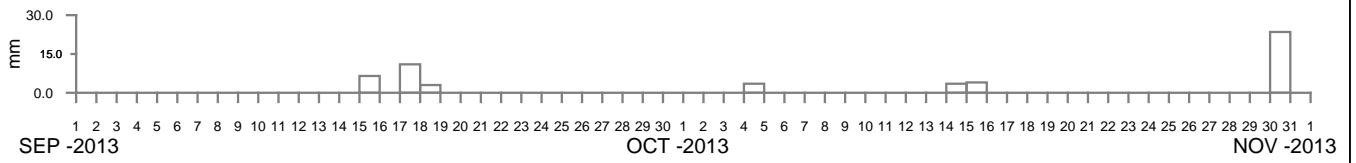
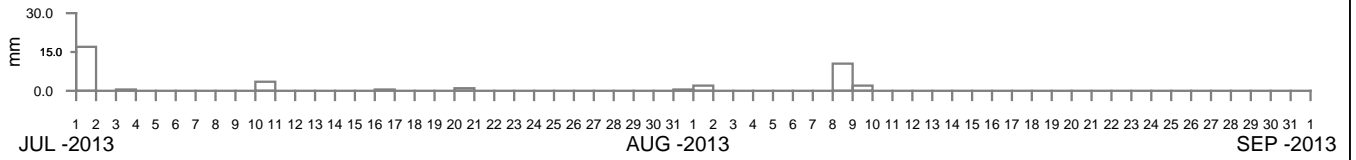
MHL
Report 2293

Figure

45

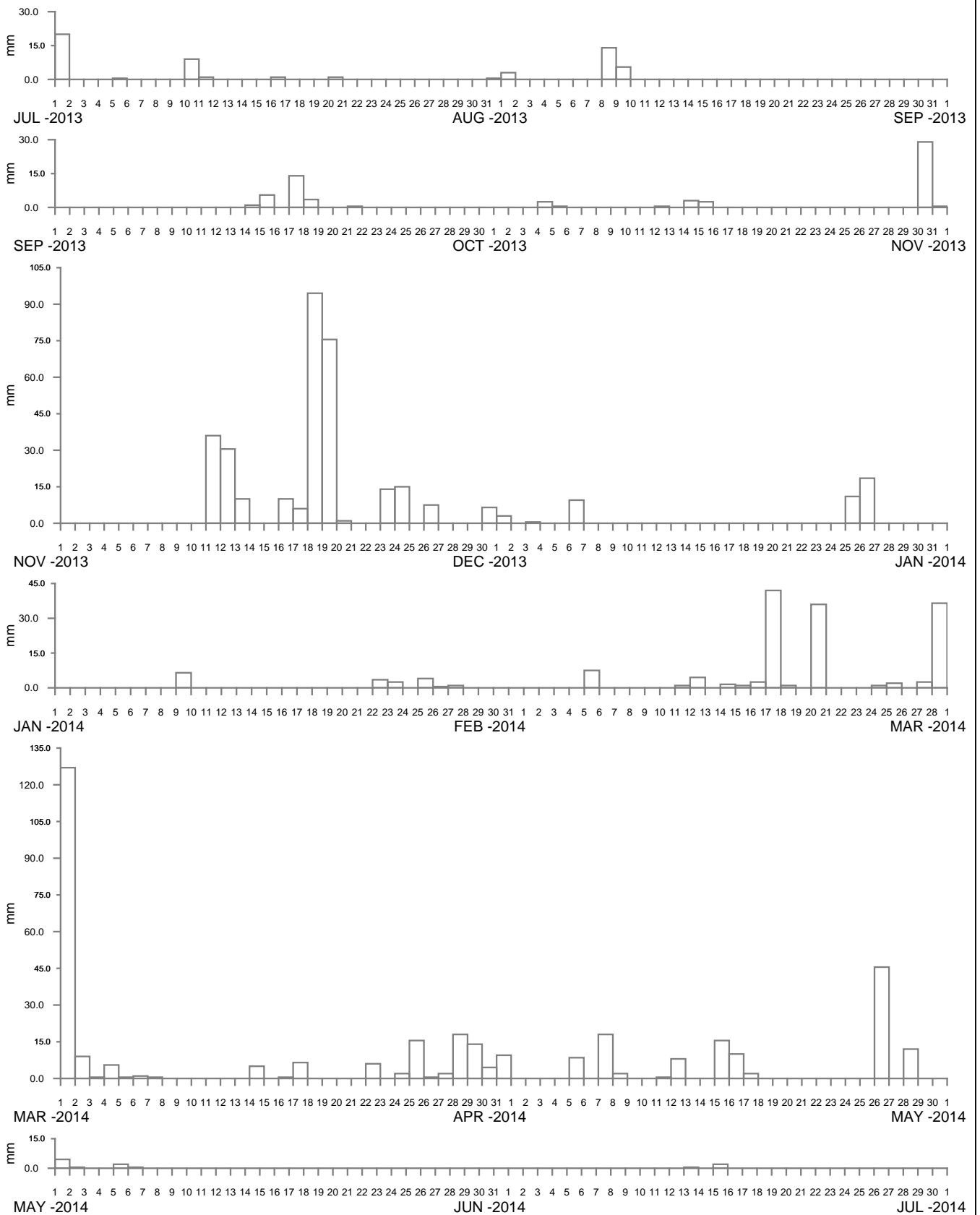
DRAWING 2293-45

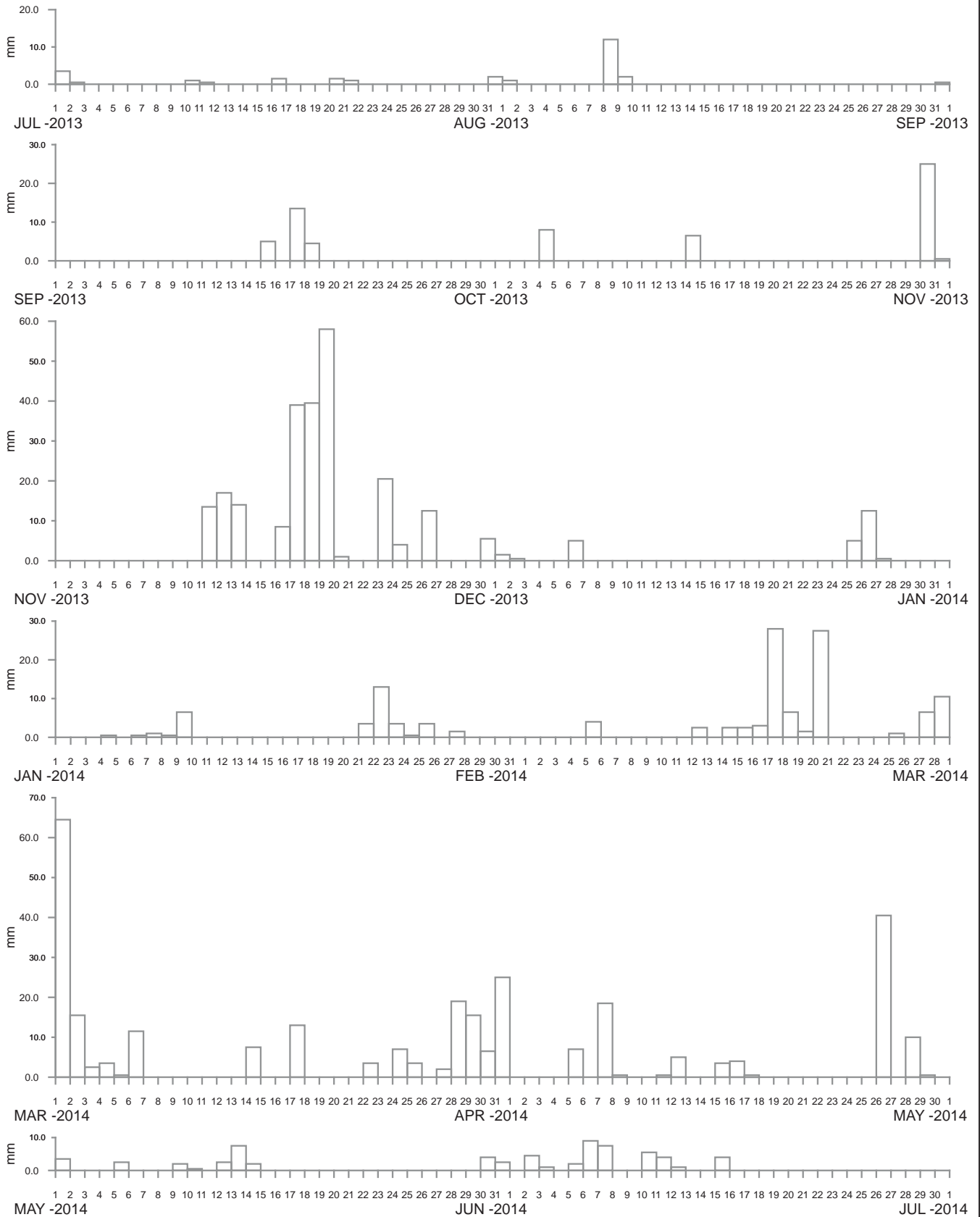




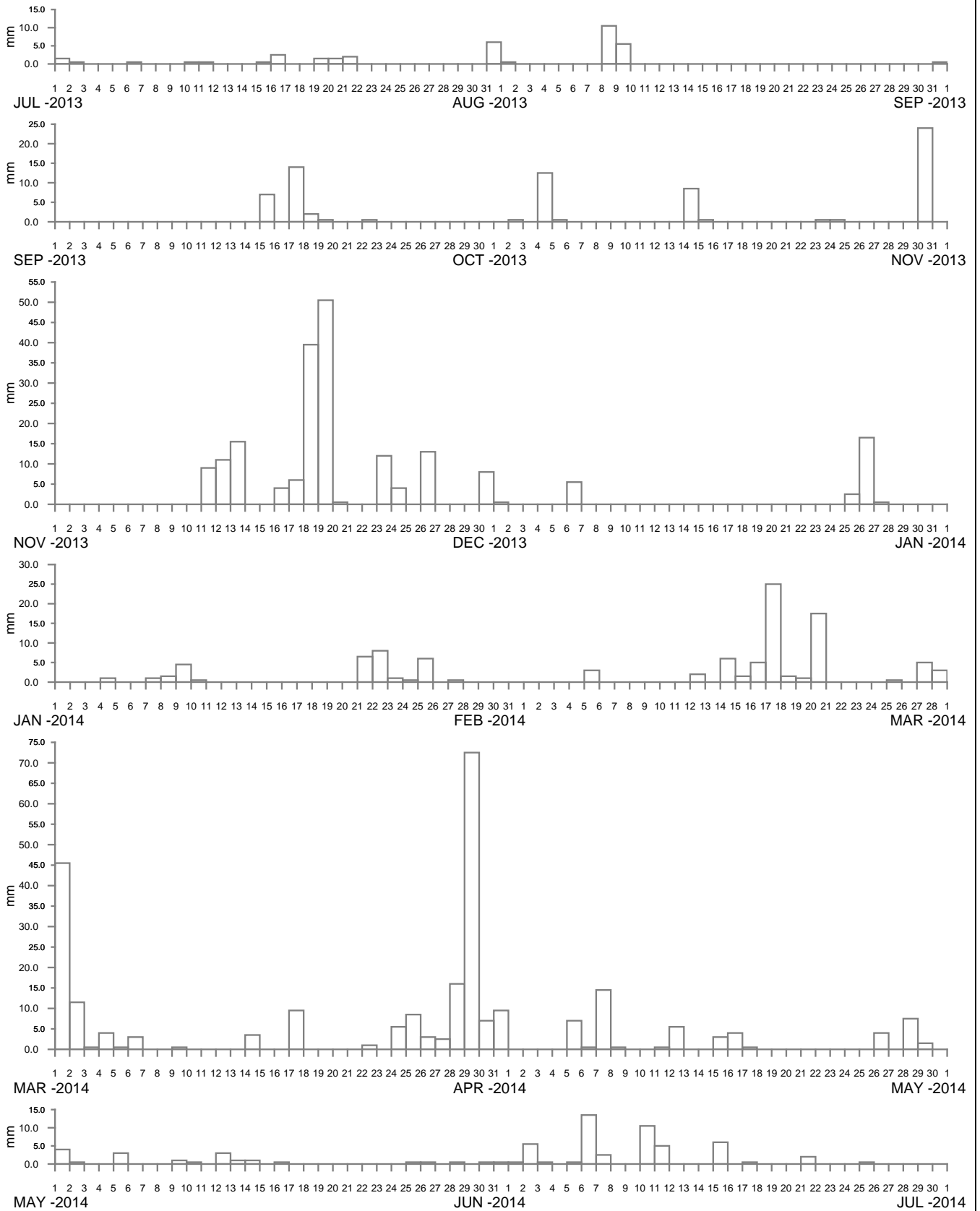
----- DATA LOSS

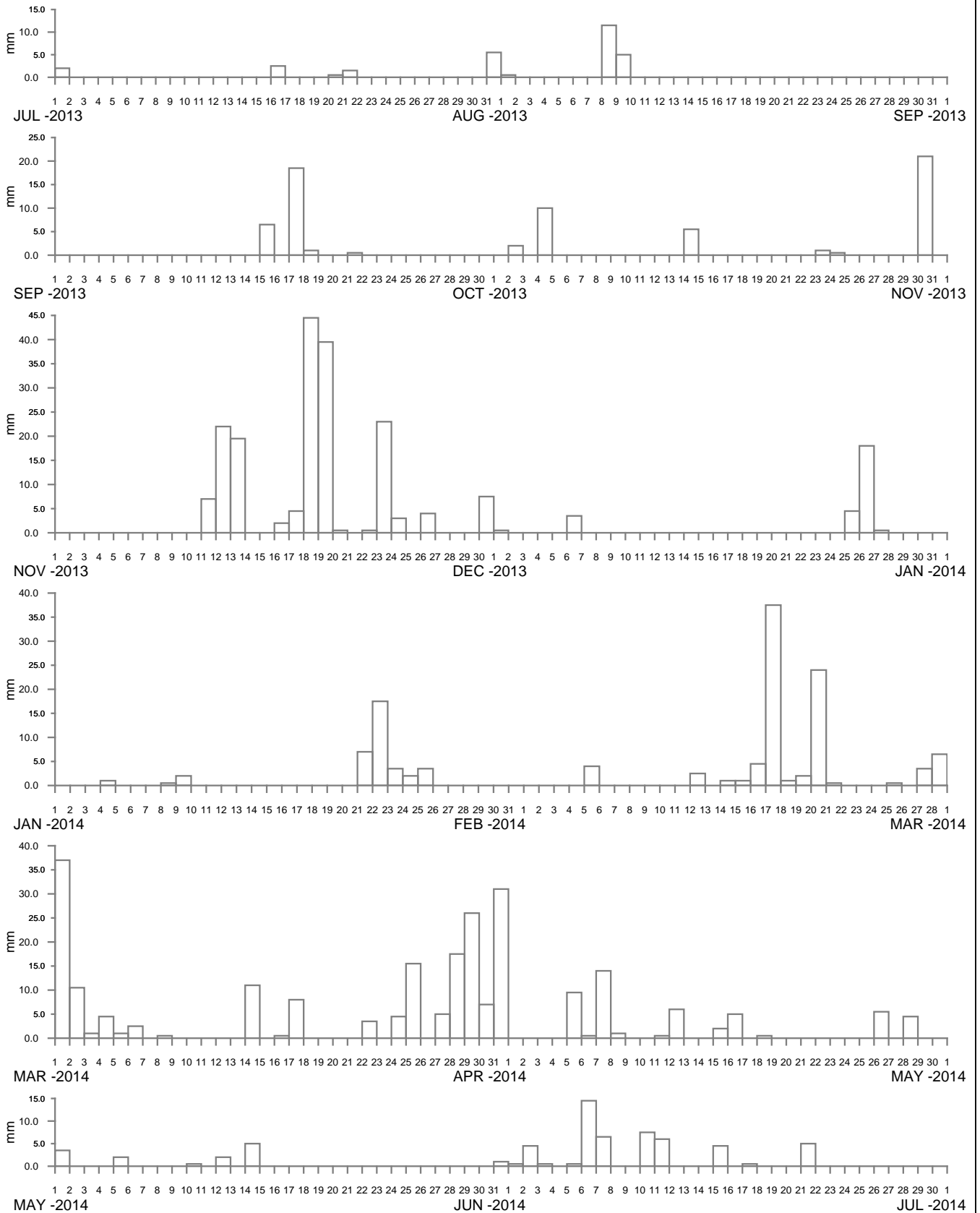






----- DATA LOSS





----- DATA LOSS



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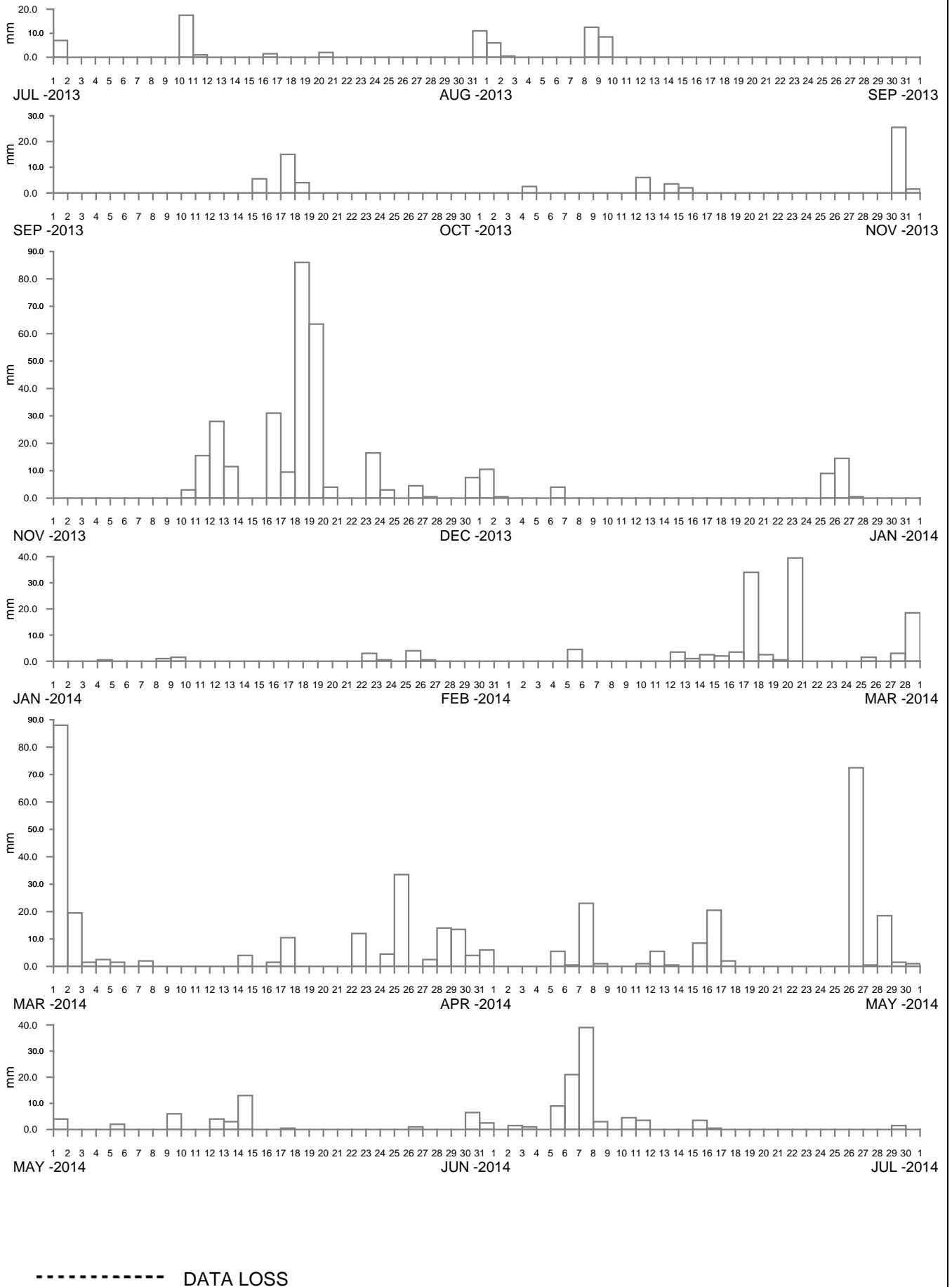
KULNURA AT GEORGE DOWNS DRIVE
2013-2014

