Melbourne Waterway Research-Practice Partnership

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Cockatoo Swamp Inundation Modelling

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The University of Melbourne

Waterway Ecosystem Research Group

Melbourne Water

Technical Report

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Cover photo: *Water level gauge on the Macclesfield Creek floodplain, Yellingbo Nature Reserve, within a Melaleuca squarrosa thicket that provides ideal habitat for the critically endangered lowland Leadbeater's Possum.*

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Executive summary

The Waterway Ecosystem Research Group (The University of Melbourne) in partnership with Melbourne Water (MW) is currently researching the environmental watering requirements of the swamp forests within the Cockatoo Swamp in the Yellingbo Nature Conservation Reserve (YNCR). These research activities require robust estimates of historical inundation depth and frequency across the swamp. Various hydraulic models have previously been developed to translate flow data into water levels within the swamp, based on the best available data at the time. New topographic and water level data for the wetland has provided the opportunity to redevelop and recalibrate the model to provide more robust estimates of inundation across the swamp under its full range of conditions.

The hydraulic model was consistent in extent with the original model developed by Water Technology (2014a) and was developed and calibrated in the modelling package TUFLOW. The model incorporated recent survey datasets including unmanned aerial vehicle LiDAR data and various feature survey datasets. New (post-2014) time-series water level data and surveyed point water levels allowed us to more confidently calibrate the model and assess its accuracy. Calibration against two events (a short-term July 2014 event and a long-term February 2014 to December 2015 event) was undertaken to ensure the model could reproduce observed water levels over a wide range of conditions.

Following an iterative process of adjusting model parameters and rerunning the model, a successful calibration was achieved. Calibration resulted in a good match with gauged water levels, particularly for the dieback-affected areas of the swamp (Dieback Area gauge). Overall, modelled water levels tended to be slightly lower (0.02-0.22 m on average for the various gauges and events) compared to gauged data. In contrast, modelled water levels tended to be slightly higher compared to surveyed point water levels in April and October 2015 (0.05-0.15 m on average for the two surveys). High flow events produced a better match than periods of low inflows or drainage flows, and drainage tended to be slightly too quick. The model is not capable of simulating exchange with groundwater, which is probably why we had difficulty fully matching drainage and low-flow behaviour. Notwithstanding these limitations, the calibrated model is capable of reproducing both long term water level time series, and point water levels, to an acceptable level of accuracy.

Following calibration, simulation of the historic flow series (1998-2018) was undertaken by running each year of flow separately. The modelling produced daily grids of water level across the entire gauged flow period. The data will be used to support research on the environmental watering requirements of the swamp forests within the Cockatoo Swamp. By better understanding the links between inundation patterns and vegetation response, targeted watering regimes can be developed to foster regeneration of swamp forests and improve habitat quality for the last remaining wild populations of the Helmeted Honeyeater and lowland Leadbeater's Possum.

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Introduction

The Cockatoo Swamp within the Yellingbo Nature Conservation Reserve (YNCR) comprises floodplain areas along the lower reaches of the Cockatoo and Macclesfield Creeks subject to inundation lasting from three to ten or months per year (McMahon and Franklin, 1993). It supports the largest extent of the threatened 'Sedge-rich *Eucalyptus camphora* Swamp' community (Turner, 2003). These swamp forests provide critical habitat for the last remaining wild populations of the Helmeted Honeyeater and lowland Leadbeater's Possum (Harley et al., 2005, Pearce and Minchin, 2001). These forests are in decline, putatively due to altered flooding regimes resulting from channel modifications for agricultural purposes, with channelization and levees having disconnected some floodplain areas while other areas suffer from prolonged inundation resulting from deposition of eroded sediments (Greet, 2016).

The Waterway Ecosystem Research Group (The University of Melbourne) in partnership with Melbourne Water (MW) is currently researching the environmental watering requirements of the swamp forests within the Cockatoo Swamp. This research includes the monitoring and assessment of the vegetation response of hydrology works by MW aimed at naturalising water regimes within the swamp. These research activities require robust estimates of historical inundation depth and frequency across the swamp. Good flow records are available, with 20 years of flow data for Cockatoo and Shepherds Creeks upstream of Cockatoo Swamp. To translate these flows into water levels within the swamp, a hydraulic model is required. This report details the development of a TUFLOW hydraulic model developed to provide this information.

Background

There have been various hydraulic models of the swamp (Water Technology, 2014a, Water Technology, 2014b, Jacobs, 2016). Each has built on the learnings of the previous as more data has become available.

To understand the performance of a model, calibration is required to observed water level data. Very little calibration data was available prior to 2014, and model validation of the original Water Technology (2014a) two-dimensional model relied on expert judgment. Some calibration was later undertaken by Water Technology (2014b) on the model and it was found to produce water levels consistently lower than expected. Jacobs (2015) initially used the same model for testing of infrastructure options but later abandoned it in favour of a simpler, one-dimensional model, which was better suited to their purpose of options testing.

While each of these models was based on the best information at the time they were developed and each was judged fit for its intended purpose, none could produce robust estimates of inundation across the swamp under its full range of conditions. Therefore, it was proposed to the research team that an opportunity to redevelop and recalibrate the model would enhance further understanding. The original model was built in the software package MIKE by DHI. In the first instance, the model was transferred to TUFLOW software and rerun, but it became clear that a complete reconfiguration and rebuild would be required to incorporate more recent data and achieve better calibration.

Objectives

The objectives of the inundation modelling were to:

1. Develop and calibrate a TUFLOW model of inundation behaviour in Cockatoo Swamp
2. Simulate long-term (1998-2018) inundation and output daily water depth grids

Input data

A hydraulic model requires topographic (digital elevation model and feature survey) and hydrologic (flow) data inputs. The quality of a model's output is directly dependent on the input data. The available input data was reviewed to understand its quality and select the best datasets for model input.

Digital elevation model

The basis of a hydraulic model is a digital elevation model (DEM). Four DEMs were available that could be used to build the model:

- UAV 2017 (Unmanned Aerial Vehicle) LiDAR DEM; collected by University of Melbourne
- Melbourne Water 1 m LiDAR DEM
- Water Technology (2014a) 5m model grid: based on LiDAR, but universally lowered by 0.3 m, then further lowered through dieback and pipeline areas and with key levee features added
- Jacobs (2016) Burn DTM: based on LIDAR, but with smoothing and drainage enforcement to minimise vegetation impact and better represent the channel

In addition, several feature survey datasets were available, reduced to Australian Height Datum levels. This allowed us to make comparisons between the DEMs and survey points to give an indication of their accuracy (**Table 1**). In addition to using the survey data to verify and adjust the digital elevation models, it was used to incorporate key features (levees and roads), to add detail to the model DEM where there was sufficient survey point density, and to estimate the capacity of the low flow channel. Surveyed point water levels were also used for calibration.

The UAV 2017 LiDAR was preferred for adoption, as the most recent and highest resolution DEM. However, processing of this DEM using an outdated ellipsoid model resulted in a vertical offset, making it, on average, 6.29 m higher than the survey data. Following discussions with the data provider, we consider this data acceptable, with a constant vertical offset of -6.29 m applied to bring it back into agreement with the other datasets.

In areas that were not covered by the UAV 2017 LiDAR, The Melbourne Water LiDAR was preferred, because it is less processed than the other two DEMs, which have had multiple adjustments applied to them. The Melbourne Water LiDAR DEM was, on average, 0.17 m higher than the survey data (outside the UAV 2017 LiDAR extent).