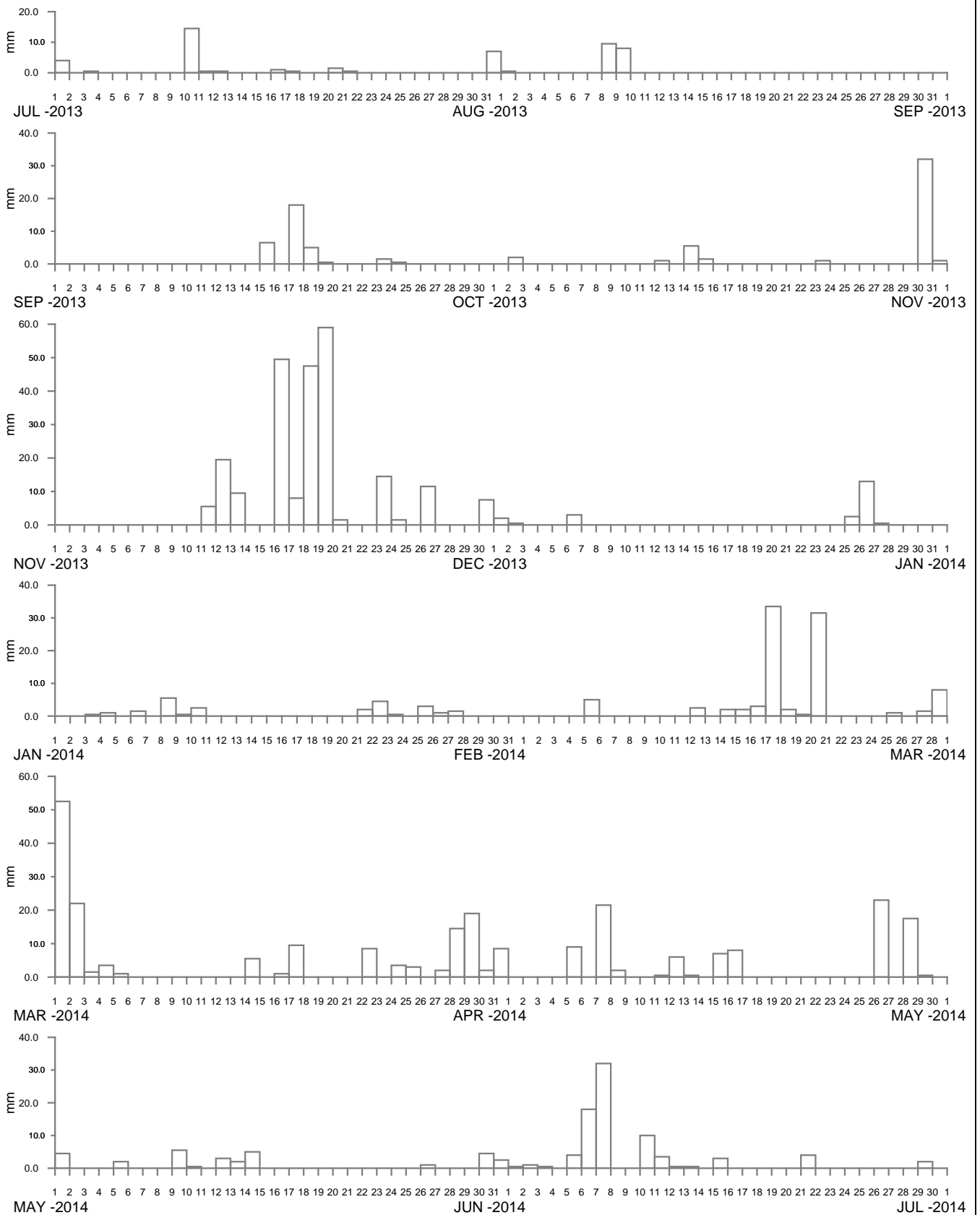
MHL
Report 2293

Figure

52

DRAWING 2293-52





----- DATA LOSS



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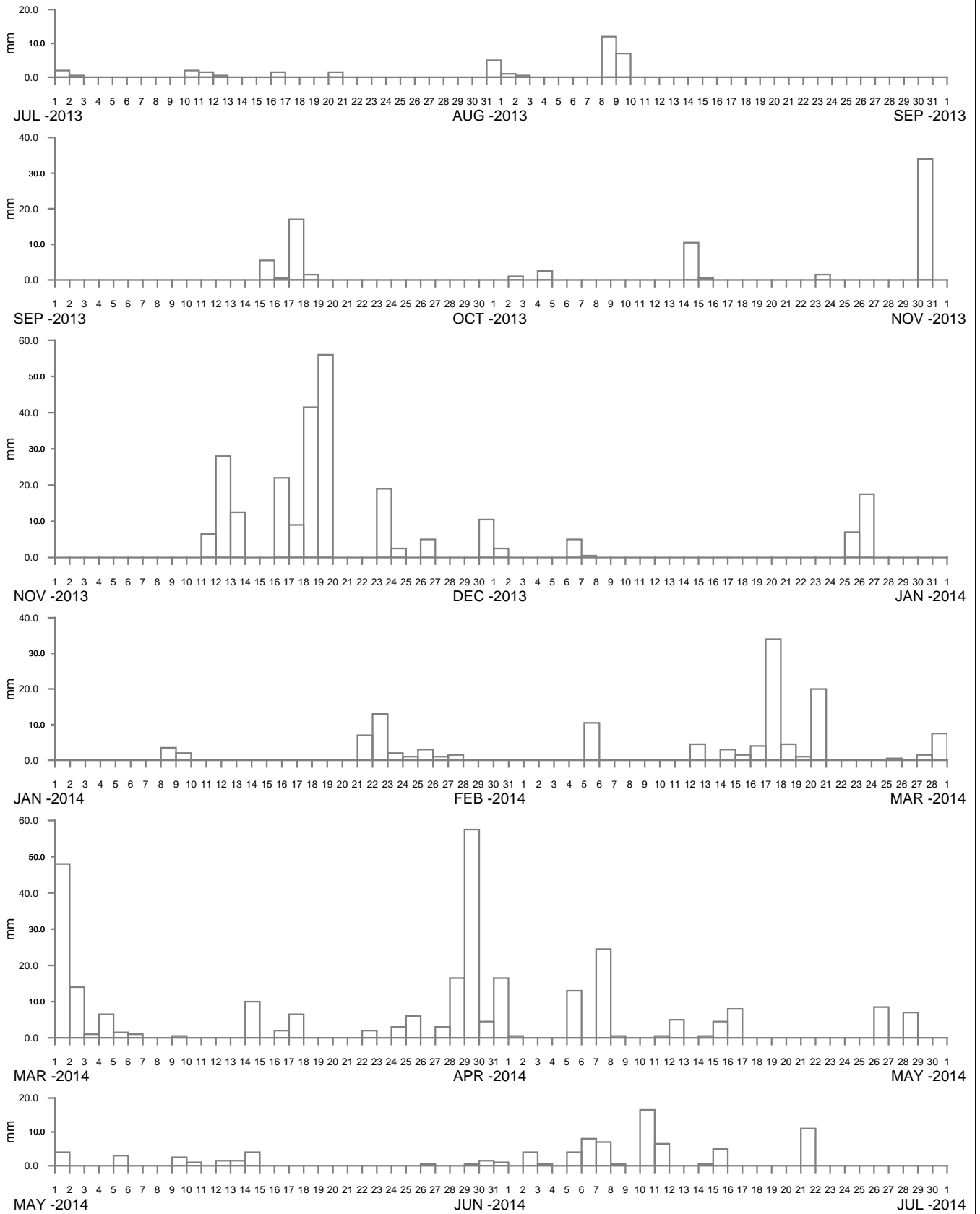
MARDI DAM AT OLD MAITLAND ROAD
2013-2014

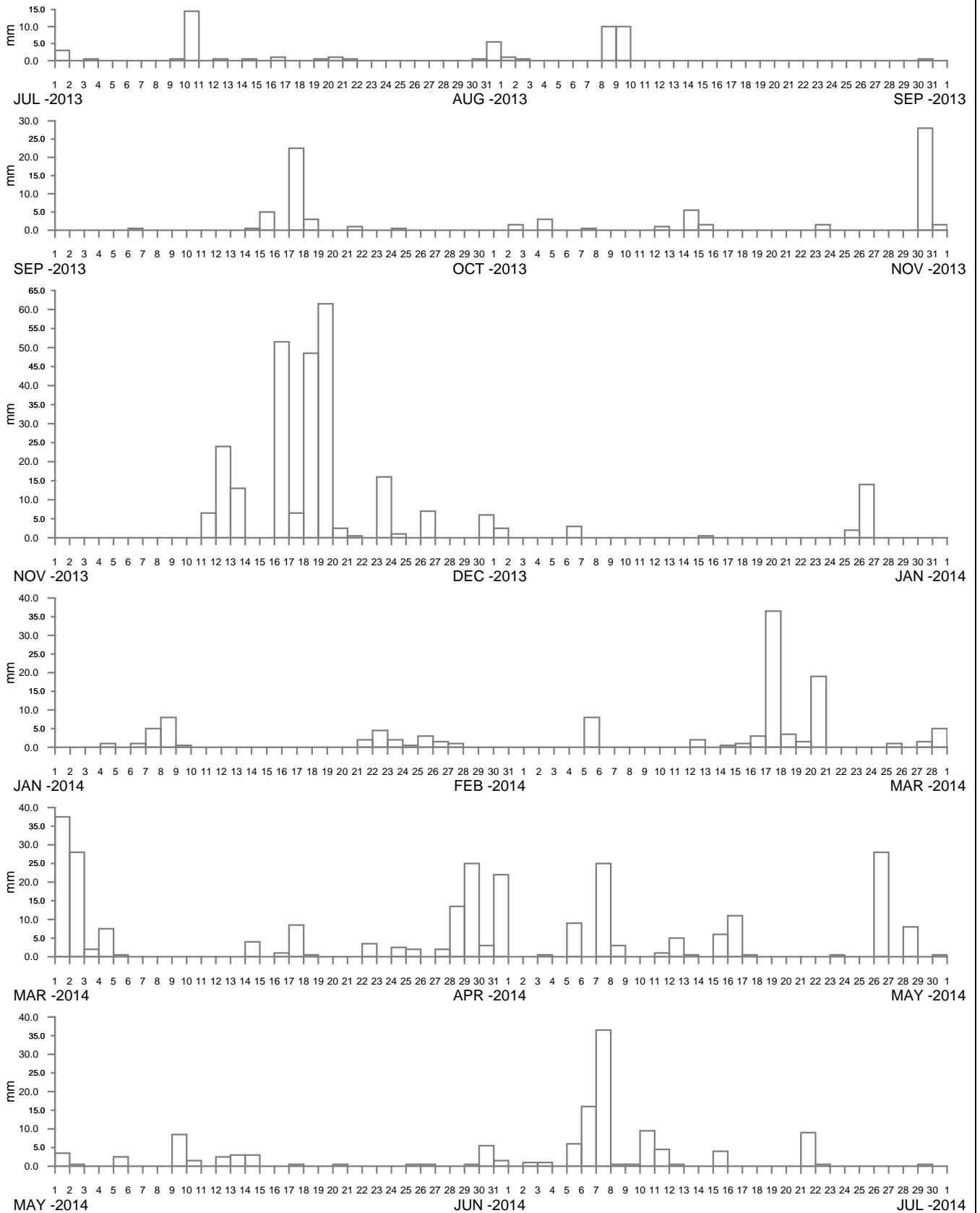
MHL
Report 2293

Figure

55

DRAWING 2293-55





----- DATA LOSS



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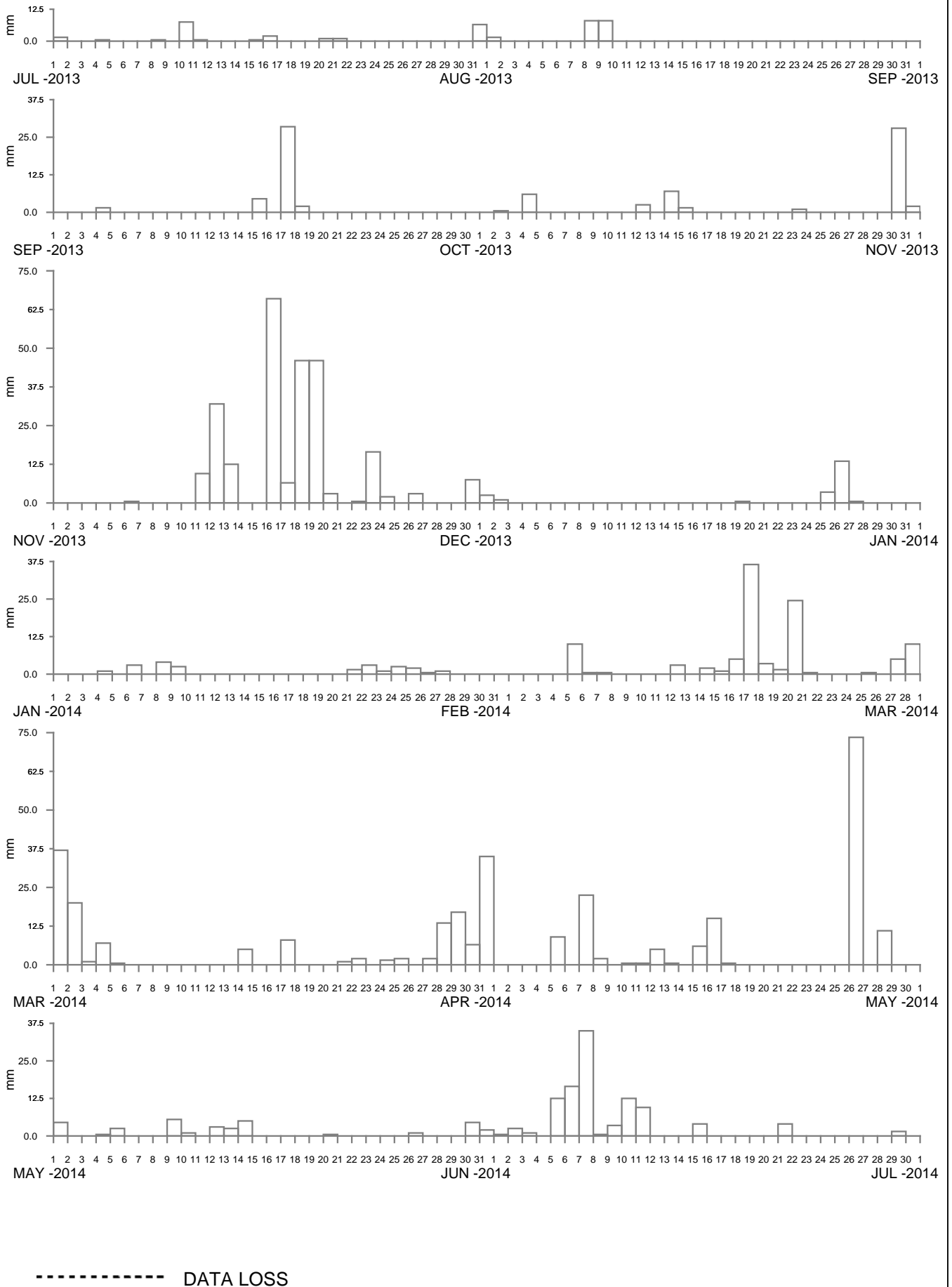
KANGY ANGY AT ORCHARD ROAD
2013-2014

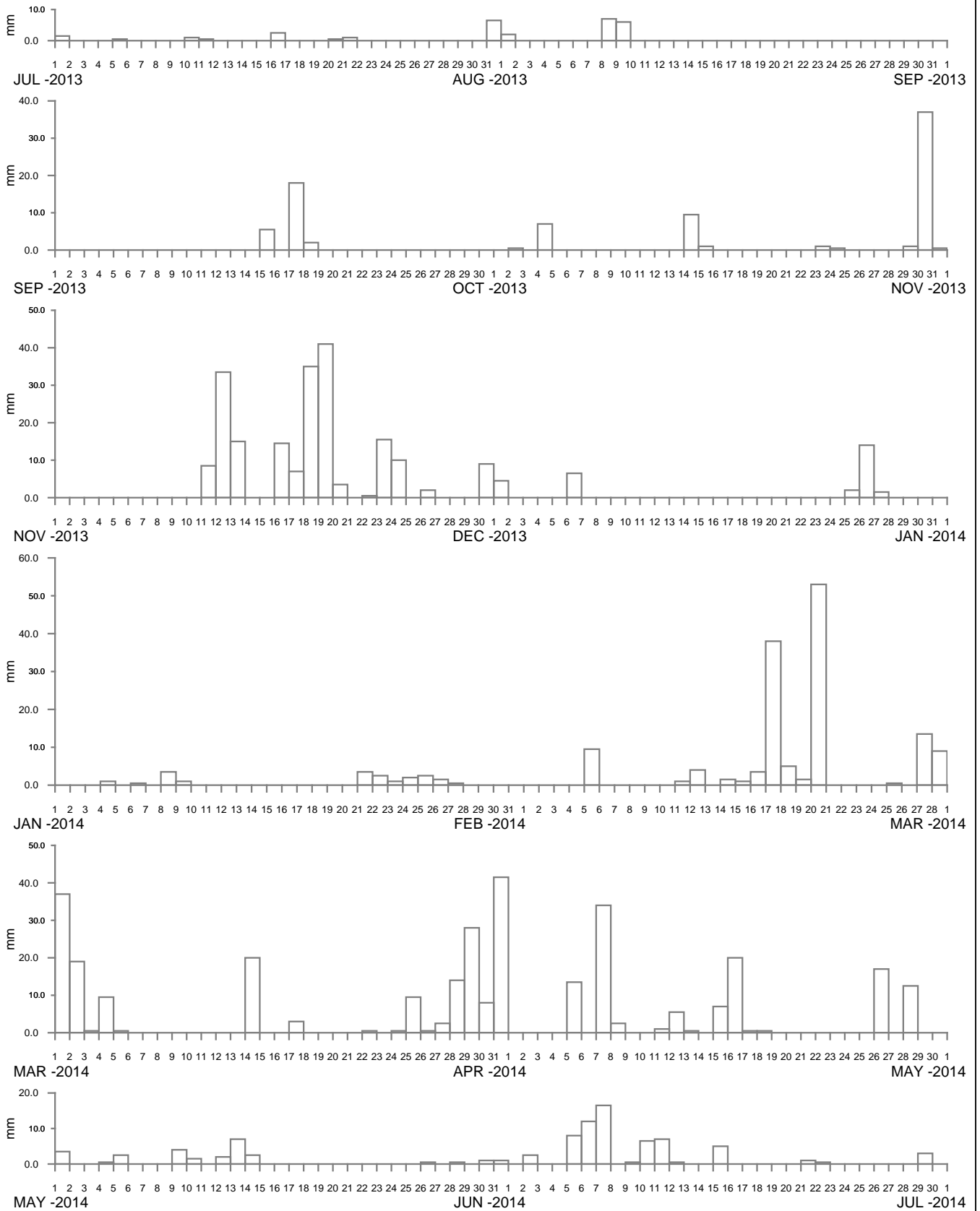
MHL
Report 2293

Figure

57

DRAWING 2293-57





----- DATA LOSS



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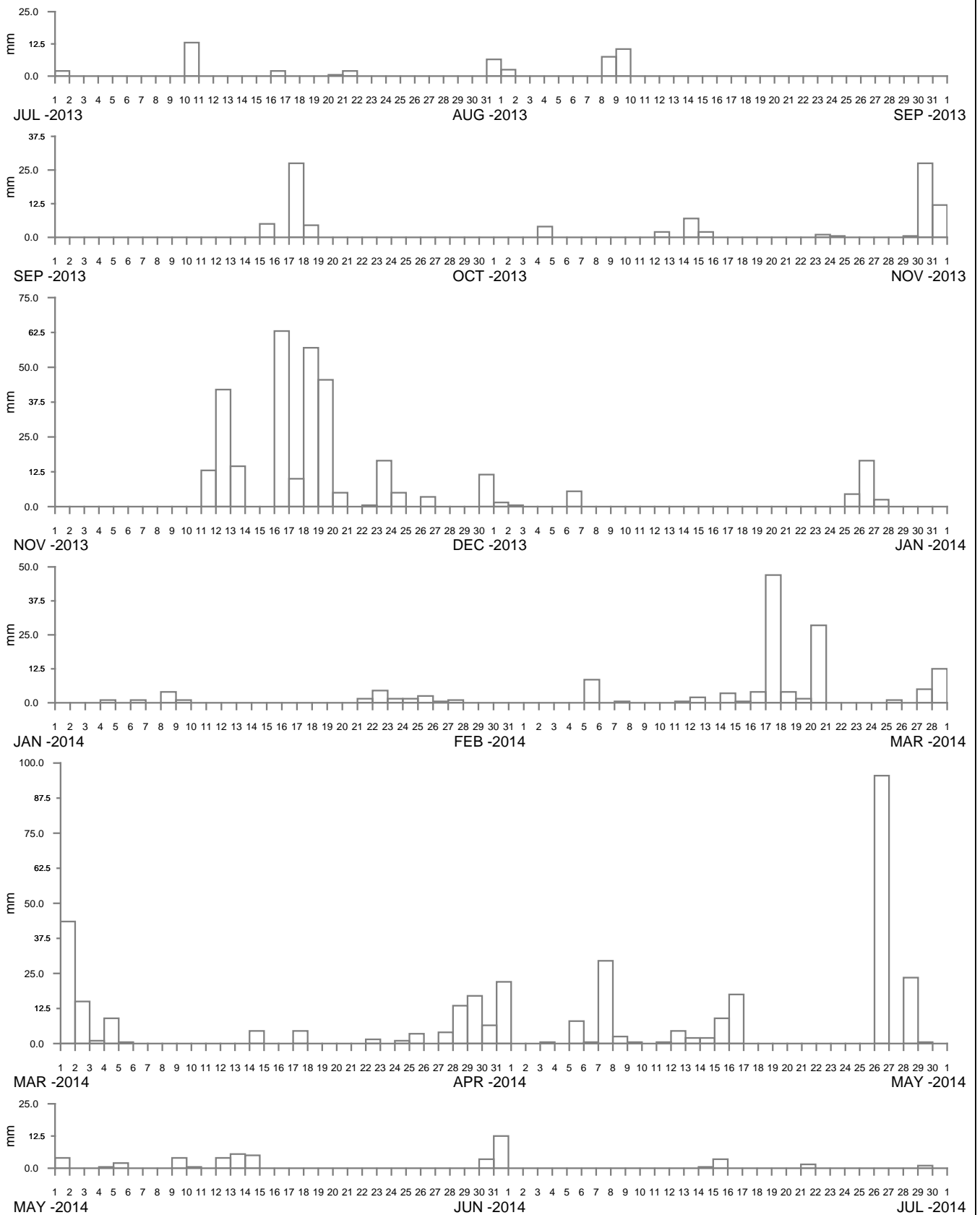
NARARA AT RESEARCH ROAD
2013-2014