Table 1 Comparison statistics of DEMs against feature survey data. Comparisons were undertaken across all data, and across only the area outside the UAV 2017 dataset.

DEM	Survey dataset	All data				Data outside UAV DTM extent			
		No. points	Mean diff. (DEM-survey) (m)	St. dev. of differences (m)	Assessment	No. points	Mean diff. (DEM-survey) (m)	St. dev. of differences (m)	Assessment
UAV (2017) DTM	SMEC 2013 survey	137	6.54	0.51	DEM on average 6.29 m higher than survey. St. dev is higher than others, probably because only points in the swamp, which have higher uncertainty, are included				
	Jacobs Oct 2015 survey (top of silt)	240	6.32	0.45					
	Oct 2016 survey (local)	113	5.93	0.28					
Melbourne Water LiDAR	SMEC 2013 survey	460	0.27	0.46	DEM consistently too high (by 0.26 m on average)	323	0.17	0.40	DEM slightly too high (by 0.17 m on average)
	Jacobs Oct 2015 survey (top of silt)	342	0.35	0.38		102	0.23	0.35	
	Oct 2016 survey (local bank survey)	223	0.11	0.19		110	0.10	0.13	
Water Technology (2014a) model	SMEC 2013 survey	460	-0.025	0.47	DEM accurate - on average 0.03 m lower than survey	323	-0.12	0.42	DEM slightly too low (by 0.13 m on average)
	Jacobs Oct 2015 survey (top of silt)	342	0.029	0.37		102	-0.10	0.28	
	Oct 2016 survey (local)	223	-0.13	0.20		110	-0.17	0.13	
Jacobs (2016) Burn DTM	SMEC 2013 survey	460	0.019	0.47	DEM accurate – on average 0.01 m higher than survey. St. dev is higher than others	323	-0.05	0.42	DEM accurate – on average 0.05 m lower than survey
	Jacobs Oct 2015 survey (top of silt)	342	0.12	0.39		102	0.07	0.30	
	Oct 2016 survey (local)	223	-0.18	0.25		110	-0.15	0.20	

Hydrology

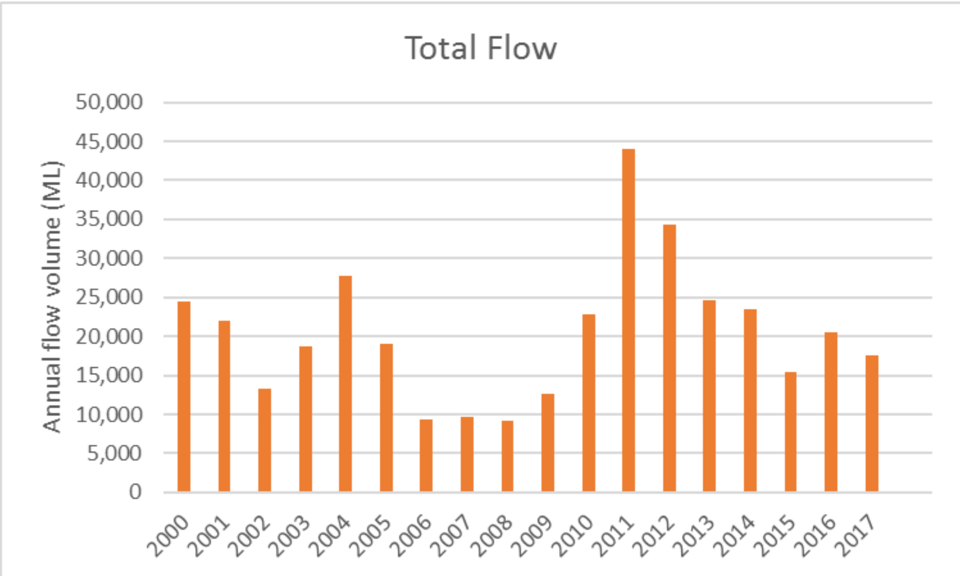
Cockatoo Swamp receives inflow from three major creeks: Cockatoo Creek, Shepherds Creek and Macclesfield Creek. Flow time series were required for these three creeks for input to the hydraulic model.

Gauged flows

Flow data was available for two gauges just upstream of the swamp, on Cockatoo and Shepherds Creek (**Table 2**). The interannual pattern of total flow and maximum flow into the swamp is illustrated in **Figure 1**. A dry period occurred from 2006 to 2008 with very low total inflow and peak flows. The wettest year on record was 2011, which has the highest total volume and peak flow.

Table 2 Available flow data for Cockatoo and Shepherds Creek upstream of Cockatoo Swamp

Gauge	Record Period	Gaps
229248A - Cockatoo Creek at Tschampions Road Nangana	April 1998 to May 2018 (20 years)	Numerous small gaps up to three months in length
229677A/B - Shepherd Creek D/S Healesville Kooweerup Rd Nangana	July 1999 to May 2018 (19 years)	Numerous small gaps up to two weeks in length



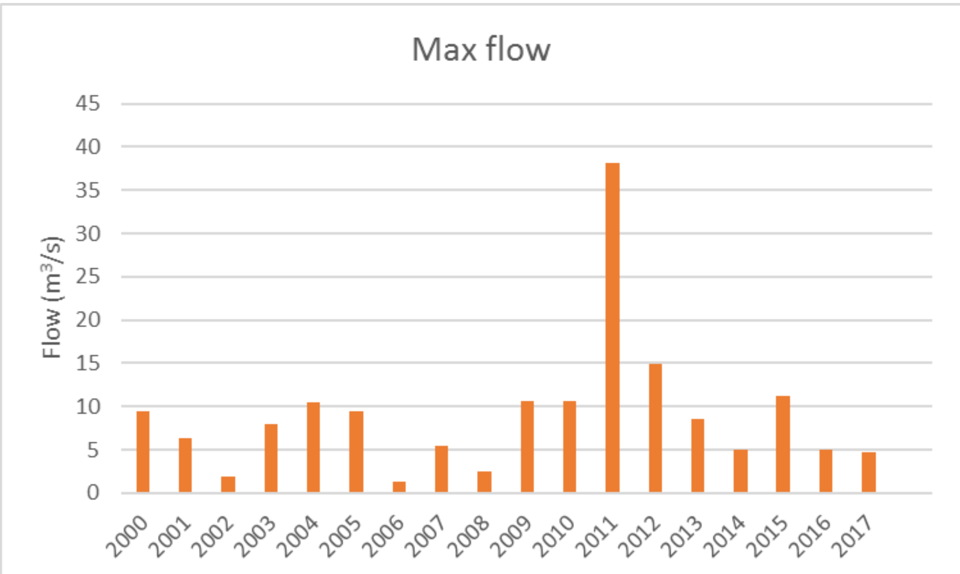


Figure 1 Total annual flow volume and annual maximum flow for combined Shepherds and Cockatoo Creek, complete years only.

Treatment of gaps

Gaps in each record were infilled by developing a regression relationship between logarithms of flows at the two gauges, which were highly correlated (R^2 = 0.91). The resulting power functions for infill of each gauge were:

- $Q_C = 0.9077Q_S^{1.1517}$
- $Q_S = 0.9571Q_C^{0.7904}$

Where Q_C is the Cockatoo Creek flow and Q_S is the Shepherds Creek flow, both in m^3/s.

Macclesfield creek flow estimates

Flow estimates were also required for Macclesfield Creek, an ungauged creek that enters Cockatoo Swamp. Previous flow estimates by Water Technology (2014a) were initially tested but were unable to produce observed levels in Macclesfield Creek during model calibration. Therefore, the flow estimation method was revisited.