MHL
Report 2293

Figure

62

DRAWING 2293-62



----- DATA LOSS



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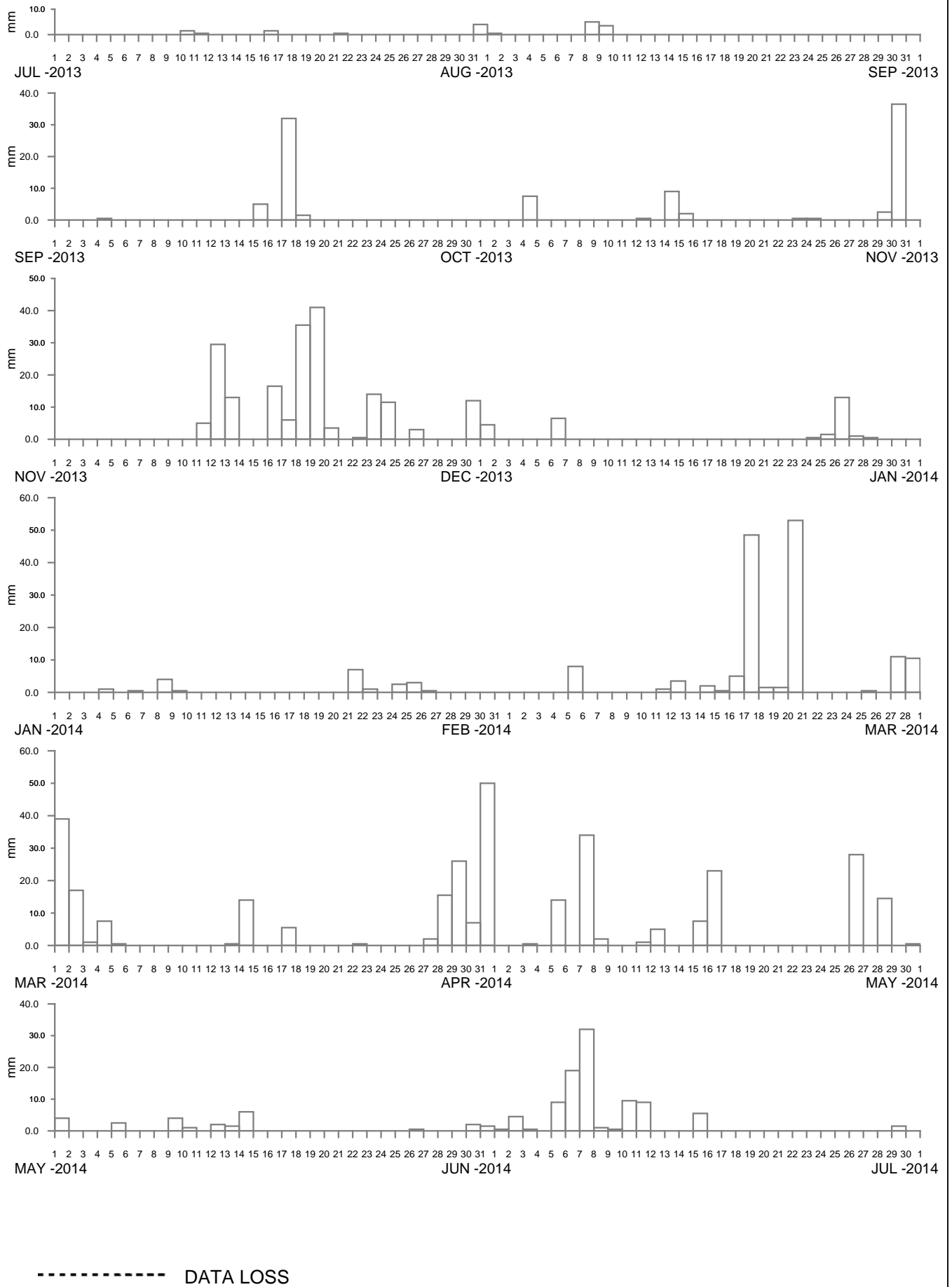
MOUNT ELLIOT AT TOOMEYS ROAD
2013-2014

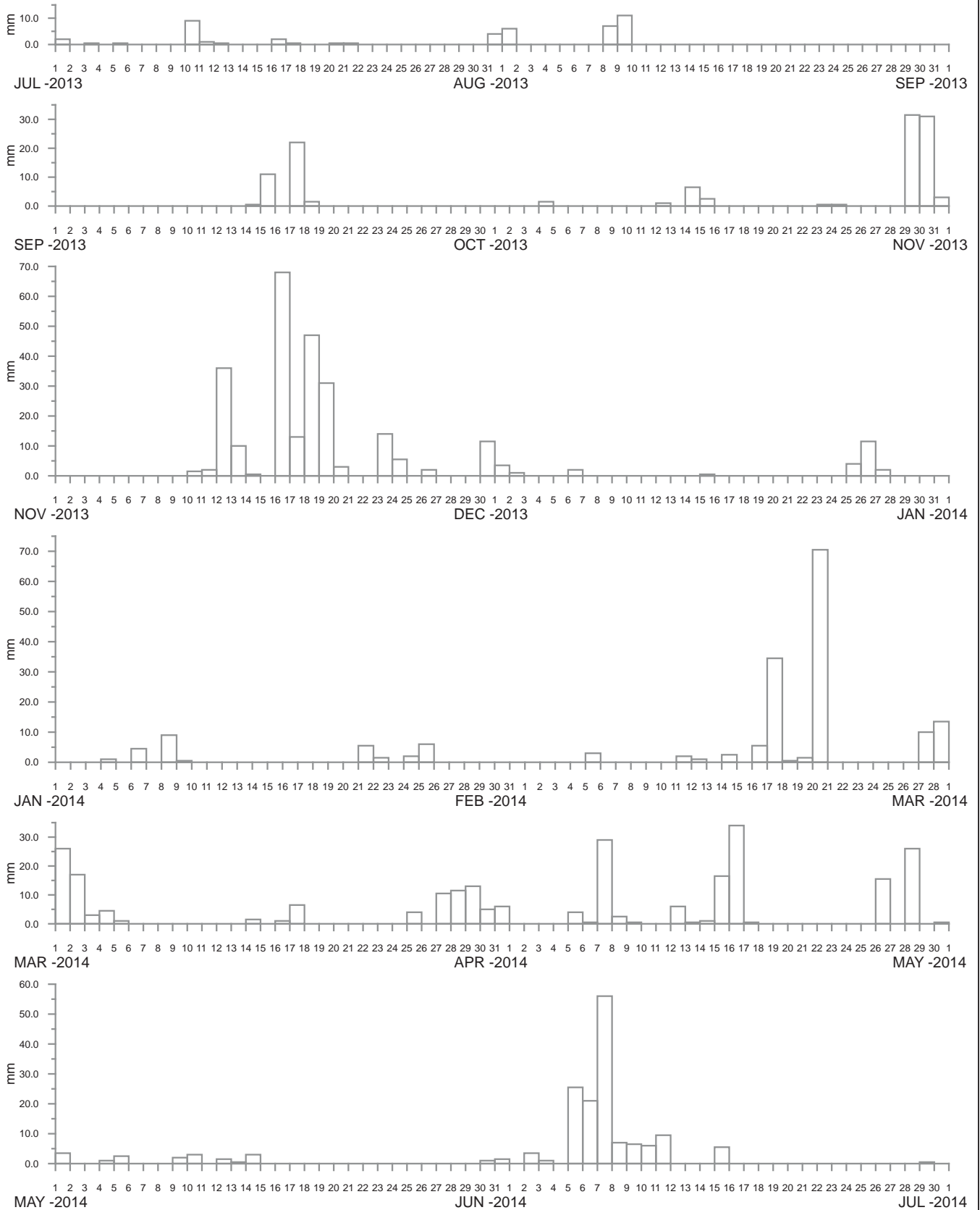
MHL
Report 2293

Figure

63

DRAWING 2293-63





----- DATA LOSS



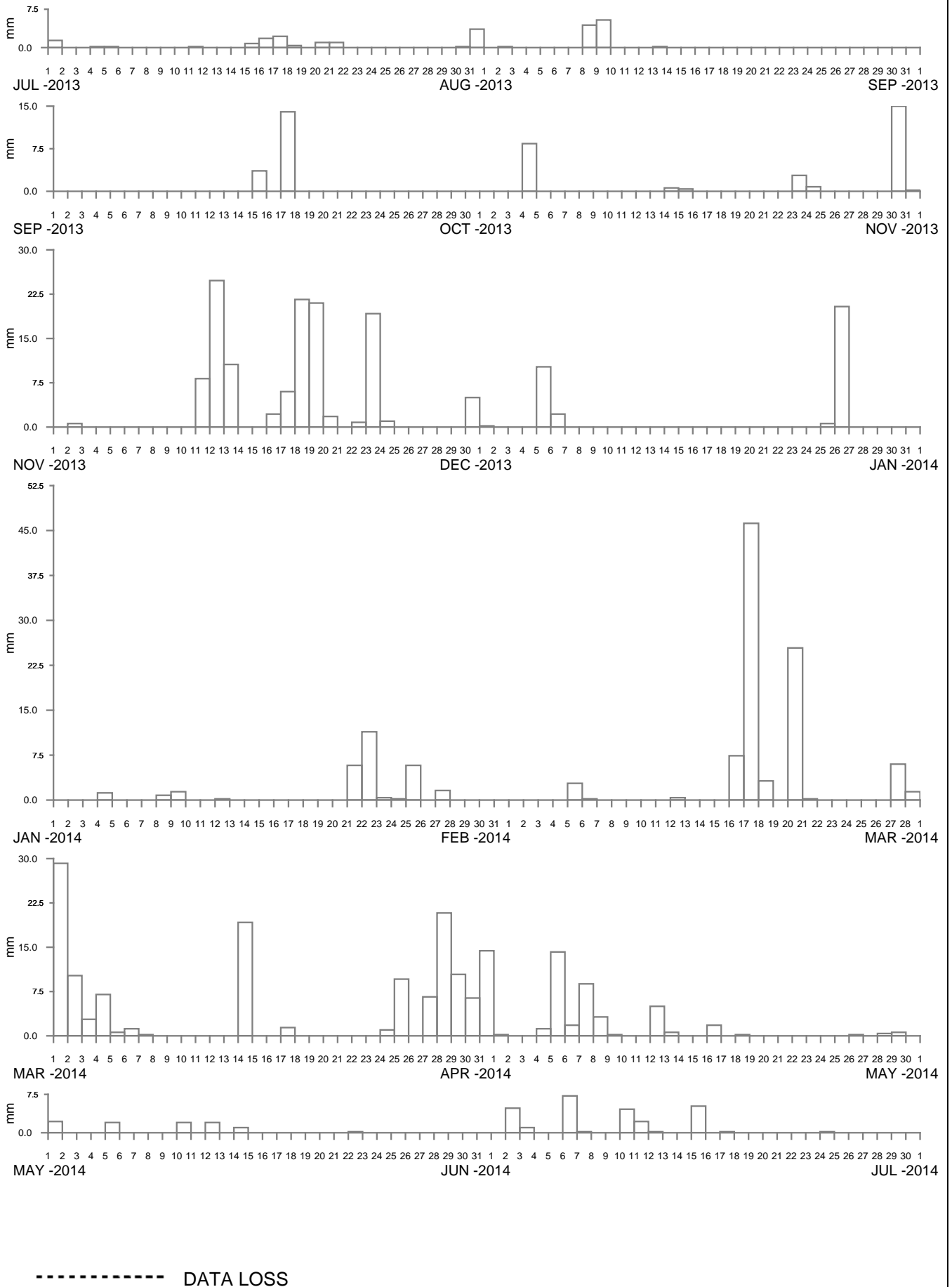
RAINFALL STATION LOCATIONS
HAWKESBURY RIVER (MID) REGION

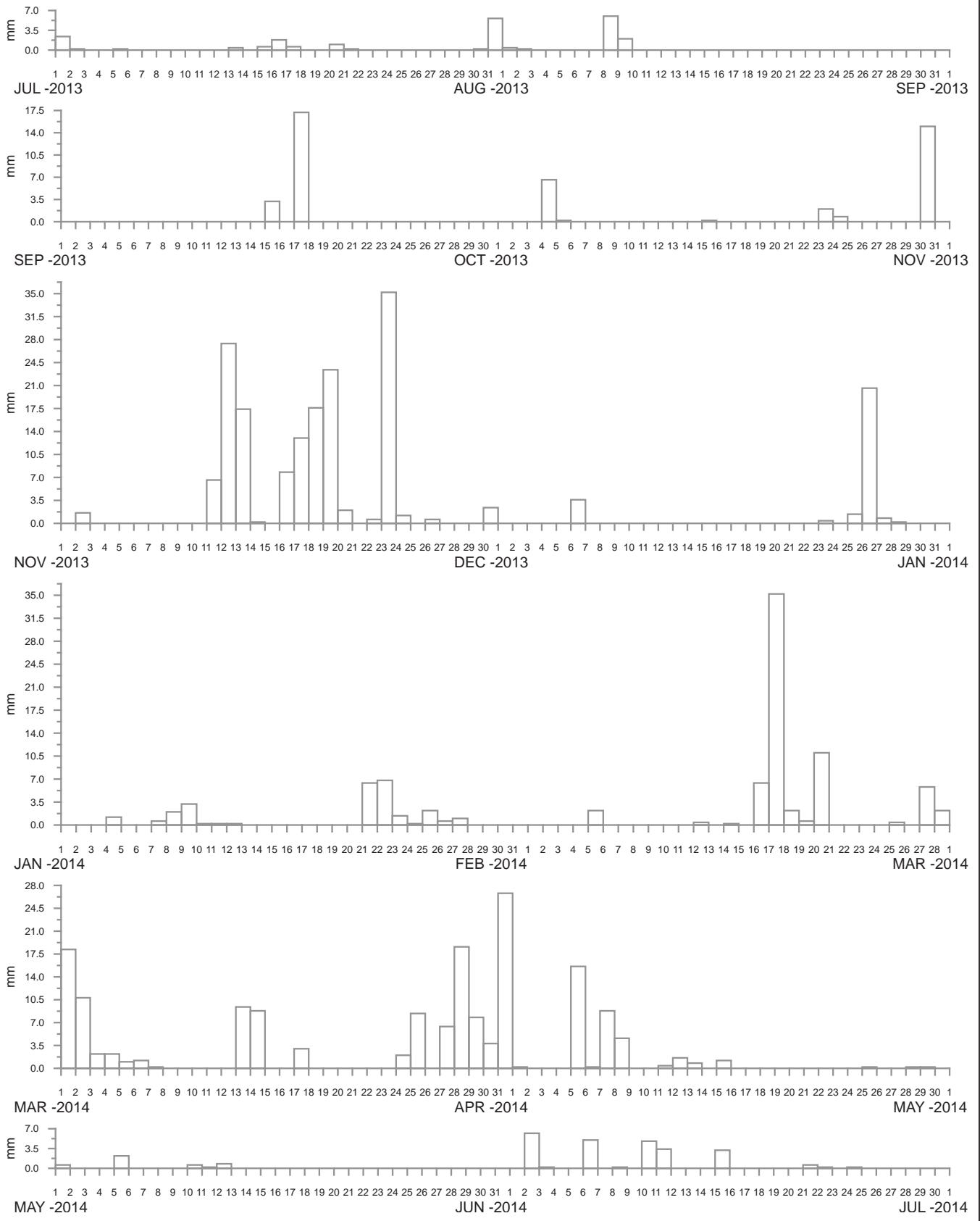
MHL
Report 2293
Figure
66

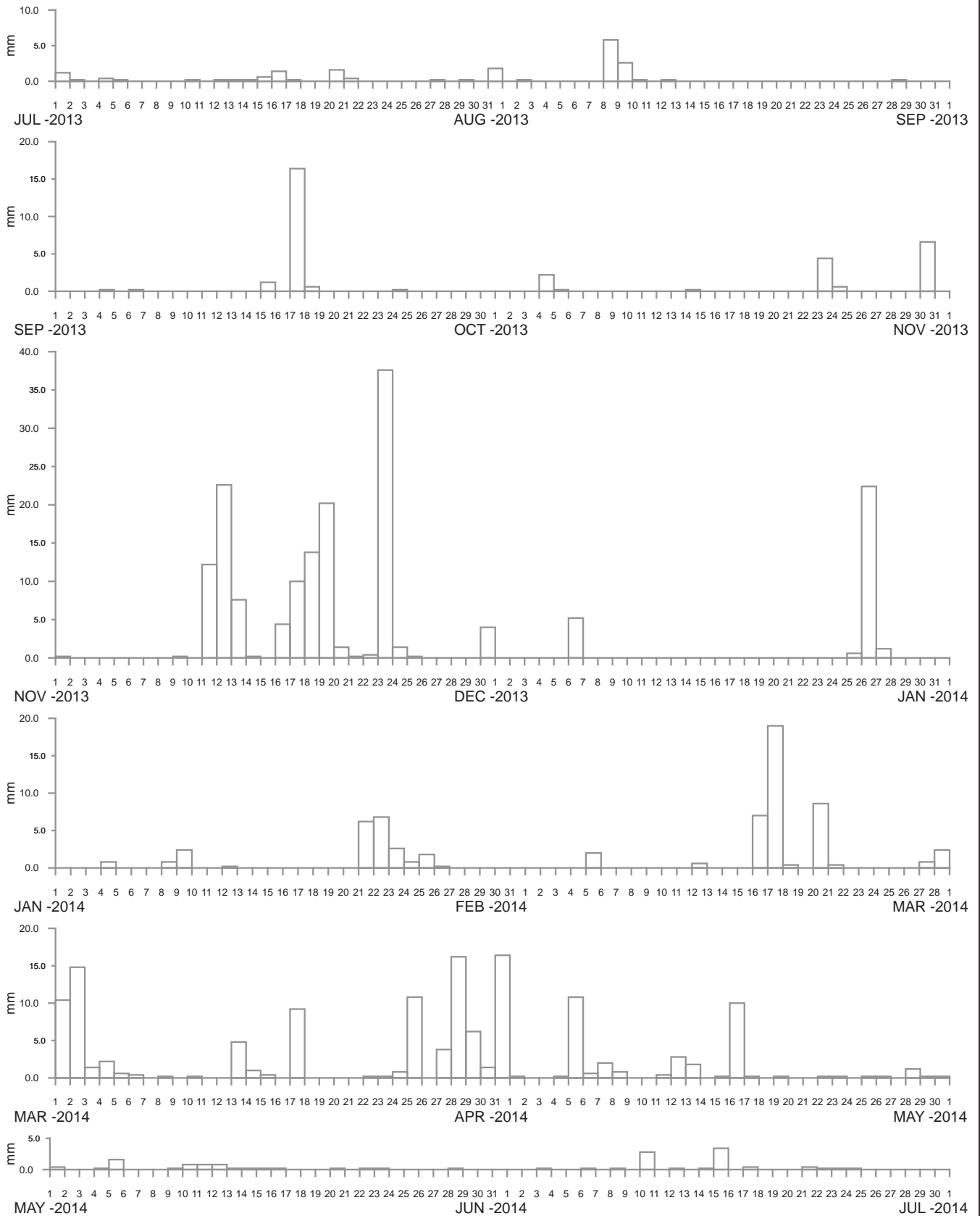


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Manly Hydraulics Laboratory

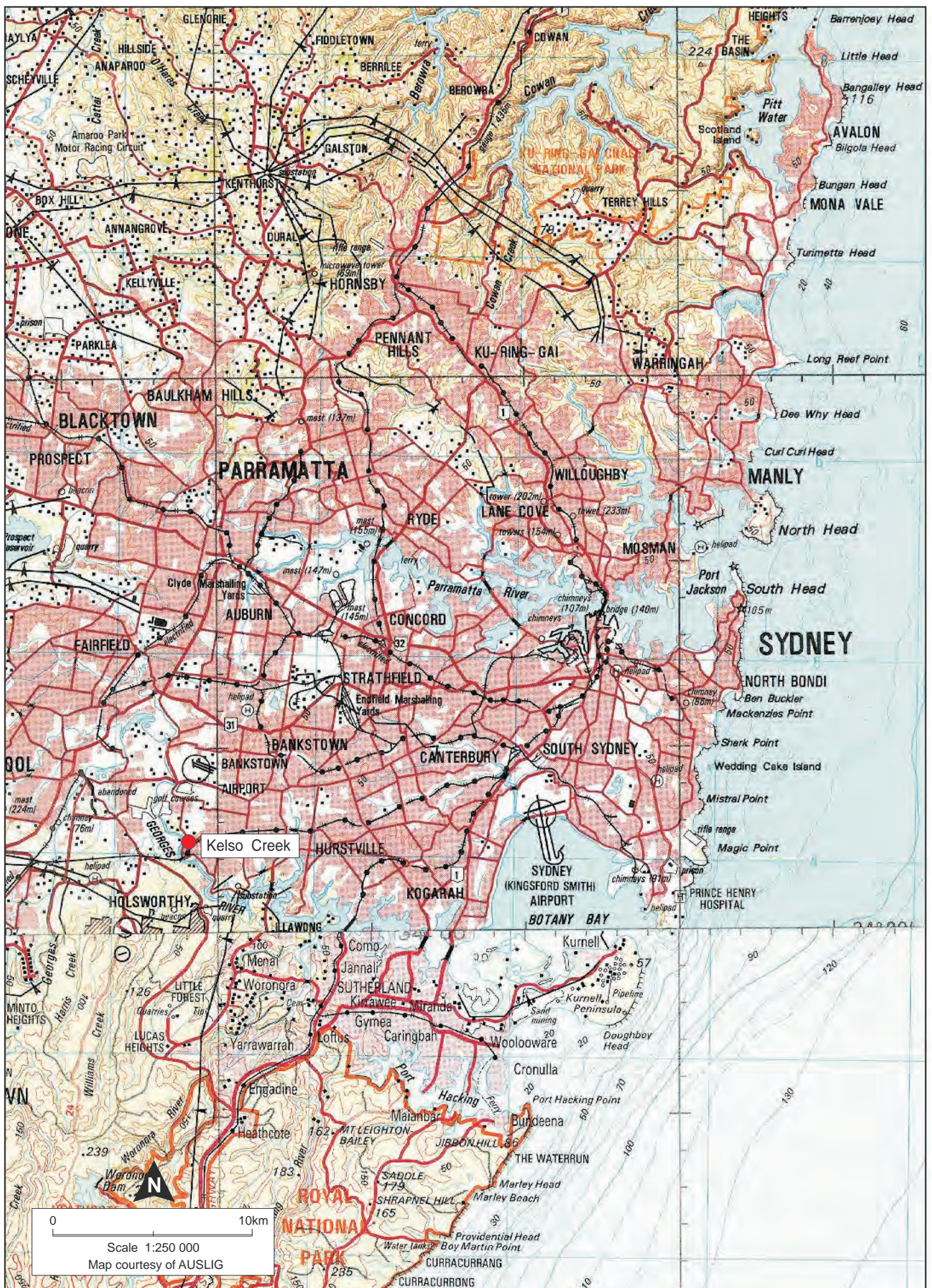
DRAWING 2293-66.cdr







----- DATA LOSS



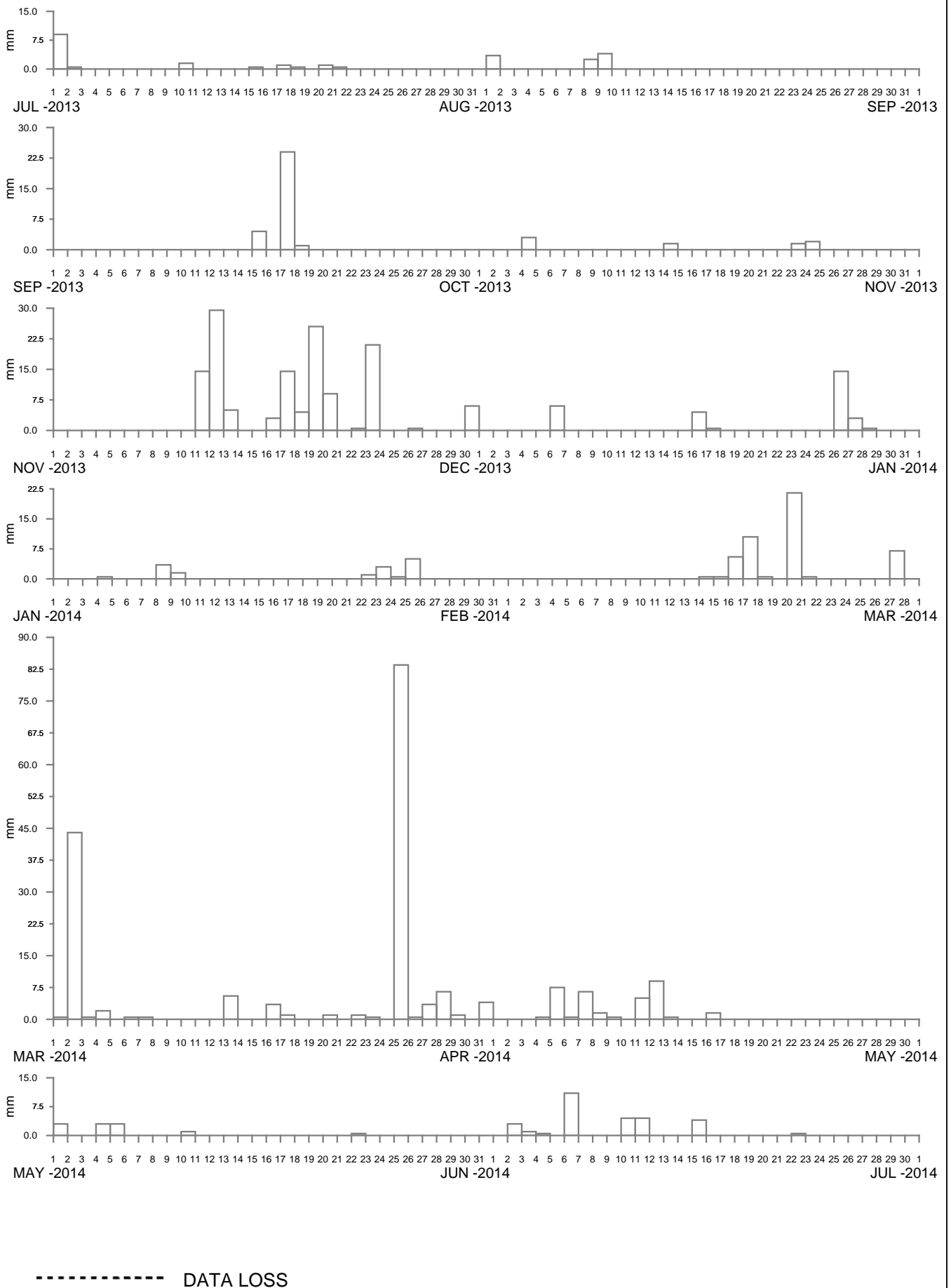
Public Works
Manly Hydraulics Laboratory

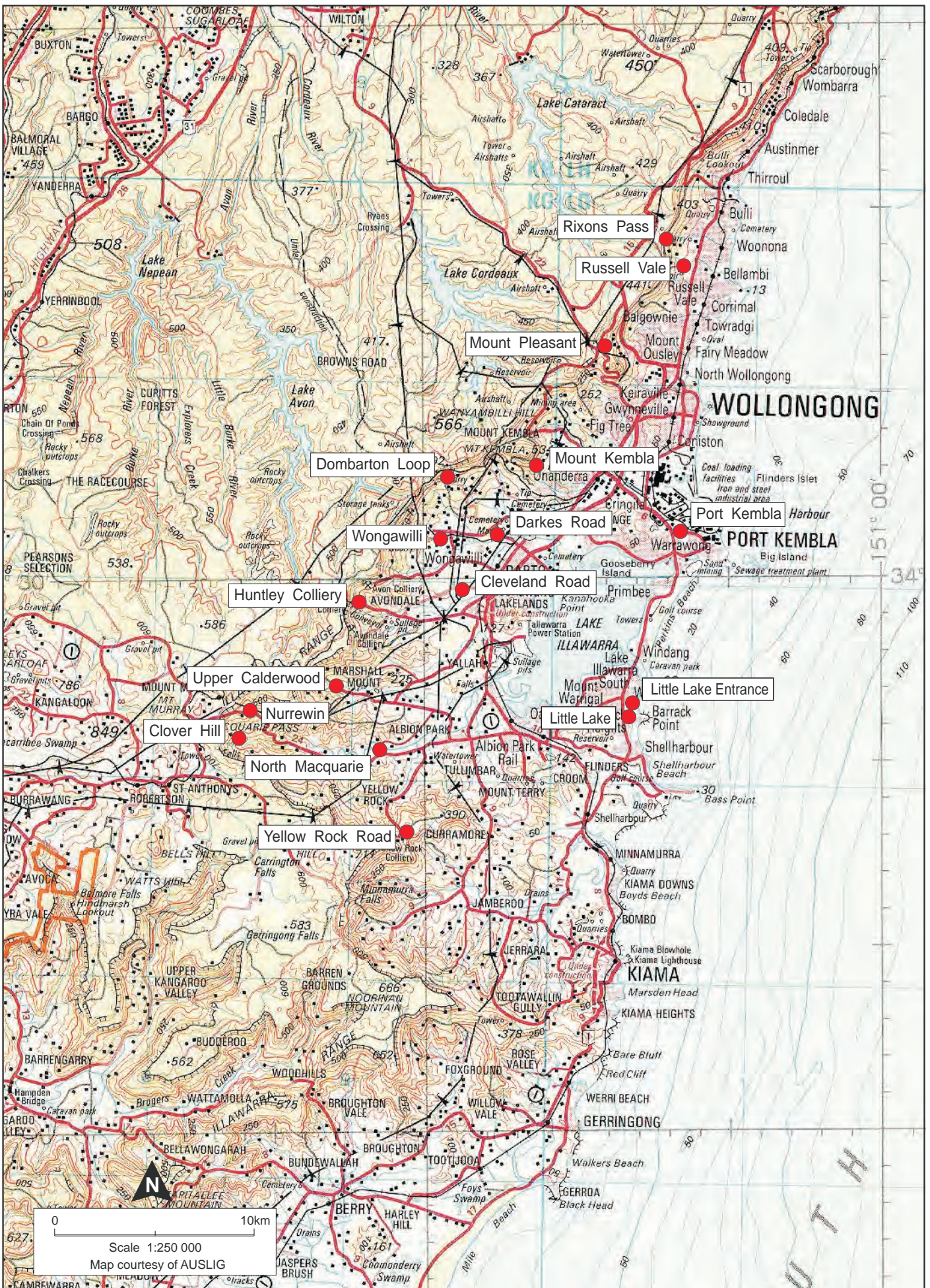
RAINFALL STATION LOCATIONS SYDNEY COASTAL REGION

MHL
Report 2293

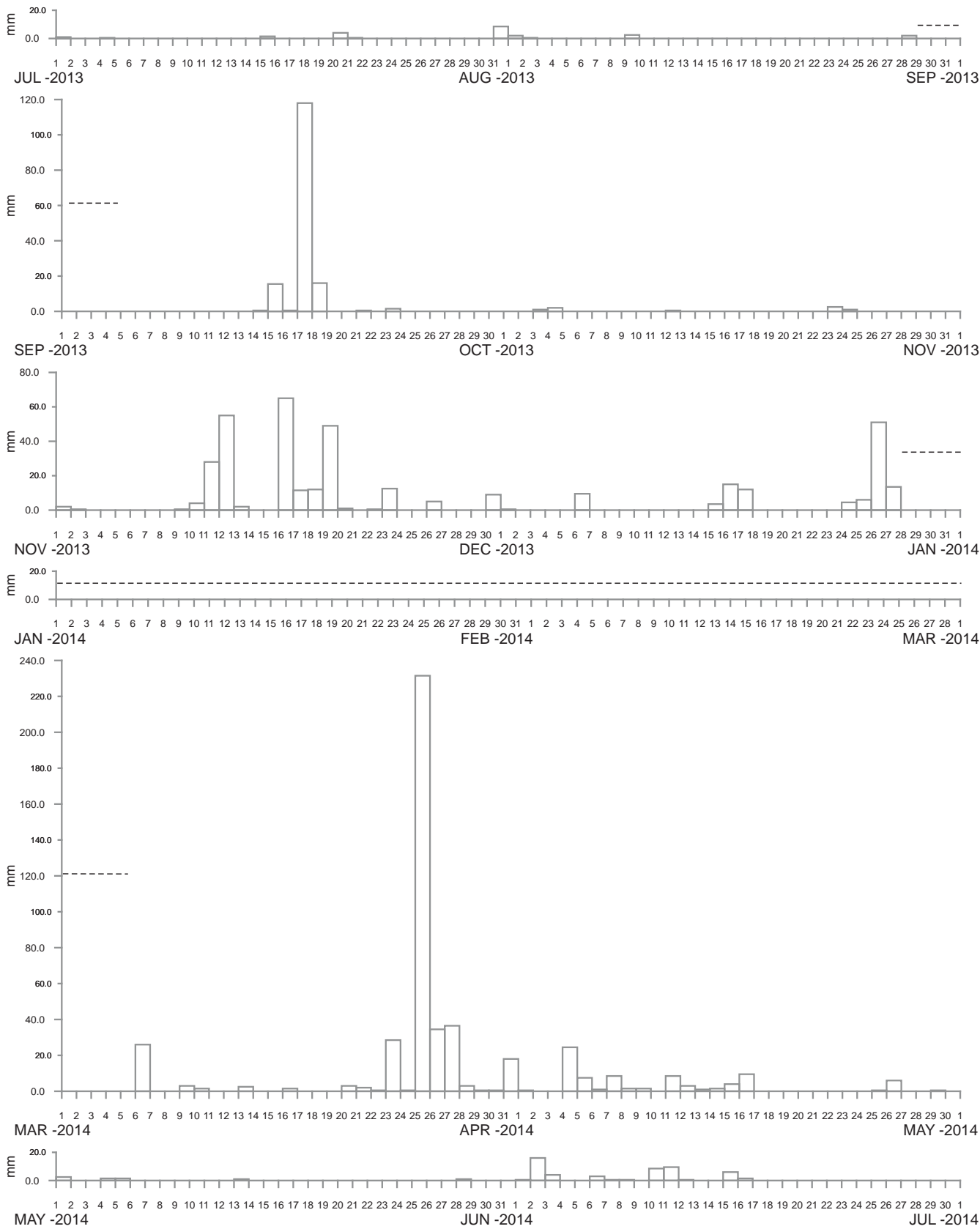
Figure
70

DRAWING 2293-70.cdr



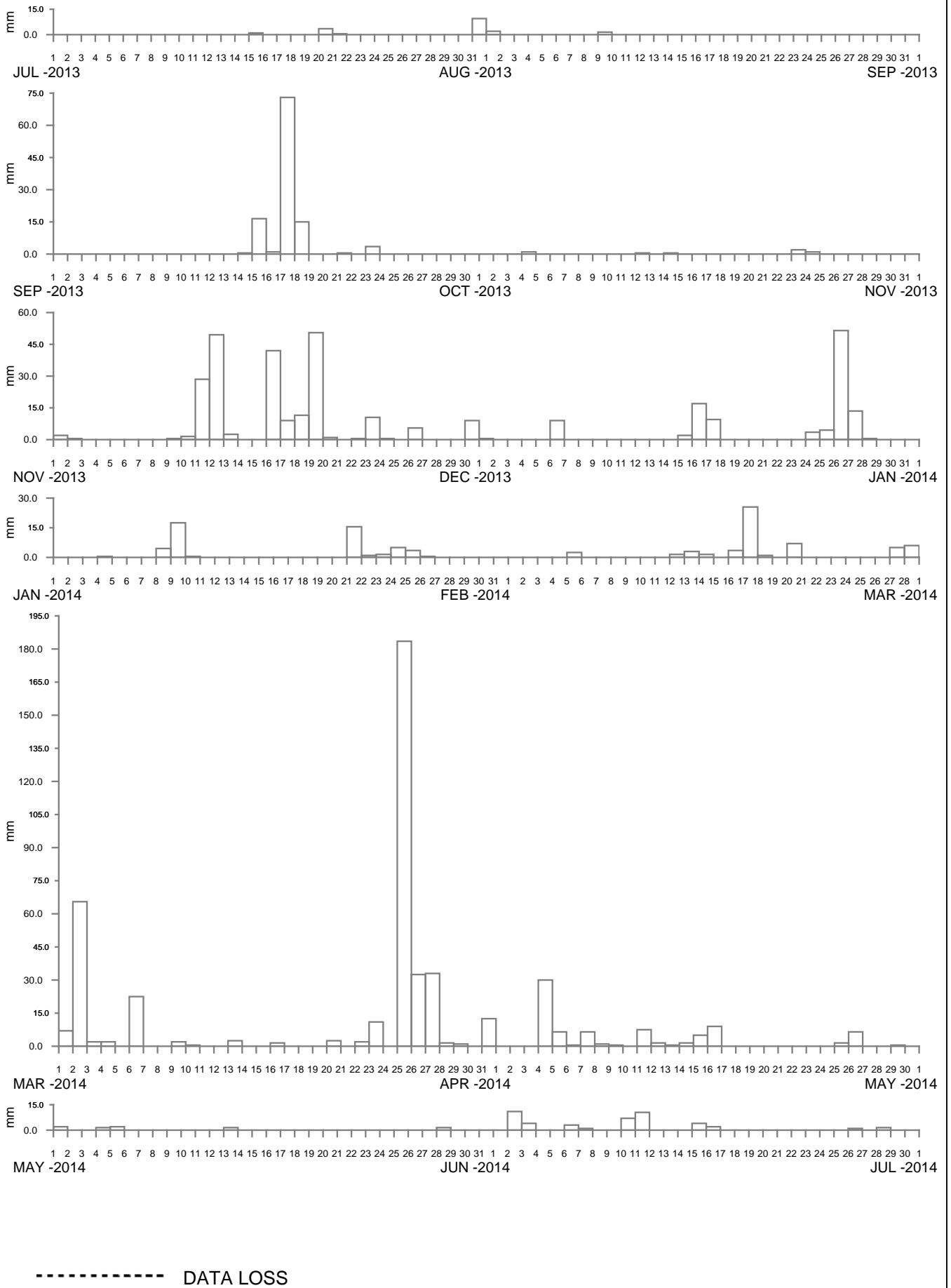


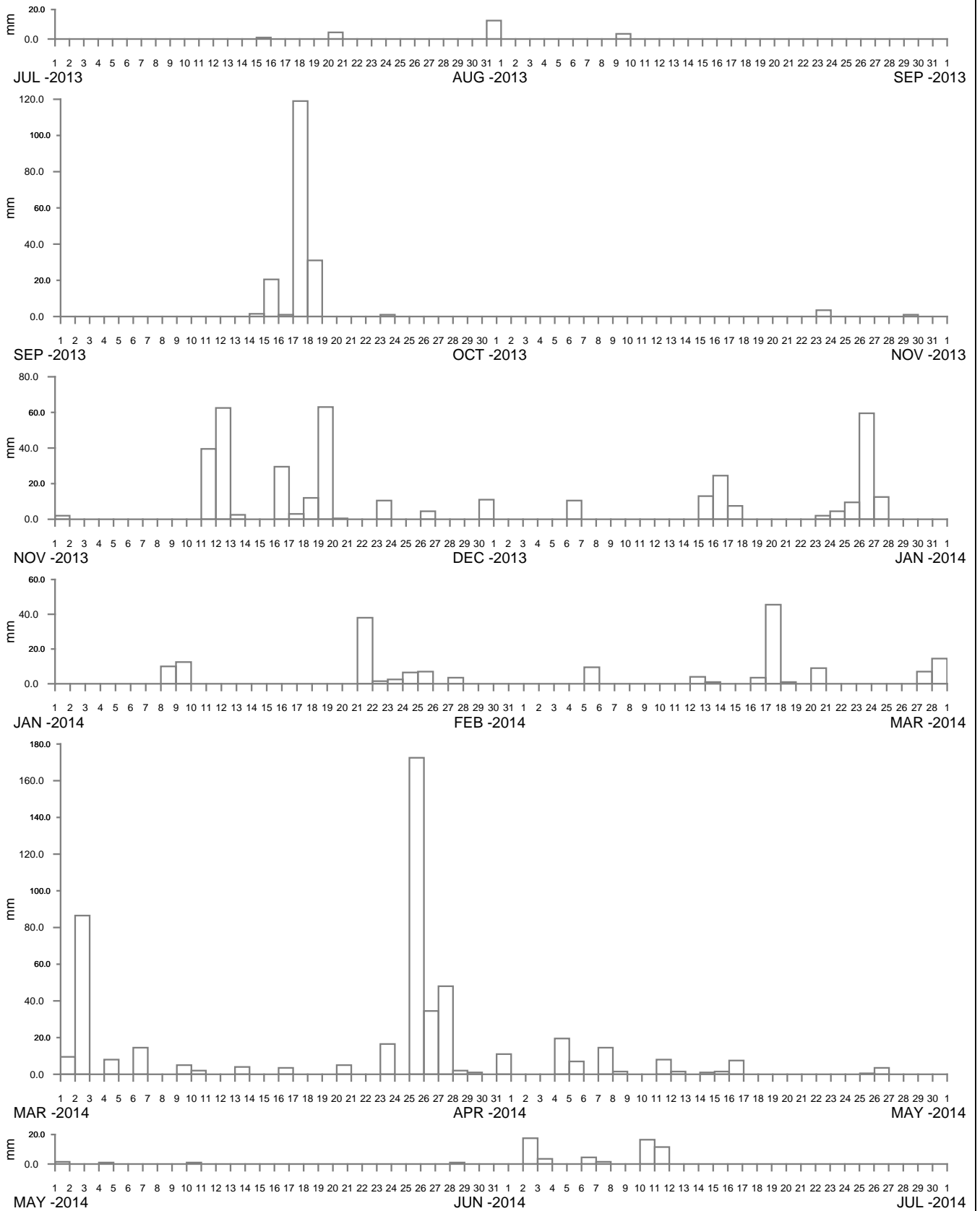
0 10km
 Scale 1:250 000
 Map courtesy of AUSLIG