Macclesfield Creek has a catchment area of 11 km^2, compared to 120 km^2 for the combined Cockatoo and Shepherds Creek catchments. The original flow scaling method (Water Technology, 2014a) took into account the high degree of farm dams in the Macclesfield Creek catchment, however the estimated flows were too low to reproduce observed levels. Therefore, a linear scaling of the Cockatoo and Shepherds Creek combined flow was used. The catchments are reasonably similar in land cover and land use, and therefore the total flow volume was expected to be 9.2% of the Cockatoo and Shepherds Creek combined flow. However, smaller catchments are expected to have higher peak flow per catchment area than larger catchments. Commonly, peak flows are assumed to scale with the ratio of catchment areas to the 0.7 power (Grayson et al., 1996). Therefore, the maximum flow of Macclesfield Creek was estimated to be 18.8% of the Cockatoo and Shepherds Creek combined maximum flow.

The following flow scaling equation was derived, to achieve both total flow volume of 9.2% and maximum flow of 18.8% of the combined Cockatoo and Shepherds Creek flow:

- $Q_M = 0.188Q_{C+S} – 0.078$

Where Q_M is the Macclesfield Creek flow and Q_{C+S} is the combined Cockatoo Creek and Shepherds Creek flow, both in m^3/s.

Hydraulic model schematisation

Approach

The hydraulic model was built in TUFLOW Classic, as a 2D grid based model, with a 1D culvert structure. The main channels (Cockatoo and Shepherds), swamp and floodplain were represented as a 2D grid. The 1D culvert at Macclesfield Creek was dynamically linked to the 2D grid to allow flow to transfer through the culvert and back to the floodplain.

The model was adapted from the MIKE FLOOD model developed by Water Technology (2014a) and subsequently used by Jacobs (2015), and then improved using recent survey data and further calibration.

2D model elements

Grid extent and resolution

The model grid extended from just upstream of the confluence of Cockatoo and Shepherds Creek to just downstream of the Melbourne Water Aqueduct Pipeline (**Figure 2**). The extent was reduced slightly from the Water Technology (2014) model to focus on the area of interest and reduce computation times.

A grid cell size (resolution) of 5 m x 5 m was adopted, as per the Water Technology (2014) model. This resolution allows output of results at an appropriate scale for the required ecological assessment.

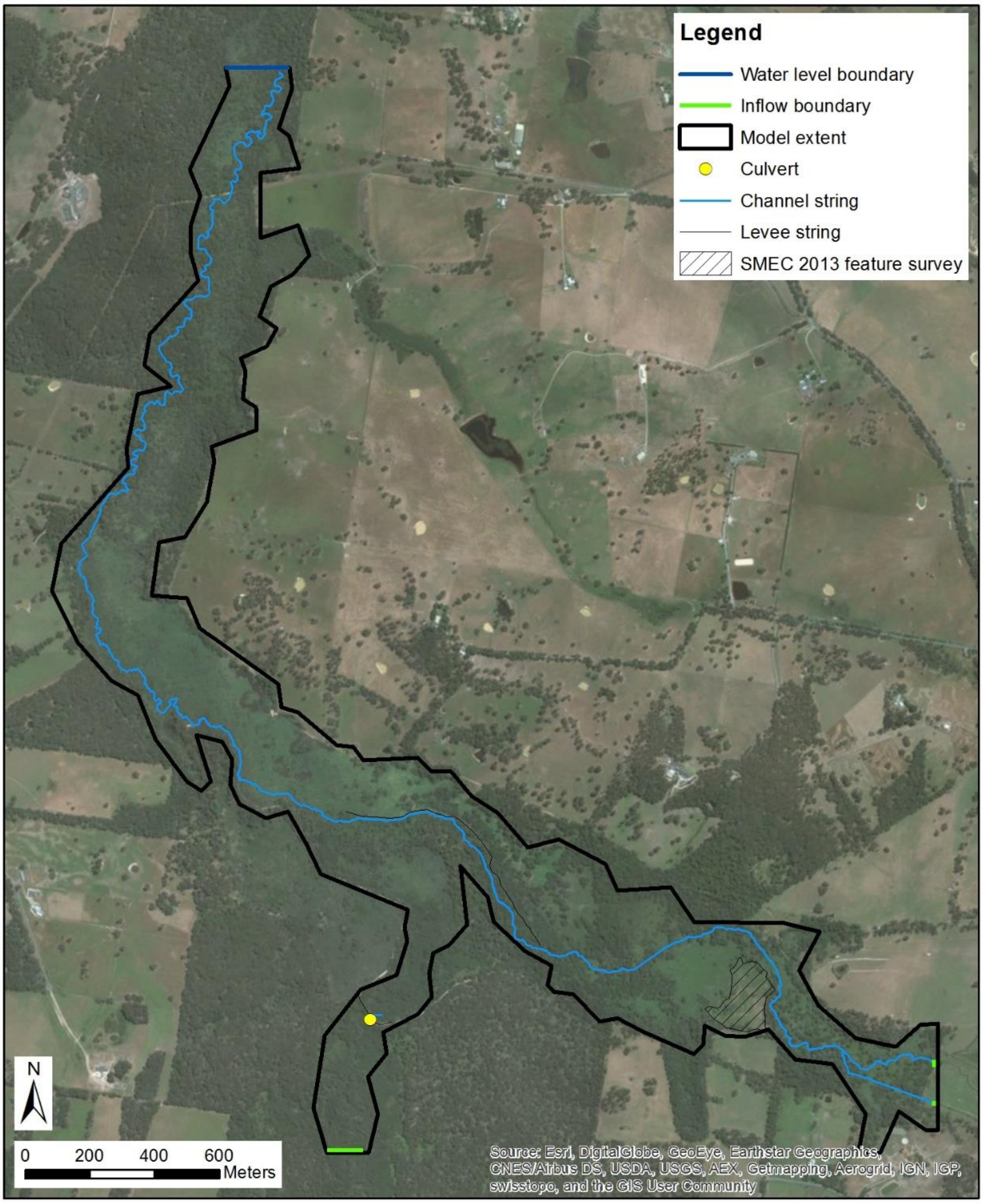


Figure 2 Model schematisation

Topography

The topography was based on the Melbourne Water LiDAR 1 m digital elevation model (DEM), and UAV LiDAR 1 m DEM collected by the University of Melbourne for this project in 2017 (**Figure 4**). The following processing was undertaken to develop the model DEM:

- The UAV 2017 LiDAR DEM required a large offset because the DEM was produced using an outdated ellipsoid model which did not allow it to be reduced accurately to Australian Height Datum (AHD). Advice from the supplier of the DEM indicated that a constant offset would be appropriate to reduce the levels to a height consistent with the other datasets. The DEM was therefore lowered by a constant 6.29 m to agree, on average, with surveyed point elevations within its extent.