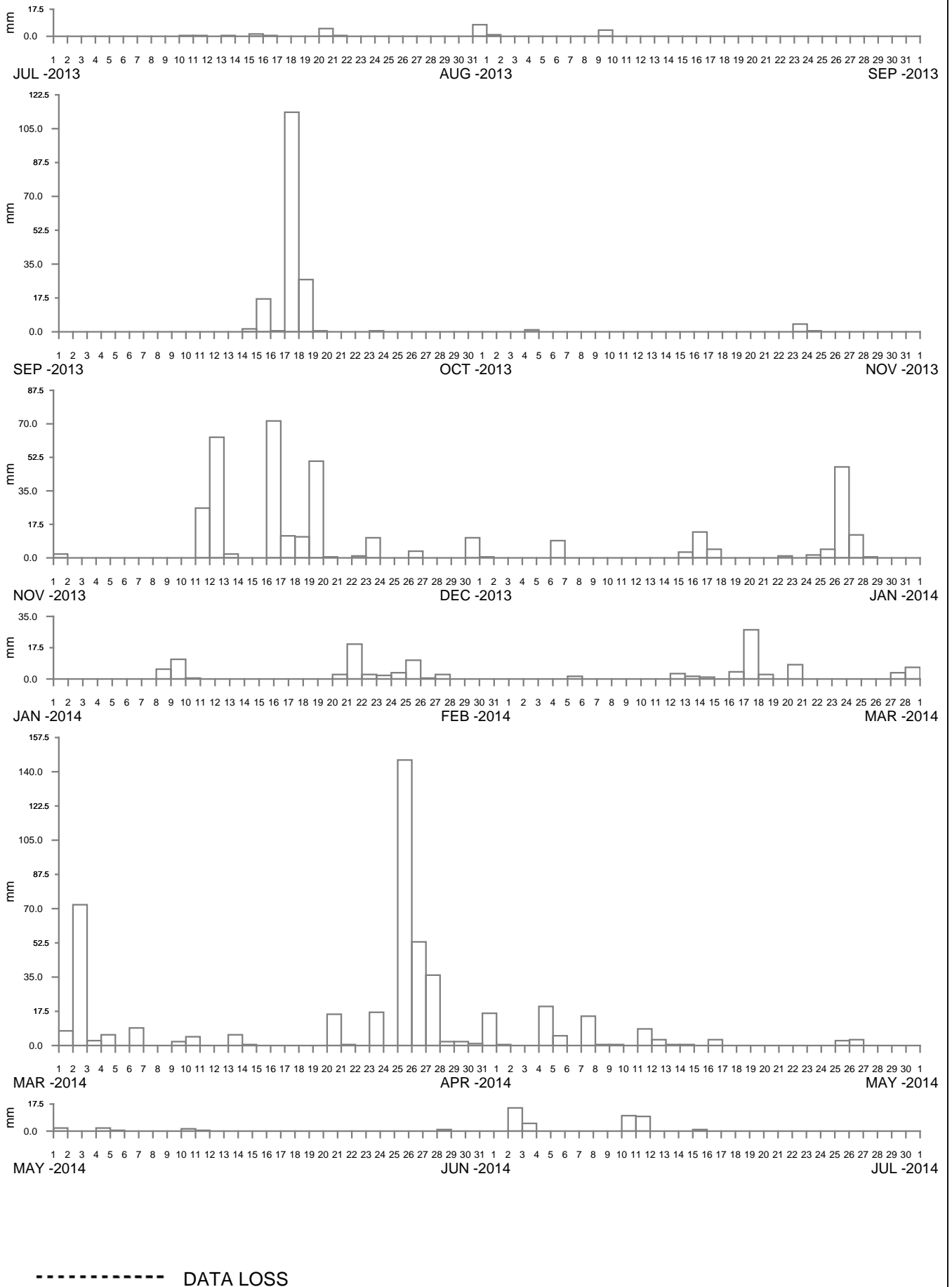


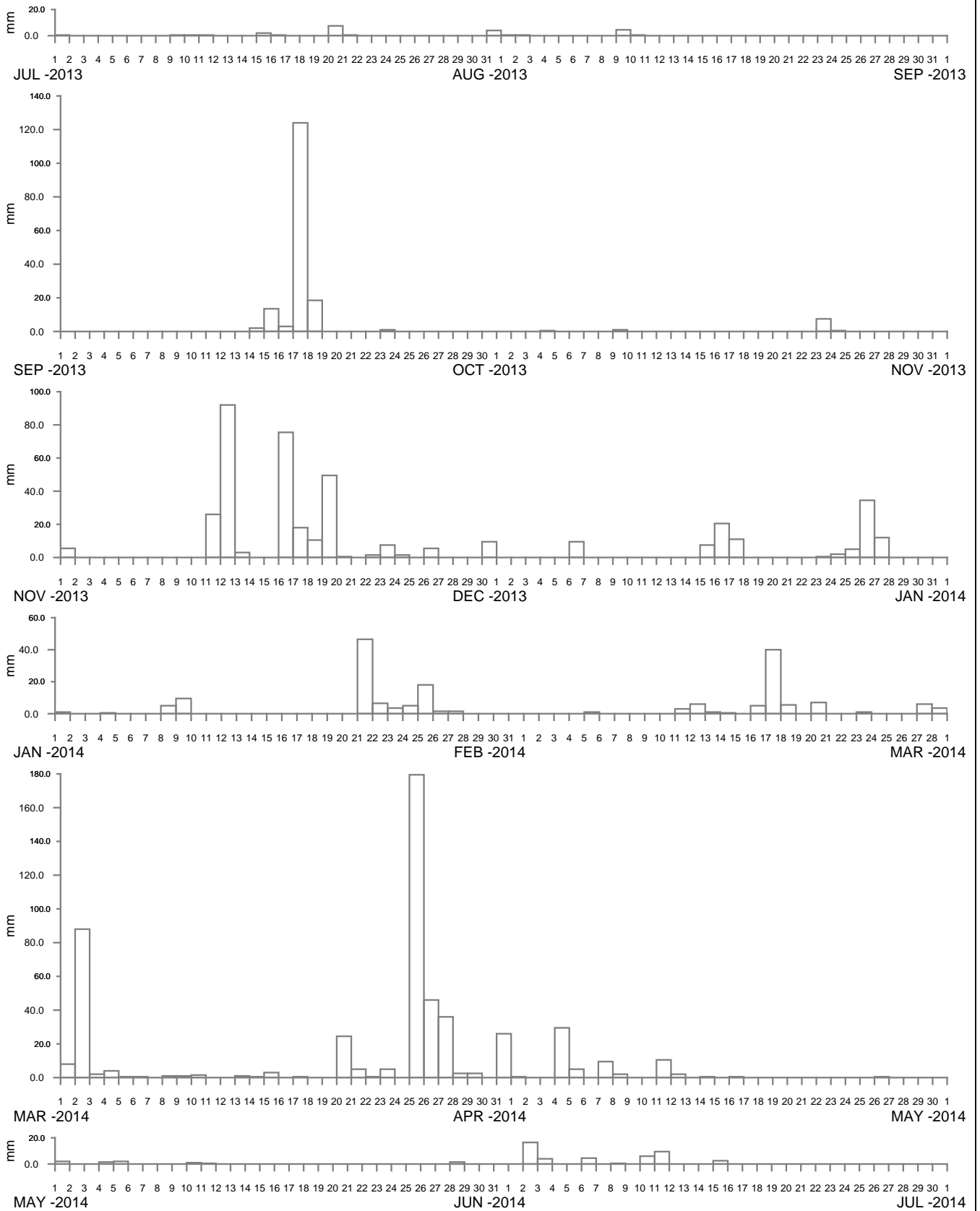
----- DATA LOSS

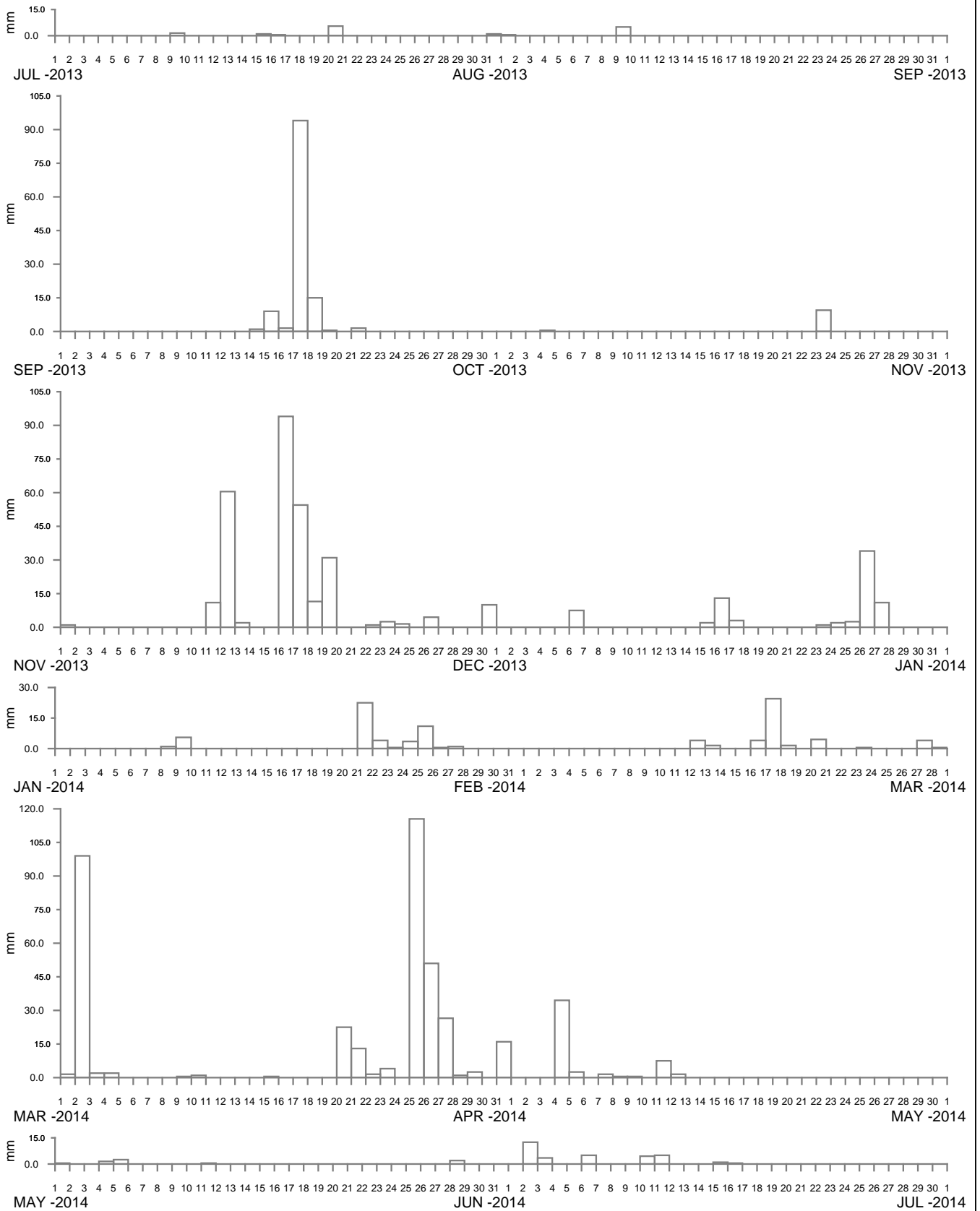


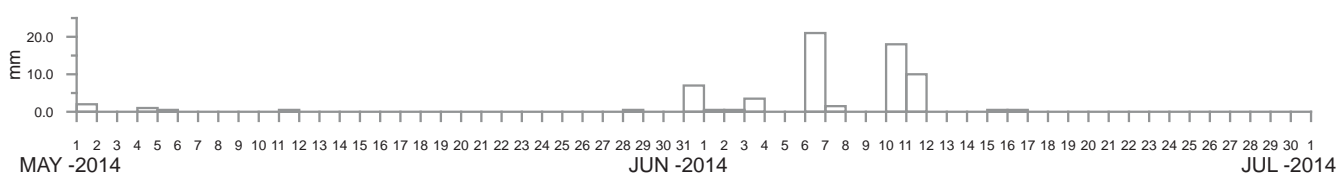
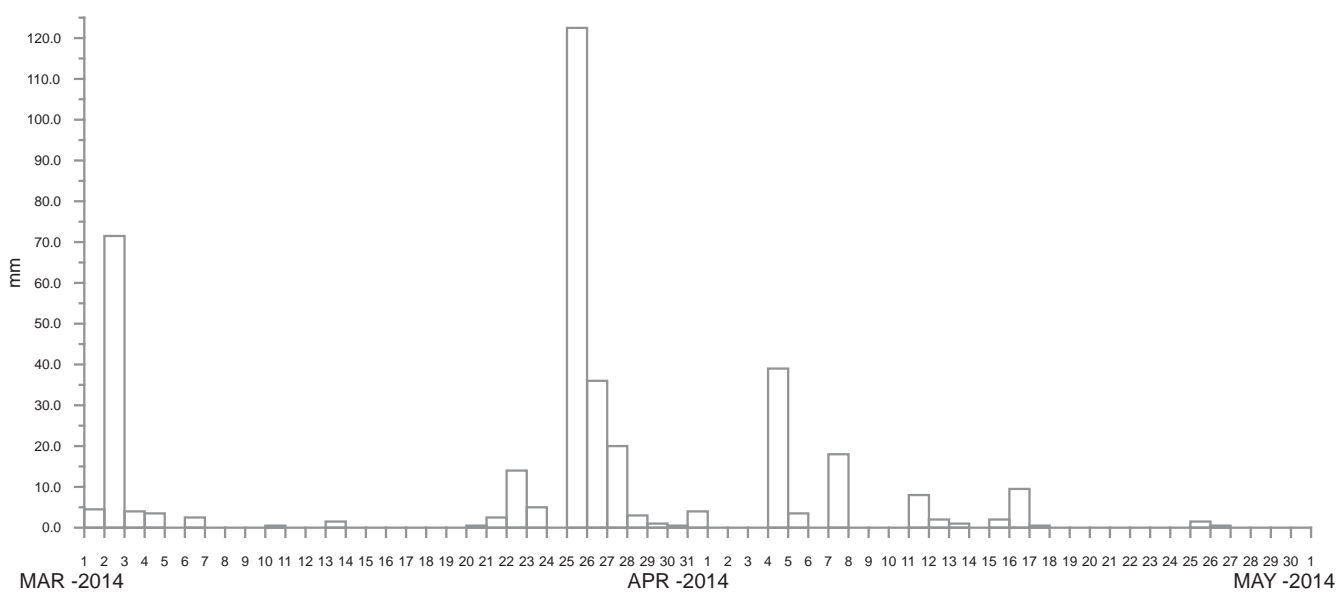
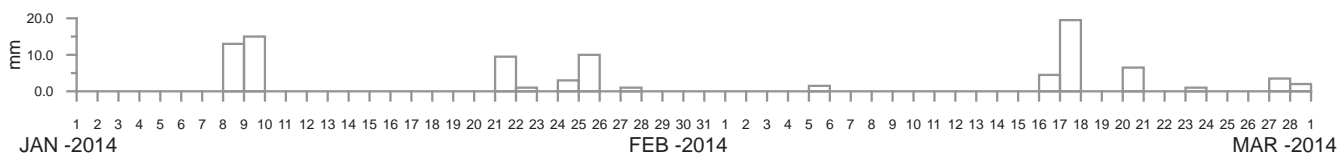
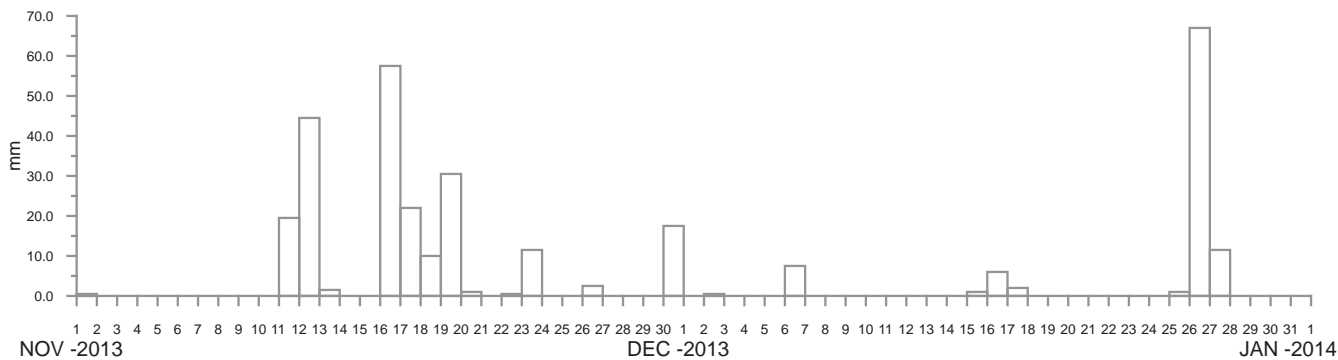
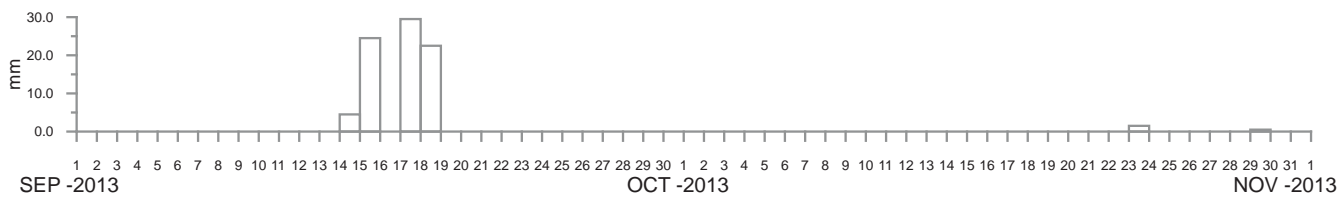
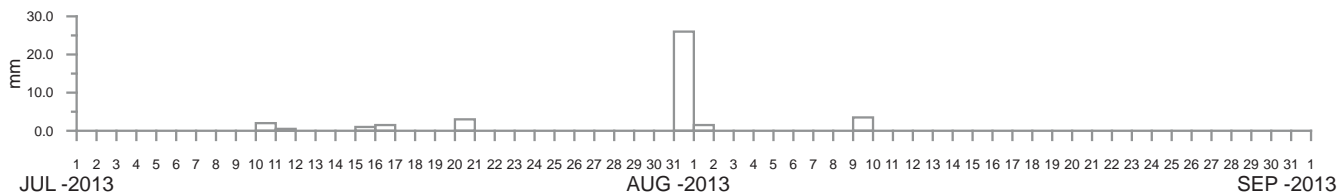