- In areas not covered by the UAV LiDAR DEM, the Melbourne Water LiDAR DEM was used. The Melbourne Water LiDAR DEM was considered too high through the swamp area based on comparison to survey data, and was lowered by a constant 0.17 m to agree, on average, with surveyed point elevations (only using those points outside the extent of the UAV DEM). This offset was less than previous studies by Water Technology, in which the Melbourne Water LiDAR data was lowered by a constant 0.3 m, and then further lowered through the dieback and pipeline areas up to a maximum of 0.5 m. The available survey datasets indicated this amount of lowering was too great, particularly for areas on the fringe of the swamp. No spatial pattern of height differences between the LiDAR and the other survey datasets was observed, therefore, a constant offset of 0.17 m was adopted.
- The levee and the Macclesfield Creek road crossing were added to the DEM based on surveyed heights and the previous Water Technology model.
- The SMEC 2013 feature survey of a floodplain area just downstream of the Shepherds/Cockatoo confluence indicated that the topography was 0.06 m too low. Therefore, the model grid was raised by 0.06 m over the surveyed area.
- The October 2016 survey of sections of the Cockatoo Creek northern river bank was converted to a DEM then added to the model topography
- The main creek channels (Shepherds and Cockatoo Creek) were not well-represented in the LiDAR DEMs. They were added to the 2D grid using a string (TUFLOW 'Z-shape') to lower the invert level based on channel cross-section survey. The channel alignments and cross-sections were first copied from the Water Technology (2014) MIKE FLOOD model then used to create the 2D string alignments and inverts. The 5 m model grid limits the detail with which small channels can be represented, however, the capacity of the channels was validated through the model calibration process. The channels tend to be triangular to trapezoidal in cross-section, and around 5 m wide. Therefore, to represent their capacity in the 5 m model grid, the invert was set to the midpoint between the surveyed channel invert and the bank height, as illustrated in **Figure 3** below.

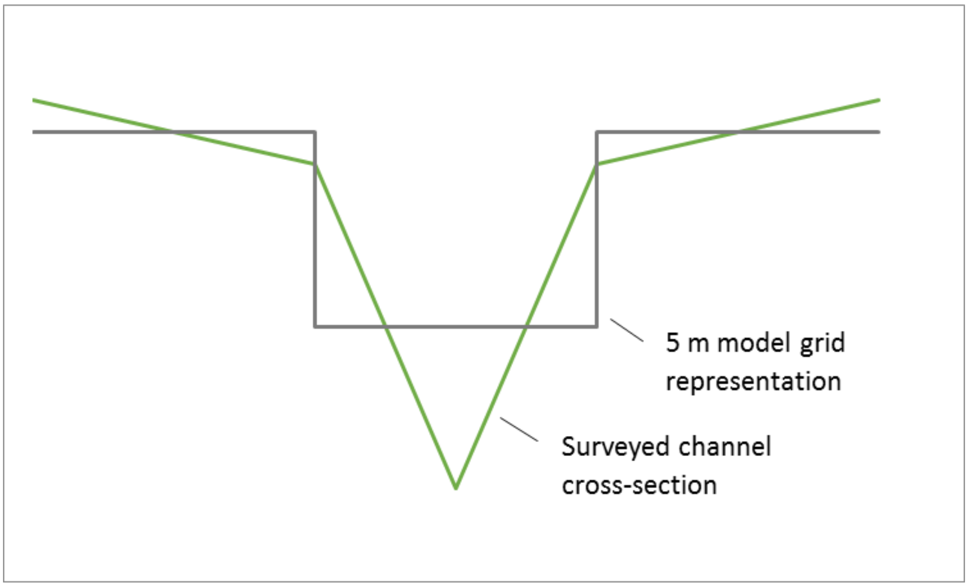


Figure 3 Treatment of channels in 2D model topography

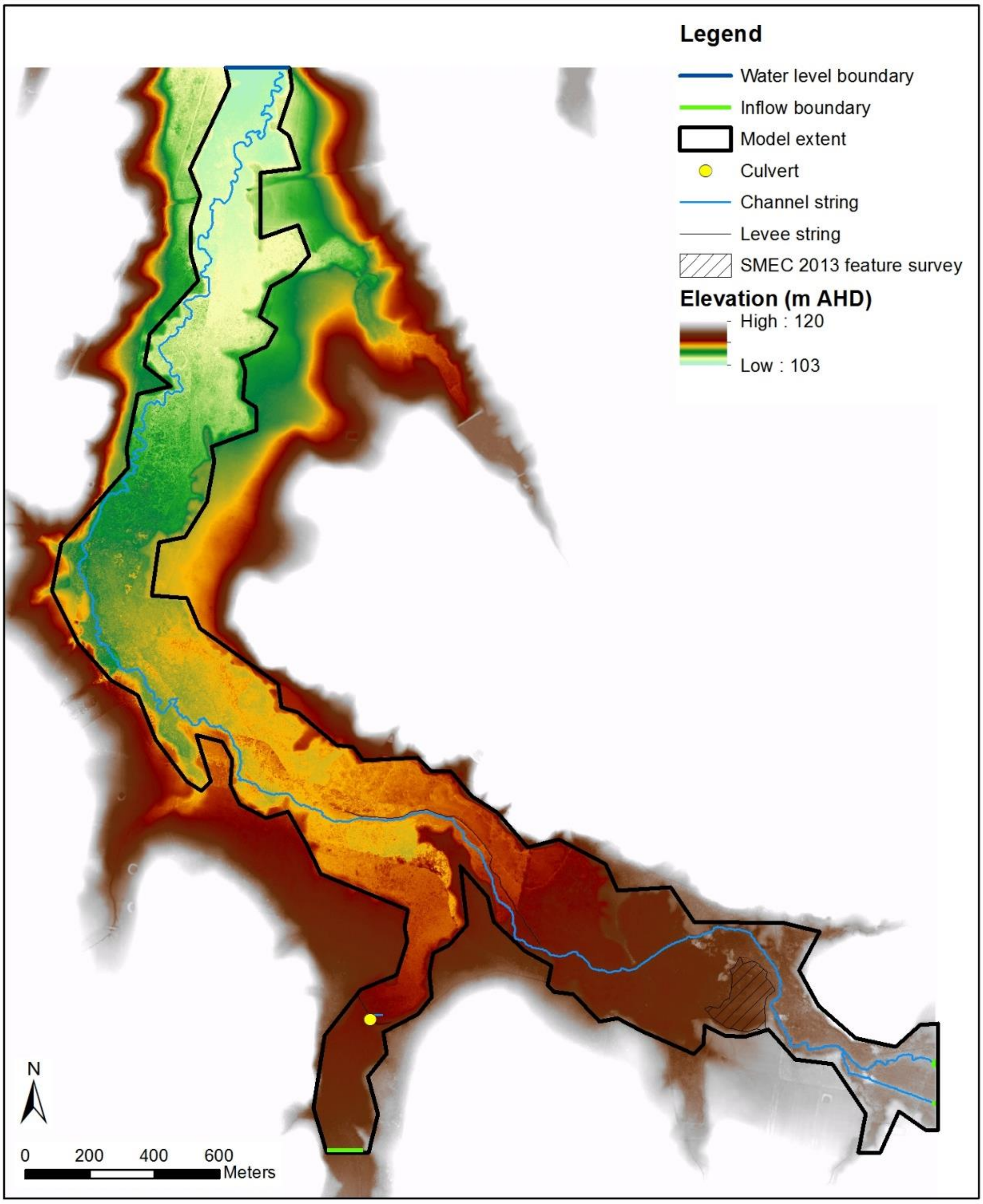


Figure 4 Model digital elevation model, constructed from UAV 2017 DEM, Melbourne Water LiDAR, and minor alterations from channel and levee strings.

Roughness

Hydraulic resistance to flow is represented in the model by the Manning's roughness coefficient, or Manning's n. The Manning's n is set based on guidance documents, modelling experience and calibration. The Manning's n was set to a constant value of 0.067, a value which is generally appropriate for floodplains with medium brush and trees (Chow, 1959).

1D Culvert

The Macclesfield Creek culvert was included as a 1D model element. The culvert was modelled as a rectangular concrete culvert with width 1.2 m and height 0.9 m, and Manning's n of 0.013.

Boundary Conditions

Boundary conditions are used in a hydraulic model to define inflows and outflows. Inflow boundaries were defined at the upstream ends of Cockatoo, Shepherd and Macclesfield Creeks. A water level boundary was applied to the 2D model at the downstream end of the model to allow outflows from the model. The treatment of these boundary conditions is described separately for the calibration and historic flow simulations in the following sections.

Hydraulic Model Calibration

Approach

Calibration was undertaken by running two events, comparing modelled and gauged water levels, then adjusting model parameters in a targeted way and rerunning the model. The key model parameters that were adjusted were:

- topography (the survey datasets included and any datum adjustments applied to them);
- channel representation (whether in a 1D model or included in the 2D grid);
- hydraulic roughness;
- downstream boundary conditions; and
- ungauged catchment inflows (i.e. from Macclesfield Creek).

Nine calibration runs were undertaken until an acceptable match was achieved between modelled behaviour and gauged water level data. A full run sheet is provided with the calibration model files. Only the final calibration results are presented here.

Calibration events and data

Two calibration events were selected, based on available flow and water level data (**Table 3**; **Figure 5**). Firstly, the July 2014 event was selected as it had been used previously for calibration of the Water Technology (2014b) model. The Feb-Dec 2015 period was selected to allow for calibration of water levels over the course of a whole wet season, including filling and draining behaviour. This period also included the highest flow of the water level gauging period. The location of gauges and surveyed water levels is shown in **Figure 5**.

Table 3 Summary of available flow and water level data for July 2014 and Feb-Dec 2015 calibration events

Event	Flow data	Water level calibration data
July 2014	Gauged flows at Shepherds and Cockatoo Creek	4 gauges with water level time series
	Macclesfield Creek flows estimated from combined Shepherds and Cockatoo Creek flow by equation $Q_M = 0.188Q_{C+S} – 0.078$ with flows in m^3/s	
Feb-Dec 2015	Gauged flows at Shepherds and Cockatoo Creek	4 gauges with water level time series
	Macclesfield Creek flows estimated from combined Shepherds and Cockatoo Creek flow by equation $Q_M = 0.188Q_{C+S} – 0.078$ with flows in m^3/s	11 point water levels on 23/04/2015 34 point water levels at 7 cross-sections on 28/10/2015-4/11/2015

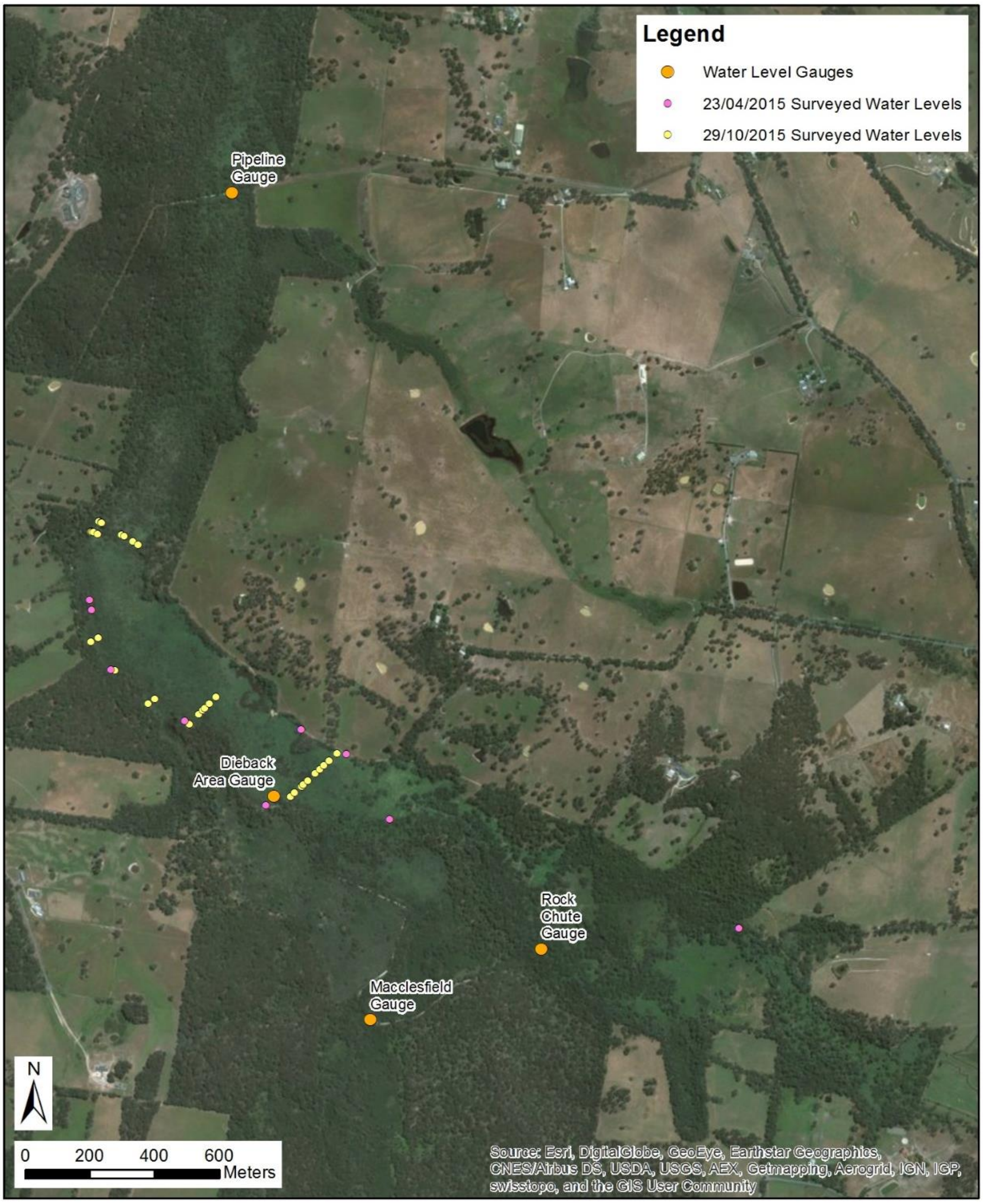


Figure 5 Available water level calibration data for July 2014 and Feb-Dec 2015 calibration events

Calibration boundary conditions

Inflow boundaries

Gauged and infilled Shepherds and Cockatoo Creek flows and estimated Macclesfield Creek flow (using flow scaling equation $Q_M = 0.188Q_{C+S} - 0.078$ with flows in m^3/s) were applied to the inflow boundaries.

Downstream boundary

The downstream boundary condition was set to a time-varying water level 0.07 m lower than the gauged level at the Pipeline. A dynamic level is required to represent the long-term storage in the swamp area over the wet season. A level slightly lower than the Pipeline water level allows drainage from the model and provides an excellent match to gauged water levels at the Pipeline.

Calibration results

Calibration resulted in a good match with gauged water levels for the July 2014 event (**Table 4**; **Figure 6**), particularly for the Dieback Area gauge (mean difference of -0.02 m, standard deviation of 0.02). Modelled water levels were, on average, 0.14 m too low at the Macclesfield Creek gauge and 0.22 m too low at the Rock Chute gauge.