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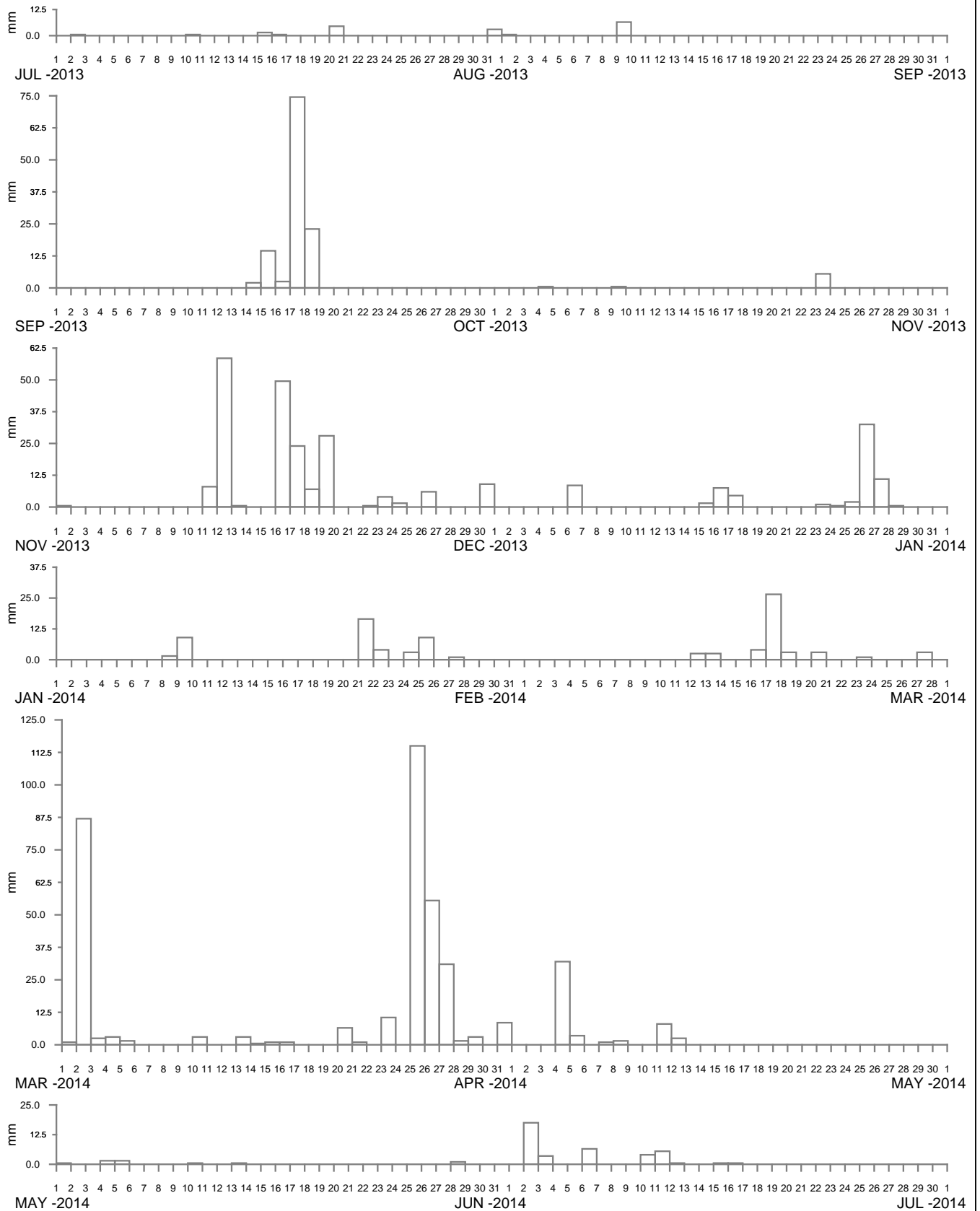
Public Works
Manly Hydraulics Laboratory

PORT KEMBLA AT FIVE ISLANDS ROAD
2013-2014

MHL
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Figure
79

DRAWING 2293-79



----- DATA LOSS



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Manly Hydraulics Laboratory

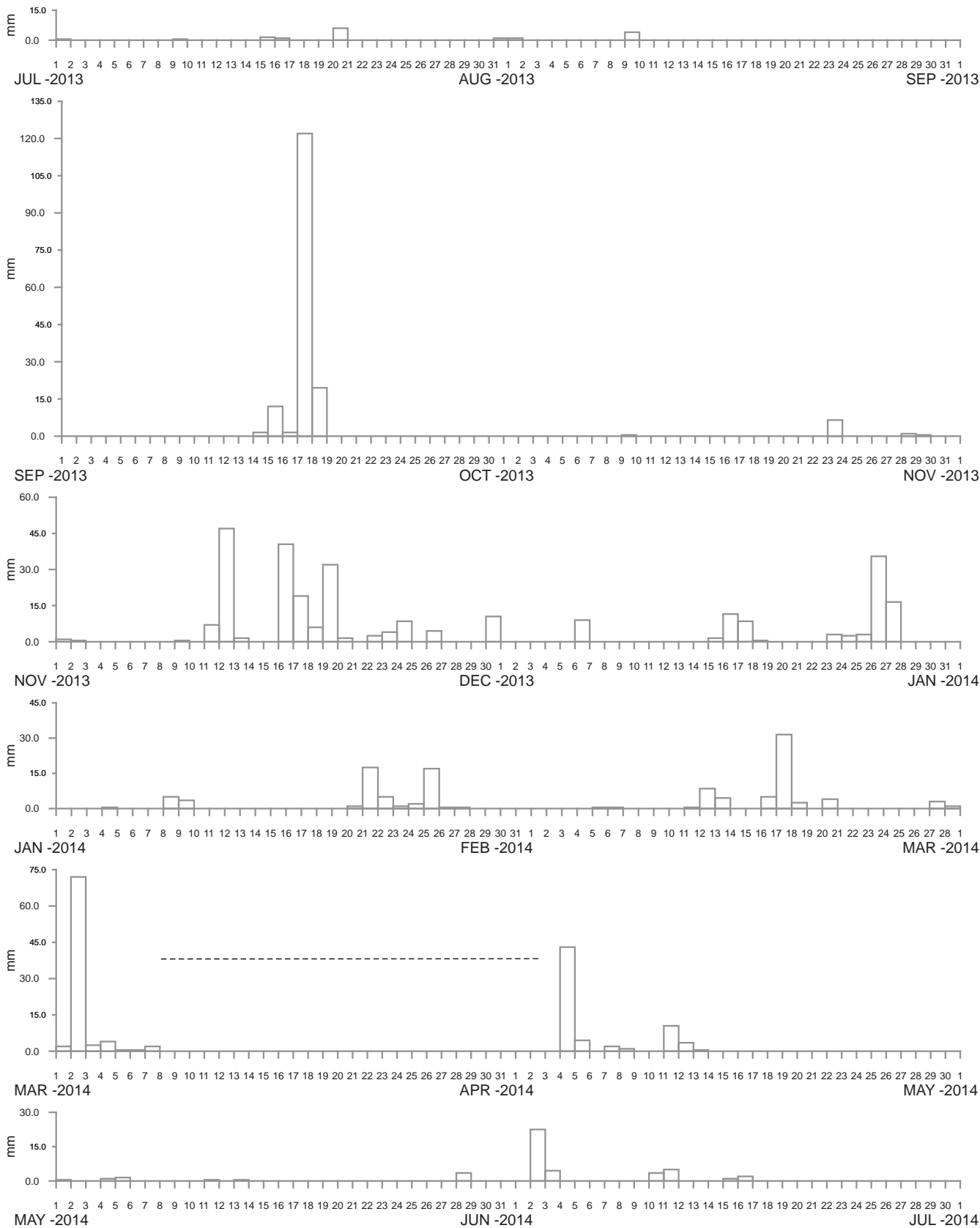
CLEVELAND ROAD AT CLEVELAND ROAD
2013-2014

MHL
Report 2293

Figure

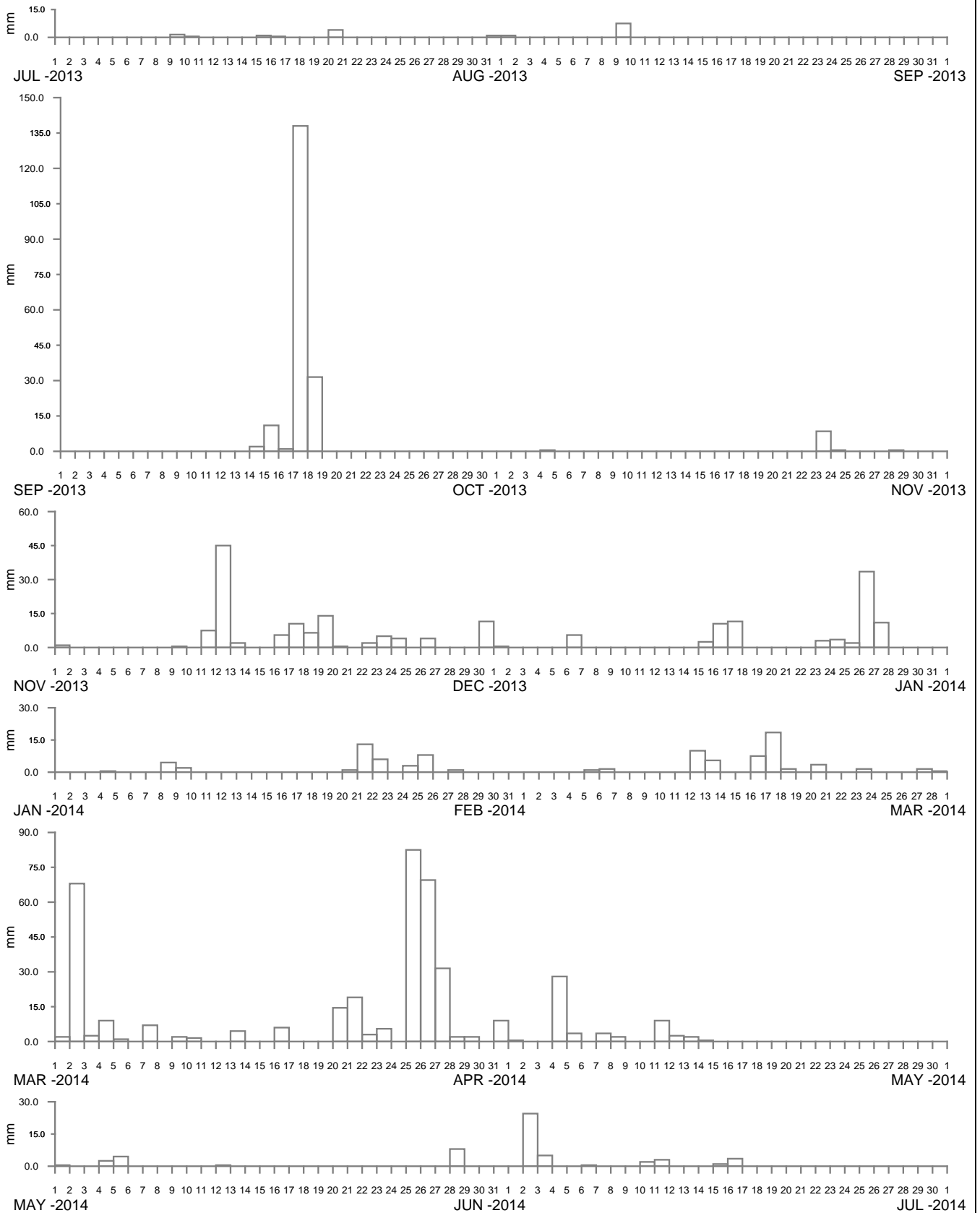
81

DRAWING 2293-81



----- DATA LOSS





----- DATA LOSS



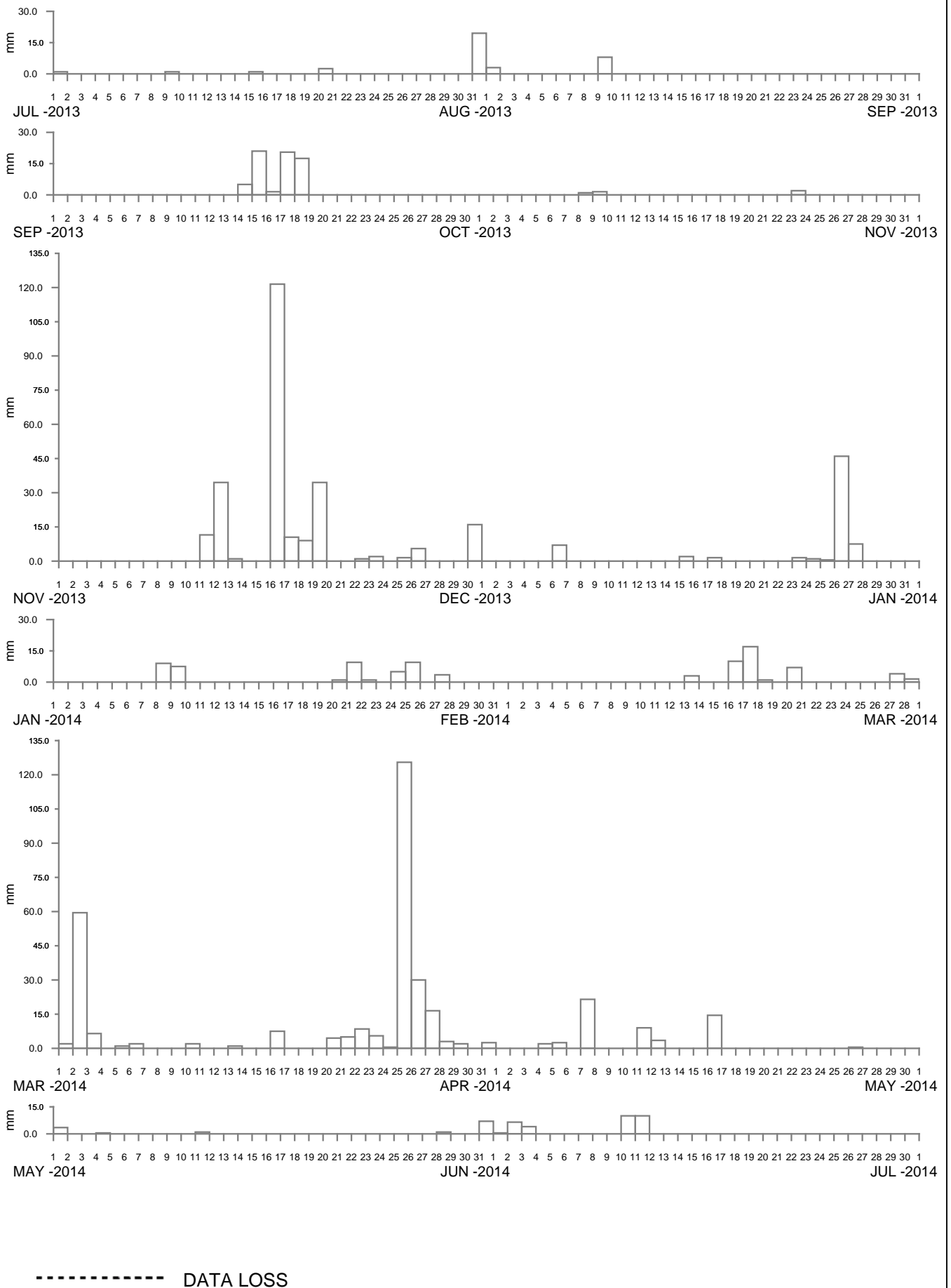
Public Works
Manly Hydraulics Laboratory

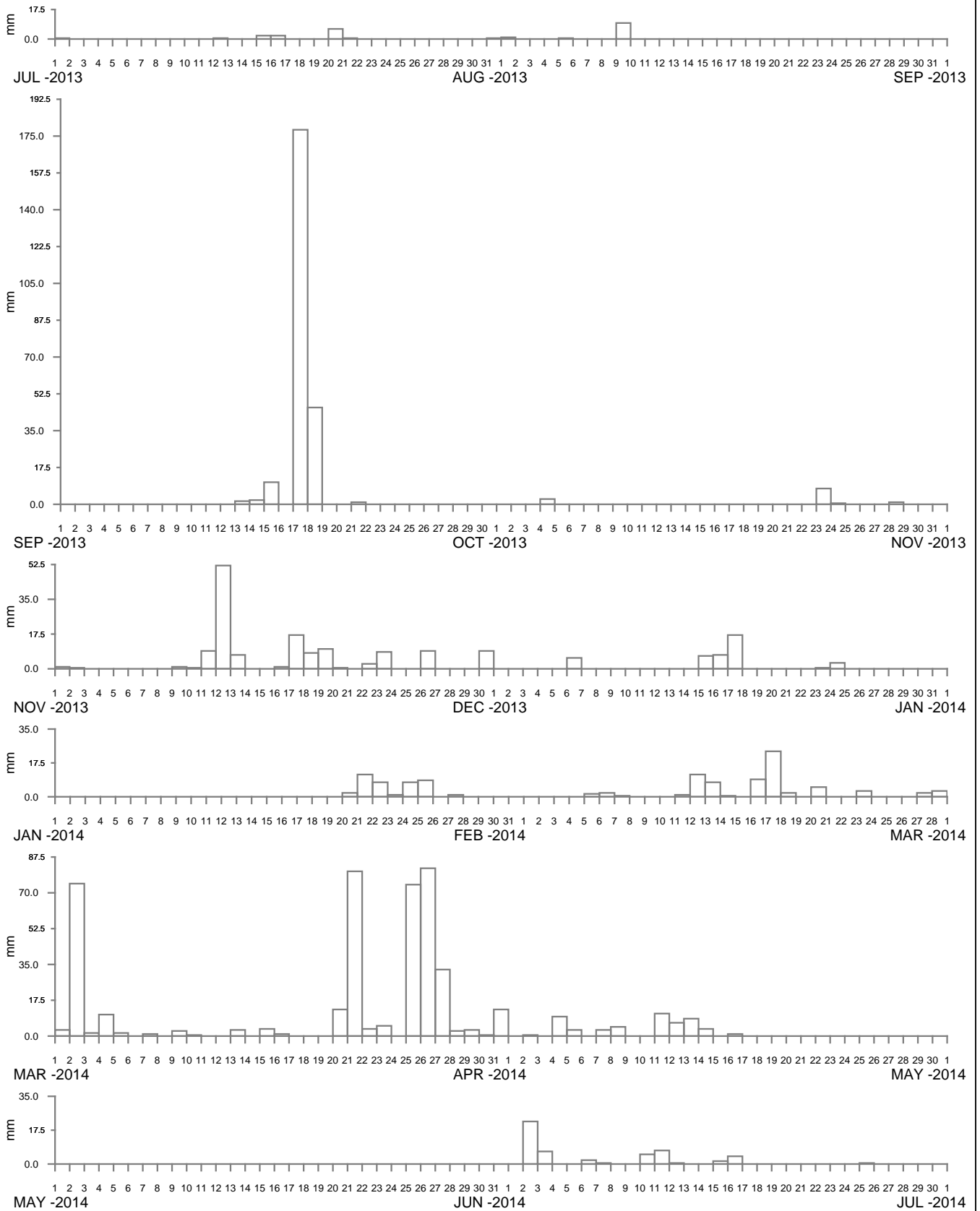
UPPER CALDERWOOD AT CALDERWOOD ROAD
2013-2014