For the Feb-Dec 2015 event (**Figure 7**), modelled water levels were again reasonably well-matched but tended to be slightly lower than gauged water levels. On average, modelled water levels at Macclesfield Creek, Rock Chute and Dieback Area gauges were 0.1 to 0.15 m too low. High flow events produced a better match than periods of low inflows or drainage flows, and drainage tended to be slightly too quick. The model is not capable of simulating exchange with groundwater, which is probably why we have difficulty fully matching drainage and low-flow behaviour. Surveyed point water levels on 23/4/2015 (**Figure 8**) were well-matched by the model (average difference 0.04 m), and those on 29/10/2015 (**Figure 9**) were slightly overestimated by the model (average difference 0.15 m). On balance, the calibration appears to match both long term water level time series, and point water levels, well, with a tendency to underestimate the former and overestimate the latter.

The Pipeline gauge was well-matched for both events, due to its measured water levels being used to set the downstream boundary water level for the model.

Table 4 Calibration results summary showing mean and standard deviation of differences between modelled and gauged water levels

	Mean diff. (modelled minus observed) (m)	St. dev. of differences (m)
July 2014		
Macclesfield Creek water level gauge – whole time series	-0.14	0.03
Rock Chute water level gauge – whole time series	-0.22	0.02
Dieback Area water level gauge – whole time series	-0.02	0.02
Pipeline water level gauge – whole time series	-0.01	0.02
Feb-Dec 2015		
Macclesfield Creek water level gauge – whole time series	-0.10	0.06
Rock Chute water level gauge – whole time series	-0.15	0.03
Dieback Area water level gauge – whole time series	-0.10	0.04
Pipeline water level gauge – whole time series	-0.01	0.01
11 point water levels on 23/04/2015	0.05	0.32
34 point water levels at 7 cross-sections on 29/10/2015	0.15	0.26

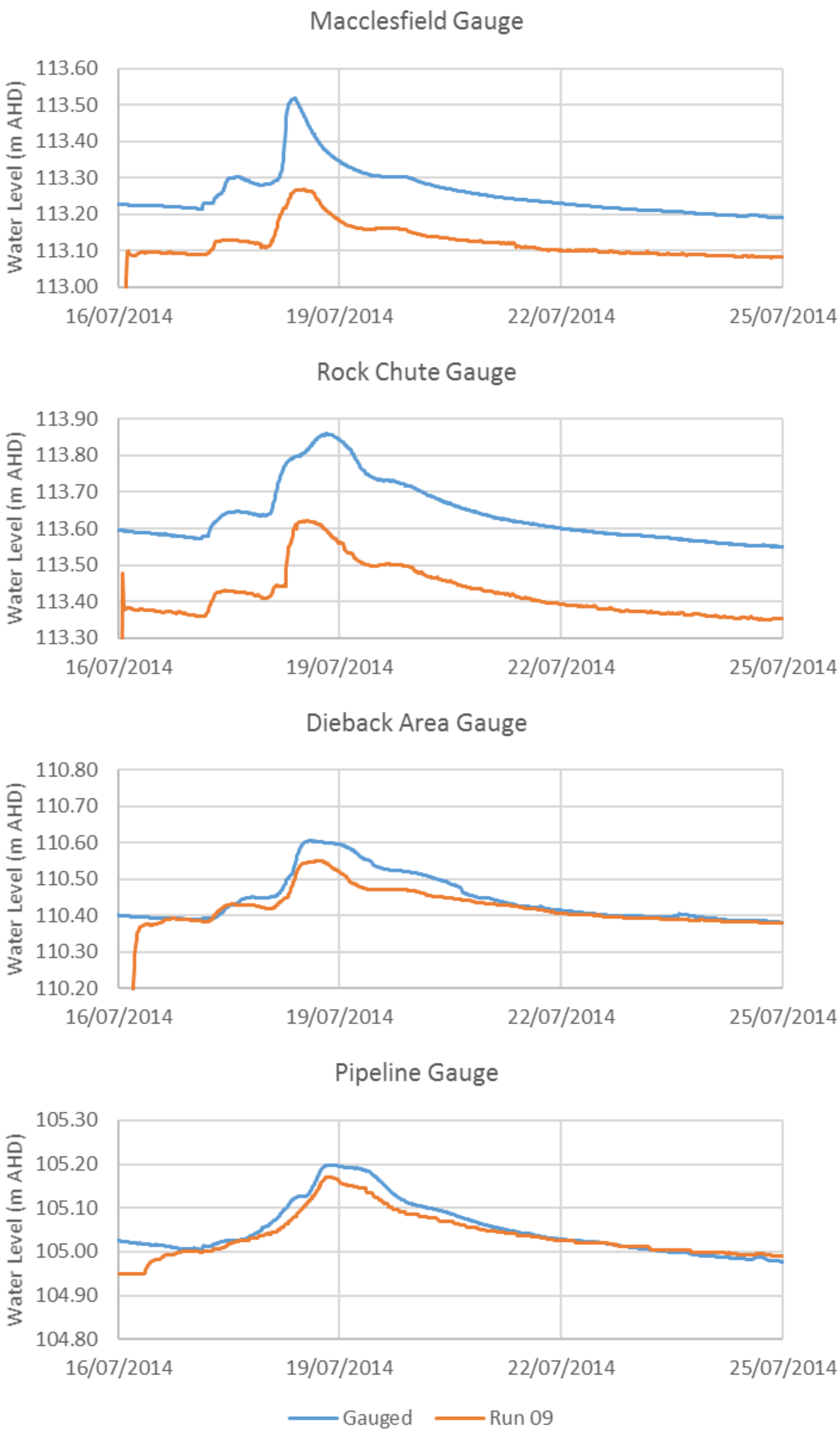


Figure 6 Calibration results for July 2014 event – modelled (Run 09) water levels vs. gauged water levels

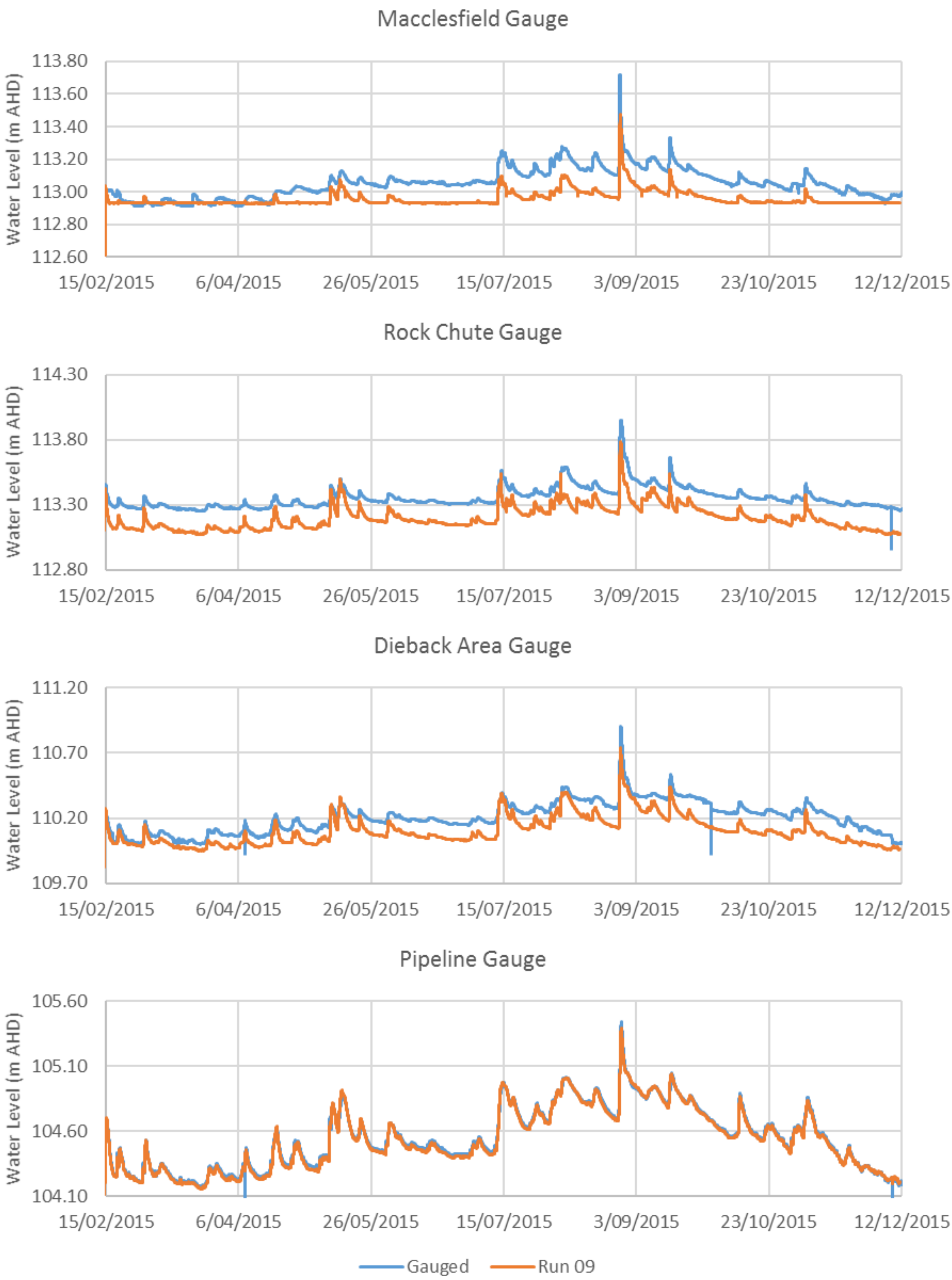


Figure 7 Calibration results for Feb-Dec 2015 period – modelled (Run 09) water levels vs. gauged water levels

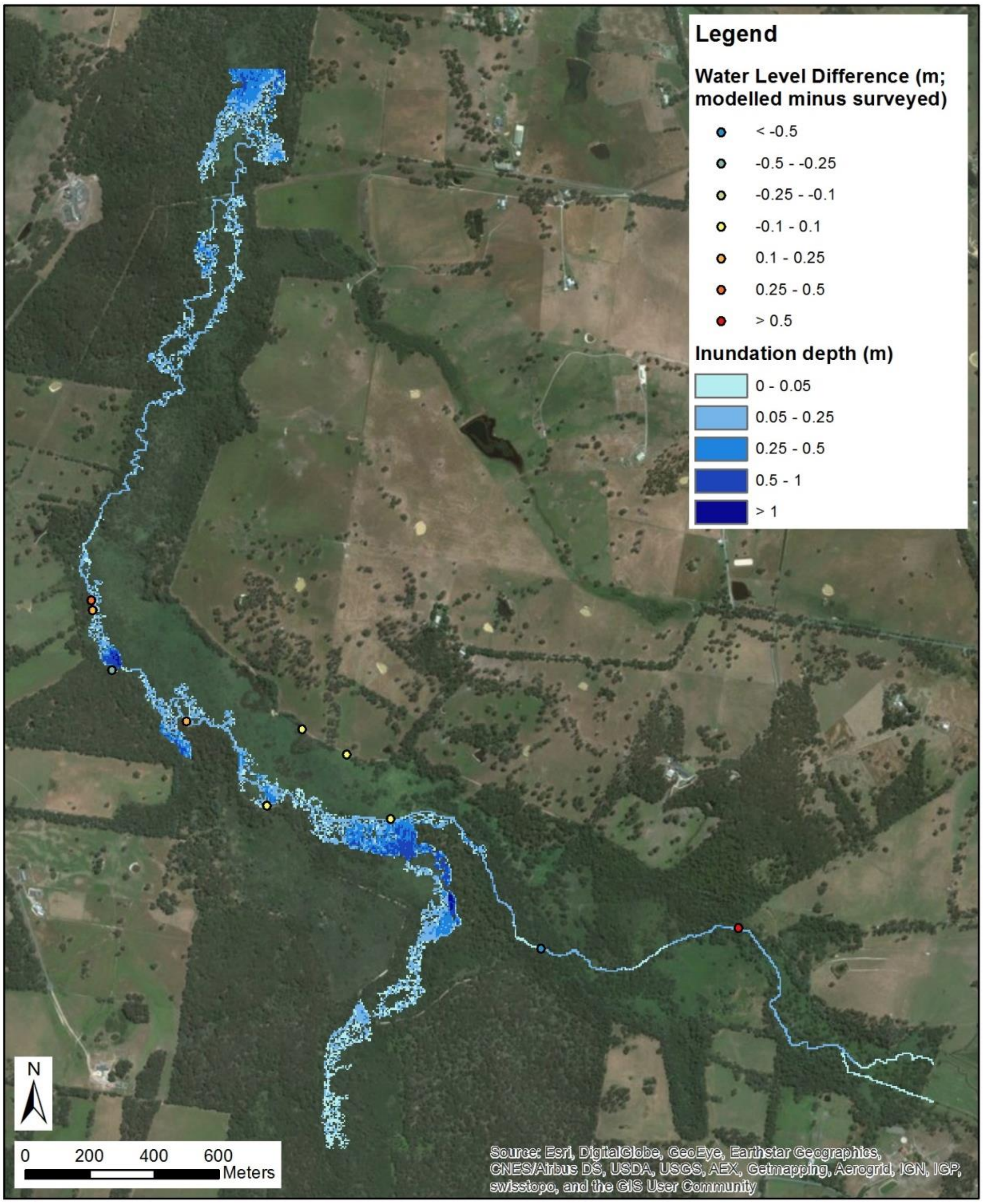


Figure 8 Calibration results for Feb-Dec 2015 event – modelled (Run 09) water levels vs. surveyed water levels, 23 April 2015