MHL
Report 2293

Figure
83

DRAWING 2293-83





----- DATA LOSS



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Manly Hydraulics Laboratory

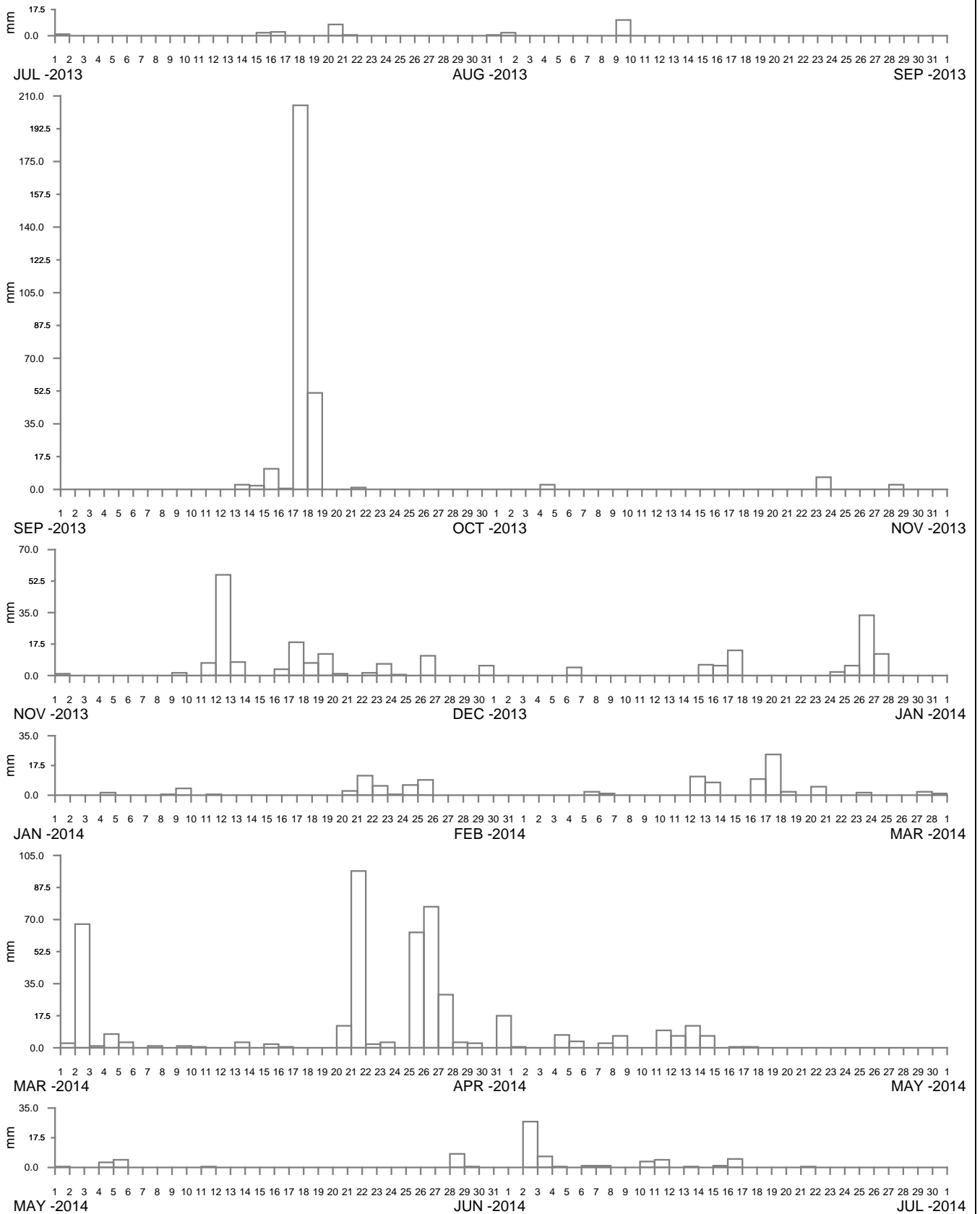
NURREWIN AT ILLAWARRA HIGHWAY
2013-2014

MHL
Report 2293

Figure

85

DRAWING 2293-85



----- DATA LOSS



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Manly Hydraulics Laboratory

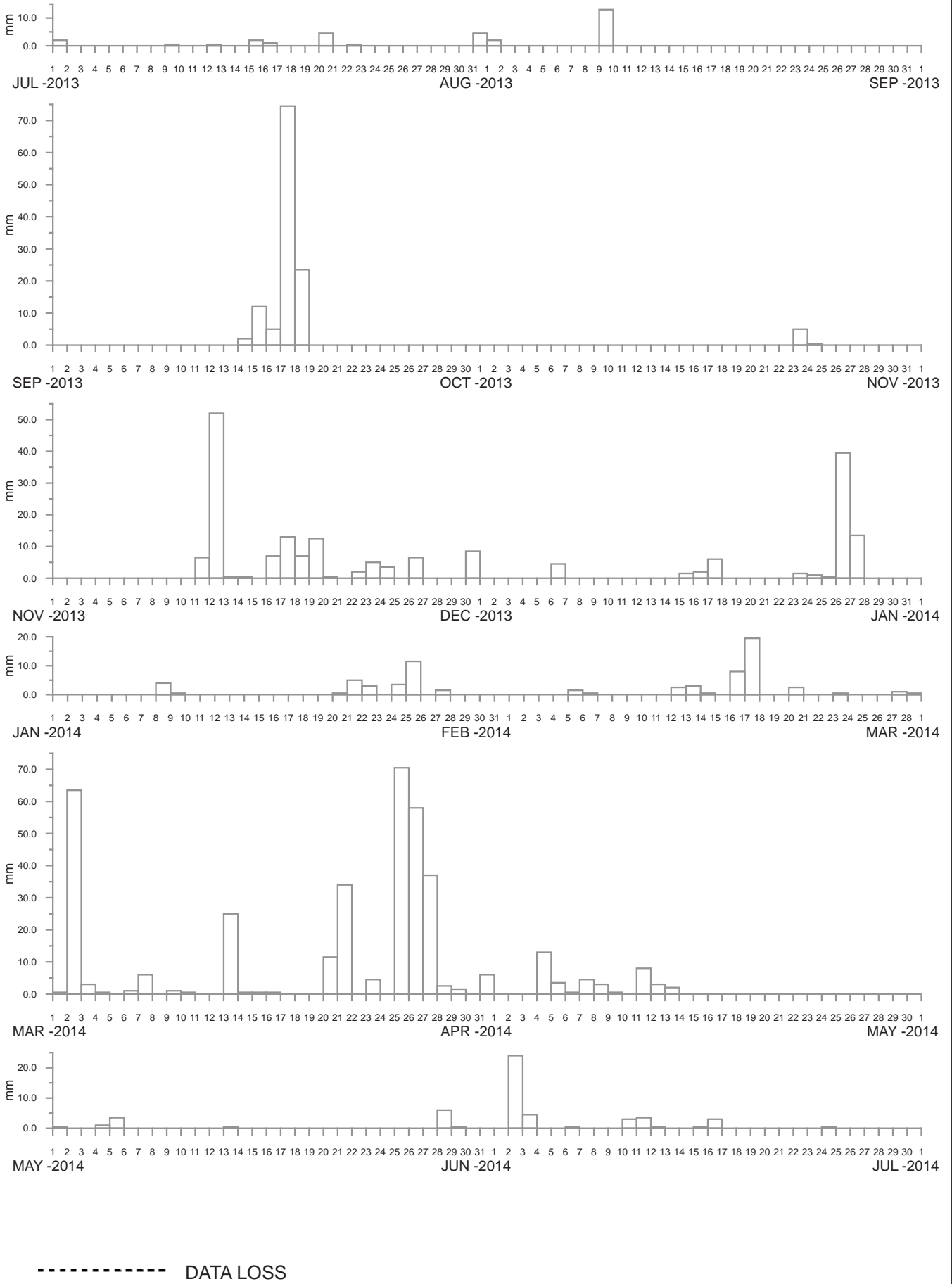
CLOVER HILL AT CLOVER HILL ROAD
2013-2014

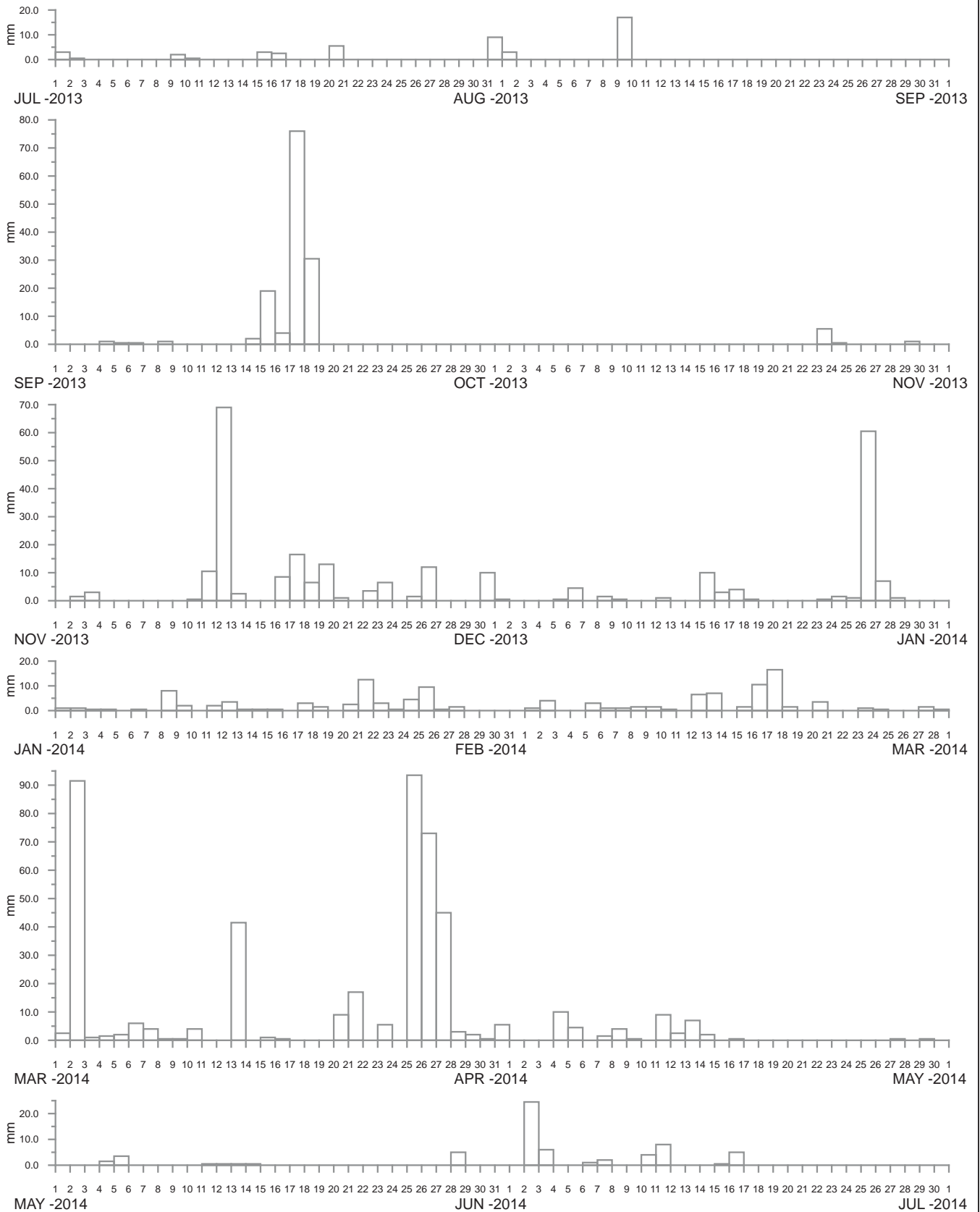
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Figure

86

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----- DATA LOSS



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YELLOW ROCK ROAD AT YELLOW ROCK ROAD
2013-2014

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Figure

88

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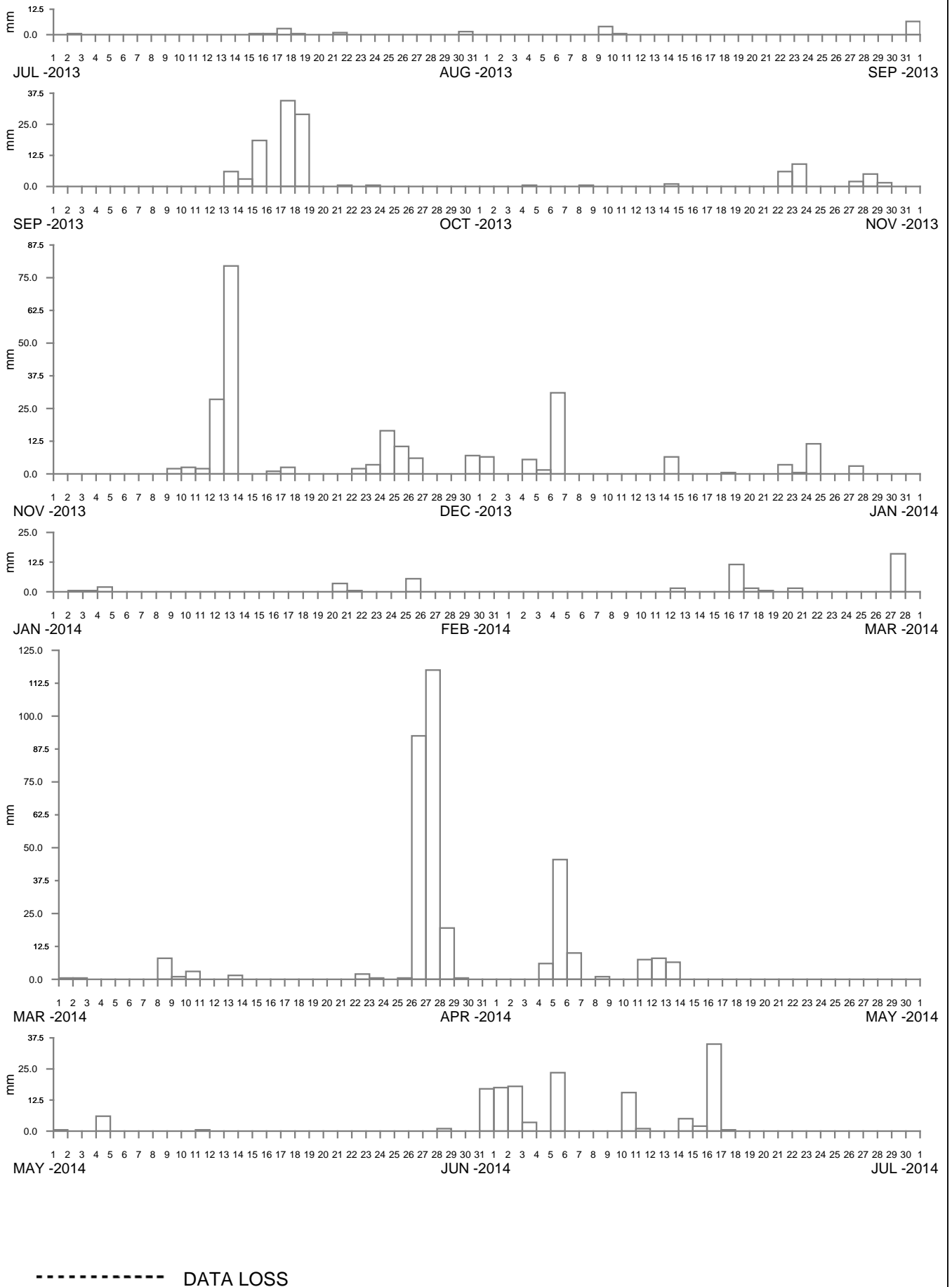
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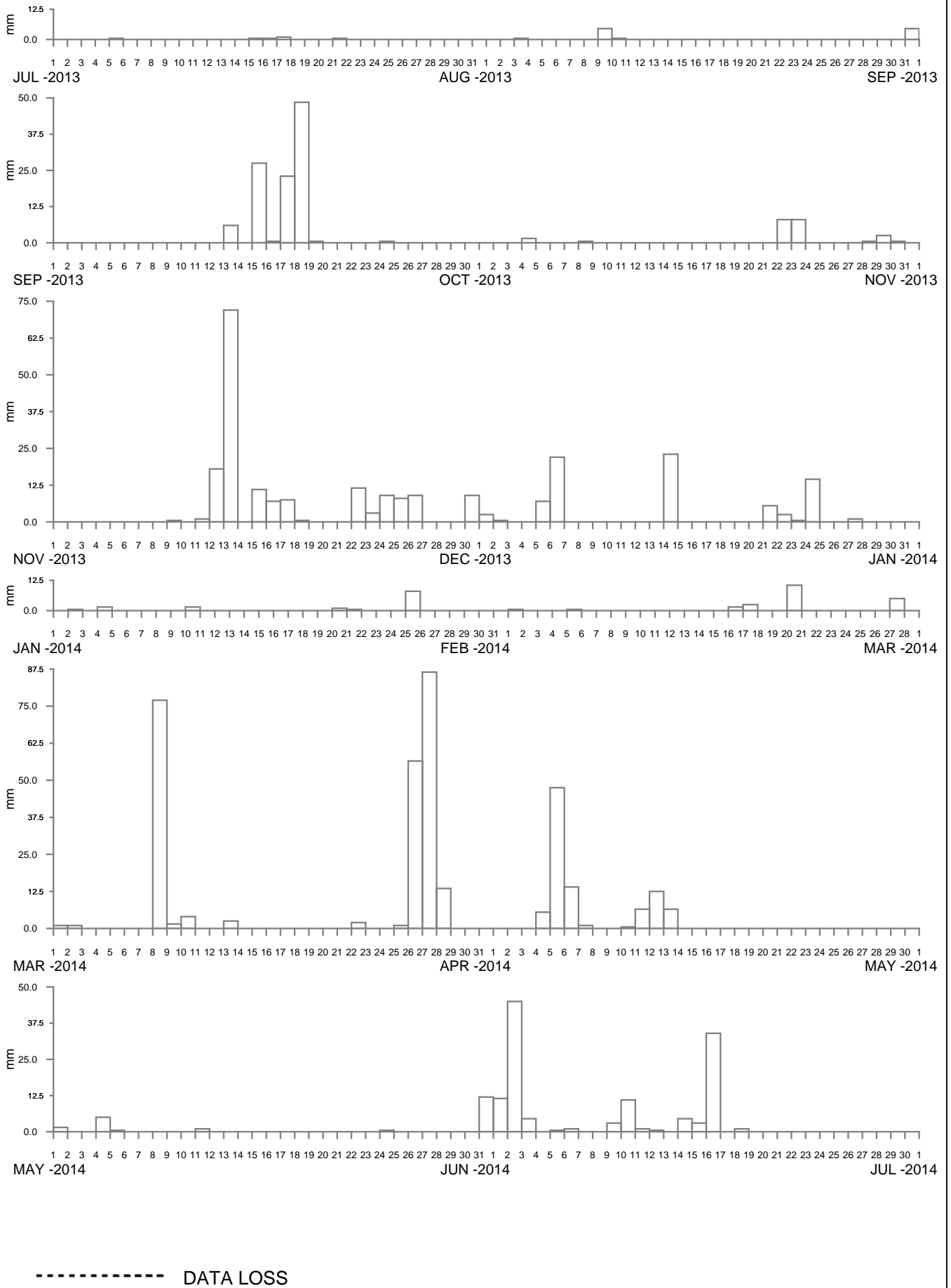
RAINFALL STATION LOCATIONS SOUTH COAST (MID) REGION

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Report 2293

Figure
89

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Appendix A

Data On-Line

Table A1 Data On-line

Region	Station	Period of Data
Tweed	Cudgera	Aug 1983 -Ongoing
Brunswick	Main Arm	Sep 1983 - Ongoing
Brunswick	Huonbrook	May 1986 - Ongoing
Brunswick	Myocum	Feb 1986 - Ongoing
Richmond	Lake Ainsworth	Oct 1994 - Ongoing
Richmond	Empire Vale	May 1998 - Jul 2000
Richmond	Wollongbar	Jul 1992 - Jul 1994
Clarence	Yamba	Apr 2002 - Ongoing
Clarence	Wyndora	Jan 1990 - Jun 1991
Clarence	Roberts Creek	May 1994 - Jun 1996
Clarence	Shannon Creek	Nov 2000 - May 2008
Bellinger	Wooli Caravan Park	Jun 1997 - Ongoing
Bellinger	Perry Drive	Dec 1998 - Ongoing
Bellinger	Shepards Lane	Dec 1998 - Ongoing
Bellinger	Red Hill	Nov 1998 - Ongoing
Bellinger	Newports Creek	Dec 1990 - Ongoing
Bellinger	Middle Boambee	Dec 1990 - Ongoing
Bellinger	South Boambee	Apr 1991 - Ongoing
Bellinger	North Bonville	Dec 1990 - Ongoing
Bellinger	Gleniffer	Aug 1993 - Feb 2007
Bellinger	Bellinger Council	Apr 1993 - Jun 2001
Bellinger	Kooroowi	May 1991 - Ongoing
Bellinger	Thora	Feb 1993 - Ongoing
Nambucca	Bowraville	Jun 1993 - Oct 2001
Nambucca	Utungun	Dec 1991 - Ongoing
Macleay	Euroka U/S	Jul 1990 – June 2011
Macleay	Aldavilla Downstream	Dec 2011 - Ongoing
Maria	Green Valley	Sep 1994 - Ongoing
Hastings	Telegraph Point	Nov 1990 - Ongoing
Hastings	Lake Cathie	Aug 1993 - Jun 2001
Hastings	Ellenborough	Jun 1991 - Sep 1999
Camden Haven	Logans Crossing	Dec 1989 - Ongoing
Manning	Mount George	Mar 1991 - Ongoing
Karuah	Nabiac	Jun 1984 - Ongoing
Karuah	Tuncurry	Aug 2002 - Ongoing
Karuah	Tiona	Jun 2002 - Ongoing
Karuah	Pacific Palms Wharf	Oct 2013 - Ongoing
Karuah	Tarbuck Bay	May 1996 - Ongoing
Karuah	Bulahdelah	Aug 1996 - Ongoing
Hunter	Gostwyck	Oct 1999 - Ongoing
Hunter	Seaham	Sep 1999 - Ongoing
Hunter	Hexham Bridge	May 1998 - Ongoing
Hunter	Belmore Bridge	Sep 1995 - Ongoing
Hunter	Cardiff	Mar 1991 - Sept 1996
Macquarie-Tuggerah Lakes	Barnsley	Jan 1988 - Ongoing
Macquarie-Tuggerah Lakes	Fassifern	Jan 1992 - Dec 1997
Macquarie-Tuggerah Lakes	Dora Creek	May 1992 - Jul 1999
Macquarie-Tuggerah Lakes	Martinsville	Mar 1988 - Ongoing

Region	Station	Period of Data
Macquarie-Tuggerah Lakes	Mandalong	Dec 1988 - Ongoing
Macquarie-Tuggerah Lakes	Wyee	May 1992 - Ongoing
Macquarie-Tuggerah Lakes	Whitemans Ridge	Apr 1989 - Ongoing
Macquarie-Tuggerah Lakes	Yarralong	Feb 1987 - Ongoing
Macquarie-Tuggerah Lakes	Kulnura	Mar 1989 - Ongoing
Macquarie-Tuggerah Lakes	Toukley	Dec 1985 - Ongoing
Macquarie-Tuggerah Lakes	Warnervale	Jan 1986 - Apr 2010
Macquarie-Tuggerah lakes	Hamlyn Terrace	Mar 2010 - Ongoing
Macquarie-Tuggerah Lakes	Wyong Weir	Jan 1986 - Apr 2008
Macquarie-Tuggerah Lakes	Wyong	Jan 1986 - Apr 1991
Macquarie-Tuggerah Lakes	Kangy Angy	Aug 2010 - Ongoing
Macquarie-Tuggerah Lakes	Chittaway	May 1989 - Aug 2010
Macquarie-Tuggerah Lakes	Berkeley Vale	Jun 1988 - Ongoing
Macquarie-Tuggerah Lakes	Mardi Dam	Jun 1988 - Ongoing
Macquarie-Tuggerah Lakes	Sterland	Apr 1989 - Ongoing
Macquarie-Tuggerah Lakes	Long Jetty	Sept 1992 - Sept 1998
Macquarie-Tuggerah Lakes	Bateau Bay	Jan 1980 - Ongoing
Macquarie-Tuggerah Lakes	Lisarow	Mar 1989 - Ongoing
Hawkesbury	Strickland	Dec 1985 - Ongoing
Hawkesbury	Narara	Apr 1989 - Ongoing
Hawkesbury	Mount Elliot	Dec 1985 - Ongoing
Hawkesbury	Wyoming	Aug 1988 - Ongoing
Hawkesbury	Kincumber	May 1987 - Ongoing
Hawkesbury	Webbs Creek	Jul 1999 - Ongoing
Hawkesbury	Colo Junction	Jul 1999 - Ongoing
Hawkesbury	Sackville Downstream	Jun 1999 - Ongoing
Hawkesbury	Woy Woy	Jul 1991 - Jul 1996
Hawkesbury	Brooklyn	Apr 1991 - Jul 1996
Hawkesbury	Cowan	Jun 1991 - Jul 1996
Hawkesbury	Penrith	Nov 1990 - Ongoing
Hawkesbury	Narellan Creek	Jan 1994 - Sep 1996
Hawkesbury	Camden Life Centre	Mar 1994 - Sep 1996
Hawkesbury	Mt Annan School	Feb 1994 - Sep 1996
Blue Mountains	Mount Boyce	Nov 1992 - Feb 1995
Blue Mountains	Clarence	Nov 1992 - Feb 1995
Blue Mountains	Zig Zag	Nov 1992 - Feb 1995
Sydney Coastal	Kuringai	Jan 1991 - Sep 1996
Sydney Coastal	Wahroonga	Nov 1990 - Jul 1996
Sydney Coastal	Beecroft	Sep 1992 - Jul 1996
Sydney Coastal	Avalon	Jun 1994 - Ongoing
Sydney Coastal	Mona Vale	Jun 1994 - Ongoing
Sydney Coastal	Narrabeen Creek	May 1998 - Ongoing
Sydney Coastal	Middle Creek	Apr 1995 - Ongoing
Sydney Coastal	Cromer	Mar 1994 - Ongoing
Sydney Coastal	Belrose	May 1994 - Ongoing
Sydney Coastal	Allambie	Jun 1999 - Ongoing
Sydney Coastal	Balgowlah	Aug 1999 - May 2005
Sydney Coastal	North Manly	May 1995 - Ongoing
Sydney Coastal	Manly Dam	Nov 1995 - Ongoing
Sydney Coastal	Chatswood	Sep 1992 - Jul 1996

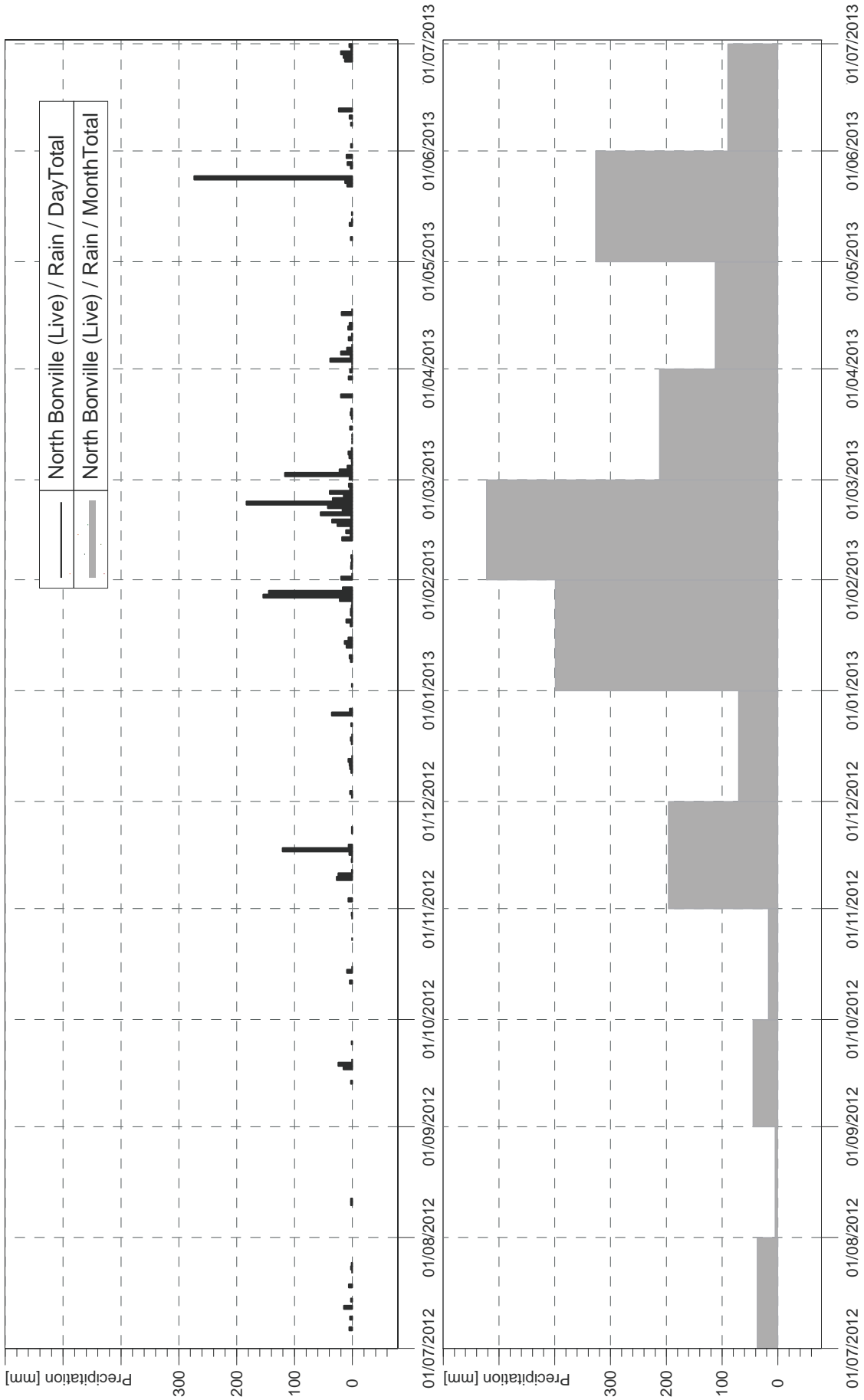
Region	Station	Period of Data
Sydney Coastal	Denistone	Jan 1990 - Jun 1996
Sydney Coastal	M4 Motorway	Jun 1993 - Sep 1996
Sydney Coastal	Homebush Bay	Feb 1993 - Mar 1994
Sydney Coastal	Kelso Creek	Nov 1996 - Ongoing
Wollongong Coastal	Bulli Pass	Sep 1982 - Oct 1998
Wollongong Coastal	Rixons Pass	Jun 1985 - Ongoing
Wollongong Coastal	Russell Vale	Jul 1982 - Ongoing
Wollongong Coastal	Corrimal Colliery	Jun 1985 - Dec 1993
Wollongong Coastal	Mount Pleasant	Jun 1997 - Ongoing
Wollongong Coastal	Mount Nebo	Sep 1982 - Feb 1997
Wollongong Coastal	Mount Kembla	Jun 1985 - Ongoing
Wollongong Coastal	Dombarton Loop	Jun 1985 - Ongoing
Wollongong Coastal	Wongawilli	Sep 1982 - Ongoing
Wollongong Coastal	Port Kembla BHP	Jan 1993 - Ongoing
Wollongong Coastal	Port Kembla	Sep 1982 - Ongoing
Wollongong Coastal	Darkes Road	Feb 1994 - Ongoing
Wollongong Coastal	Cleveland Road	Jun 1985 - Ongoing
Wollongong Coastal	Huntley Colliery	Jun 1982 - Ongoing
Wollongong Coastal	Calderwood	Jan 1983 - Jun 1985
Wollongong Coastal	Upper Calderwood	Jun 1985 - Ongoing
Wollongong Coastal	Little Lake	May 1991 – Oct 2014
Wollongong Coastal	Little Lake Entrance	May 2014 - Ongoing
Wollongong Coastal	Airport	Jun 1991 - Mar 1995
Wollongong Coastal	North Macquarie	Jul 1985 - Ongoing
Wollongong Coastal	Clover Hill	Aug 1985 - Ongoing
Wollongong Coastal	Nurrewin	May 2005 - Ongoing
Wollongong Coastal	Yellow Rock Road	Jun 1982 - Ongoing
Wollongong Coastal	Balgownie	Jul 1982 - Jun 1987
Wollongong Coastal	Woonona	Jul 1982 - Jun 1985
South Coast	Lake Wollumboula	Feb 1999 - Oct 2000
South Coast	Barlows Bay (Narooma)	Jul 1999 - Ongoing
South Coast	Regatta Point	Jan 1999 - Ongoing
South Coast	Merimbula Wharf	Aug 1997 - Sep 2001
South Coast	Agnew Wharf	Aug 1997 - Jun 2000

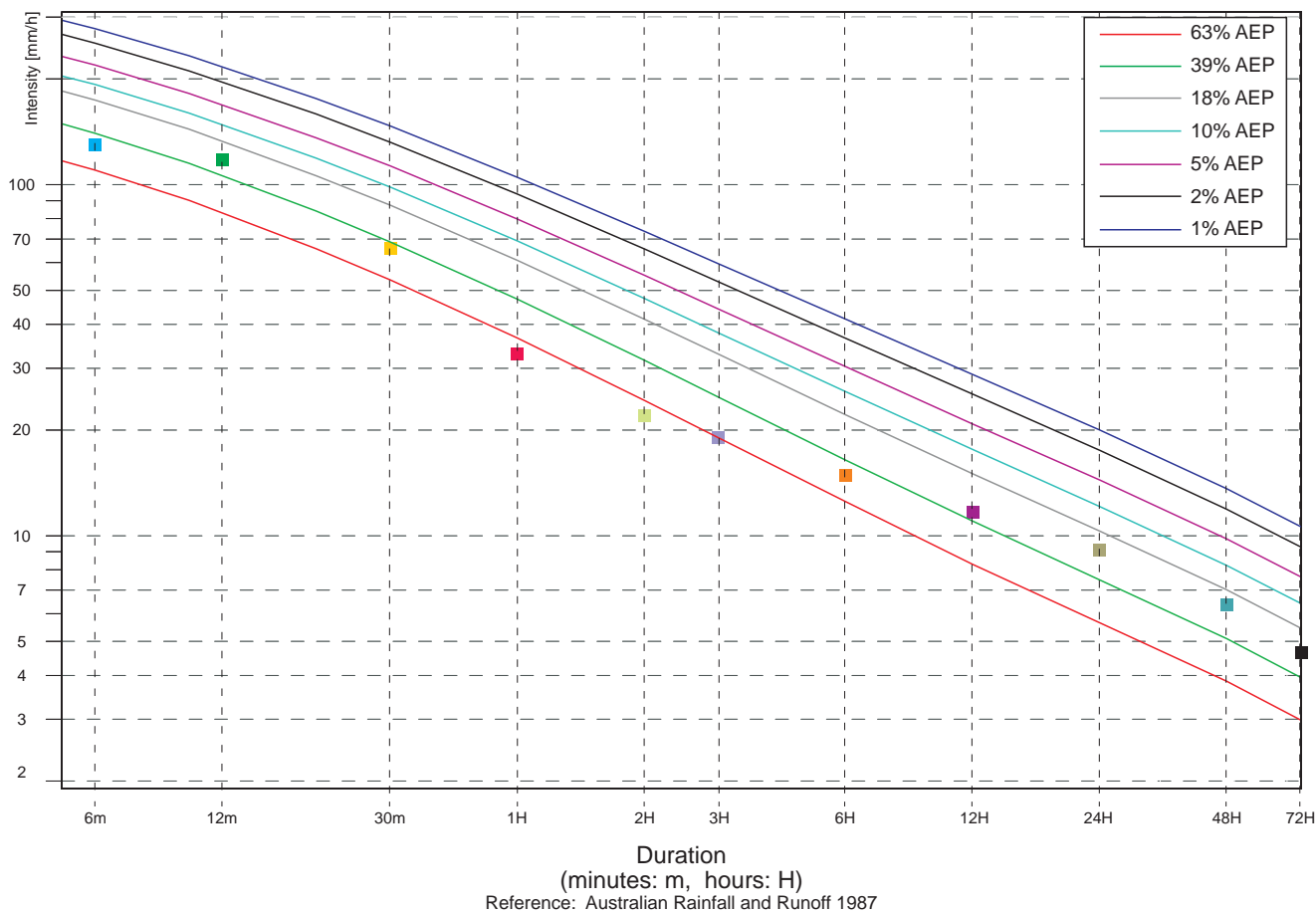
Appendix B

Sample Rainfall Data Outputs



SAMPLE DAILY AND MONTHLY RAINFALL PLOTS





North Bonville Rainfall Intensity 21 January-21 March 2013		
Duration (minutes: m) (hours: H)	Intensity (mm/hr)	Date/Time
6m	130.00	17/02/2013 17:14
12m	117.50	17/02/2013 17:14
30m	66.00	17/02/2013 17:26
1H	33.00	17/02/2013 17:26
2H	22.00	22/02/2013 14:44
3H	19.00	22/02/2013 14:42
6H	14.83	22/02/2013 16:40
12H	11.67	22/02/2013 19:56
24H	9.08	28/01/2013 11:12
48H	6.35	28/01/2013 21:46
72H	4.64	29/01/2013 5:54

Australian Rainfall and Runoff (Institute of Engineers Australia 1987) states:
Use of the terms 'recurrence interval' and 'return period' has been criticised as leading to confusion in the minds of some decision-makers and members of the public. Although the terms are simple superficially, they are sometimes misinterpreted as implying that the associated magnitude is only exceeded at regular intervals, and that they are referring to the elapsed time to the next exceedance.

The use of the term 'Average Recurrence Interval' (ARI) can lead to confusion. It is preferable, therefore, to express the rarity of a rainfall event in terms of Annual Exceedance Probability (AEP). For example, 'a rainfall total of 60mm falling in 3 hours at Cudgera has a 0.010 (i.e. 1%) probability of being equalled or exceeded in any one year' can be easier to understand than the equivalent statement of 'rainfall total of 60mm in 3 hours has an ARI of 100 years'.

Adapted from: <http://www.bom.gov.au/water/designRainfalls/ifd/glossary.shtml>

Station Name North Bonville (Live)
 Station Number 559050
 MGA Easting (m zone 56) 500592.91
 MGA Northing (m zone 56) 6641143.16

Date	Time	Value [mm]	State of value
26/01/2013	2:35:17	0.5	5 (Very Good)
26/01/2013	2:40:12	0.5	5 (Very Good)
26/01/2013	4:04:04	0.5	5 (Very Good)
26/01/2013	4:04:53	0.5	5 (Very Good)
26/01/2013	4:07:48	0.5	5 (Very Good)
26/01/2013	5:56:18	0.5	5 (Very Good)
26/01/2013	5:57:42	0.5	5 (Very Good)
26/01/2013	5:59:16	0.5	5 (Very Good)
26/01/2013	6:00:32	0.5	5 (Very Good)
26/01/2013	6:01:22	0.5	5 (Very Good)
26/01/2013	6:02:22	0.5	5 (Very Good)
26/01/2013	12:20:33	0.5	5 (Very Good)
26/01/2013	12:20:51	0.5	5 (Very Good)
26/01/2013	12:21:32	0.5	5 (Very Good)
26/01/2013	12:22:02	0.5	5 (Very Good)
26/01/2013	12:22:42	0.5	5 (Very Good)
26/01/2013	12:23:49	0.5	5 (Very Good)
26/01/2013	12:24:37	0.5	5 (Very Good)
26/01/2013	12:25:42	0.5	5 (Very Good)
26/01/2013	12:35:17	0.5	5 (Very Good)
26/01/2013	19:16:58	0.5	5 (Very Good)
26/01/2013	19:49:01	0.5	5 (Very Good)
26/01/2013	19:51:13	0.5	5 (Very Good)
26/01/2013	21:12:07	0.5	5 (Very Good)
26/01/2013	21:55:36	0.5	5 (Very Good)
26/01/2013	22:01:34	0.5	5 (Very Good)
26/01/2013	22:05:28	0.5	5 (Very Good)
26/01/2013	22:10:31	0.5	5 (Very Good)
26/01/2013	22:12:16	0.5	5 (Very Good)
26/01/2013	22:13:47	0.5	5 (Very Good)
26/01/2013	22:15:34	0.5	5 (Very Good)
26/01/2013	22:17:57	0.5	5 (Very Good)



Appendix C
Publications of Interest

Appendix C Publications of Interest

Data Reports

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).

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).

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).

MHL Annual Wave Climate and Coastal Air Pressure Summaries available:

MHL Report Nos. 547 (87-88), 560 (88-89), 581 (89-90), 600 (90-91), 627 (91-92), 655 (92-93), 695 (93-94), 733 (94-95), 779 (95-96), 877 (96-97), 948 (97-98), 1016 (98-99), 1072 (99-00), 1132 (00-01), 1208 (01-02), 1279 (02-03), 1349 (03-04), 1425 (04-05), 1514 (05-06), 1766 (06-07), 1850 (07-08), 1935 (08-09), 2012 (09-10), 2091 (10-11), 2160 (11-12), 2221 (12-13).

Flood Reports

Manly Hydraulics Laboratory Flood Reports:

- *NSW North Coast Flood Summary January–March 2013*, MHL Report No. 2202
- *Northern Rivers May 2009 Flood Report*, MHL Report No. 1965
- *NSW Coffs Harbour and Bellinger River Regions April 2009 Flood Summary*, MHL Report No. 1913
- *NSW Coffs Harbour, Bellinger and Nambucca Rivers Region February 2009 Flood Summary*, MHL Report No. 1908

- *Bellinger and Coffs Harbour Regions January 2008 Flood Summary*, MHL Report No. 1804
- *Clarence River January 2008 Flood Summary*, MHL Report No. 1803
- *Richmond River January 2008 Flood Summary*, MHL Report No. 1802
- *Tweed and Brunswick Rivers January 2008 Flood Summary*, MHL Report No. 1802
- *NSW Hawkesbury and Nepean June 2007 Flood Summary*, MHL Report No. 1756
- *NSW Hunter Valley, Wallamba River and Myall River June 2007 Flood Summary*, MHL Report No. 1755
- *NSW Central Coast June 2007 Flood Summary*, MHL Report No. 1754
- *NSW North Coast March 2006 Flood Summary*, MHL Report No. 1482
- *NSW North Coast January 2007 Flood Summary*, MHL Report No. 1469
- *NSW North Coast Flood Summary June 2005*, MHL Report No. 1426

Other References

Bureau of Meteorology 2002, 'Climate Glossary – Southern Oscillation Index' *Australian Government*. Retrieved from <http://www.bom.gov.au/climate/glossary/soi.shtml>

The Institution of Engineers 1987, *Australian Rainfall and Runoff*



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