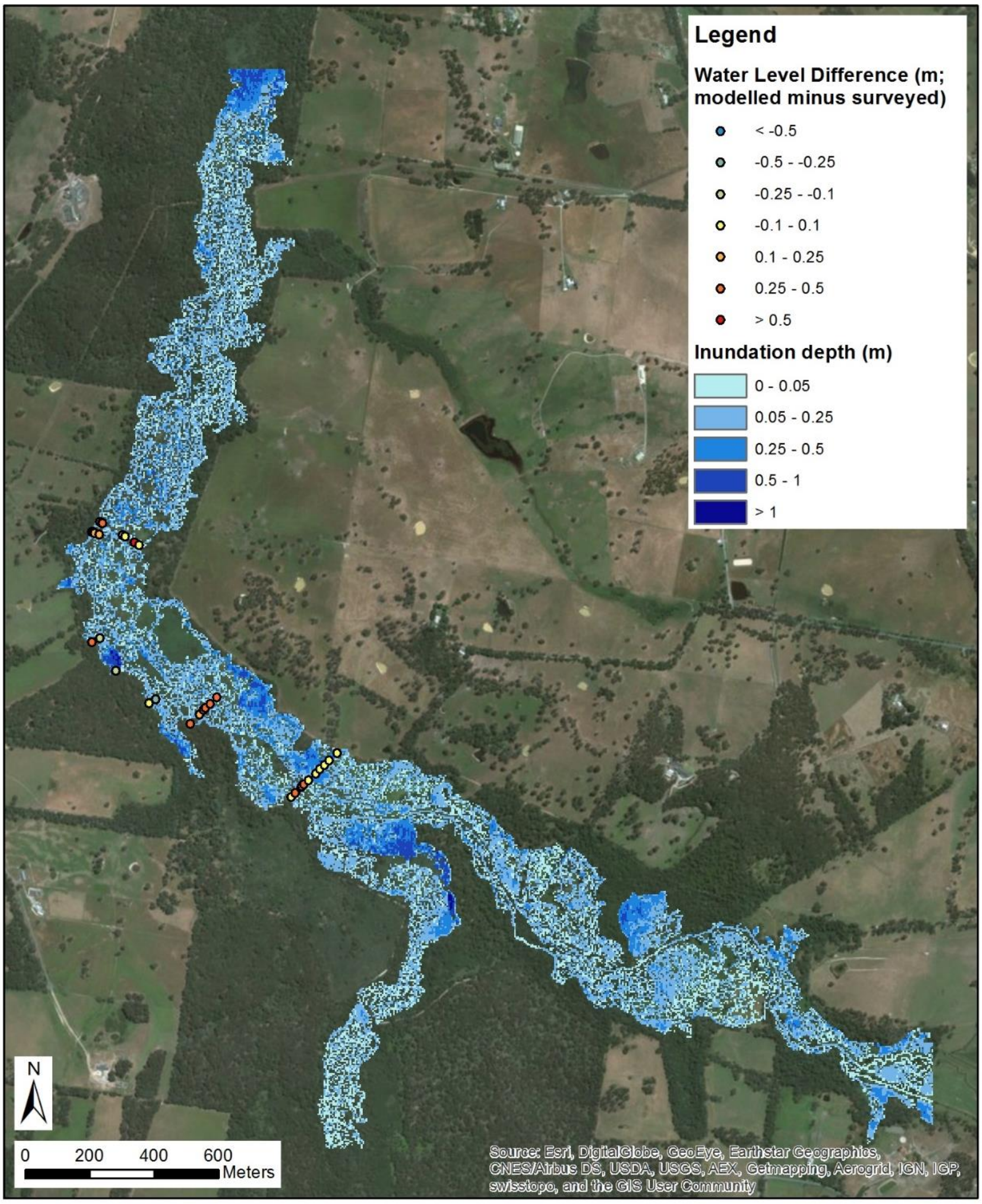


Figure 9 Calibration results for Feb-Dec 2015 event – modelled (Run 09) water levels vs. surveyed water levels, 29 October 2015

Historic Flow Simulations

Approach

Simulation of the historic flow series (1998-present) was undertaken by running each year of flow separately. The driest time of year is generally the start of March, however a January-December flow year is a reasonable approximation, and allows for easier interpretation. The historic flow modelling covered the entire gauged flow period from April 1998 to May 2018.

Boundary conditions

Inflow boundaries

Gauged and infilled Shepherds and Cockatoo Creek flows and estimated Macclesfield Creek flow (using flow estimation equation $Q_M = 0.188Q_{C+S} – 0.078$ with flows in m^3/s) were applied to the inflow boundaries.

Downstream boundary

Where gauged water levels were available at the Pipeline (April 2014 to February 2018), the downstream boundary water level was set to a time-varying water level 0.07 m lower than the gauged level.

For the remaining period, a sinusoidal water level model was adopted as an approximation to the annual pattern of water level at the Pipeline:

$$WL_P = -0.357 \cos\left(2\pi\left(\frac{d - 62}{365}\right)\right) + 104.56$$

Where WL_P is the predicted water level at Pipeline (m AHD), and d is day of year from 1 January. This equation was derived by first transforming the day of year using a cosine function, then fitting a linear regression with the gauged water level. The fit of this curve to the data is shown in **Figure 10**. The boundary water level was set to 0.07 m lower than the predicted water level at Pipeline.

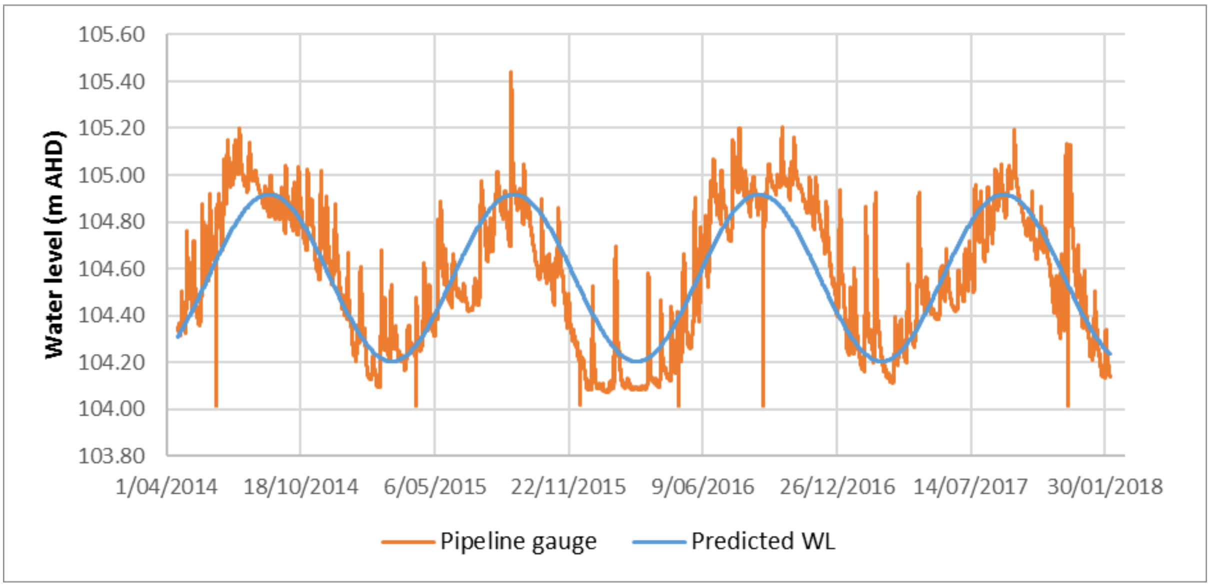


Figure 10 Pipeline water level model and fit to gauged data

Model Outputs

The key outputs from the TUFLOW model are ascii grids of depth and water level (5 m resolution), saved at a daily time step.

The naming convention is:

- Cockatoo_5m_Historic_Flows_01_2017_d_000024.asc
- Cockatoo_5m_Historic_Flows_01_2017_h_000024.asc

The tail end of the file name indicates the year, type of data and date/time:

- _2017 - the year
- _d/h - depth/water level results

- _000024 - time in hours from start of year (this would be 1 day from start of year, i.e. 2 Jan 2017 at 0:00 AEST)

In addition, other outputs have been saved which may be useful, including time series of water level and flow at key locations throughout the swamp (e.g. inflows, outflows, confluences, gauges, culvert), saved at a 15-minute time step.

Other files, including all input, log and check files, are provided and may assist with quality control, reporting and mapping. These files are organized and named in standard TUFLOW format, and the TUFLOW manual (https://www.tuflow.com/Download/TUFLOW/Releases/2016-03/TUFLOW%20Manual.2016-03.pdf) may be of assistance in understanding the data types and directory structure.

All files are securely stored and backed up on The University of Melbourne network drive and will be made readily available accessible to all Melbourne Water staff upon request.

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