final report

Project code: B.FLT.0380

Prepared by: Andrew Wiebe, Christine Killip

Katestone Environmental

Date published: July 2015

ISBN: 9781741919332

PUBLISHED BY
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

Heat Load Index forecast service – Feedlot AWS data integration

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

In the 2012 upgrade of the heat load forecast service, the Heat Load Data Network (HLDN) was developed to allow integration of feedlot site weather station data into the heat load forecast via the Cattle Heat Load Toolbox (CHLT). This project was implemented to assist feedlots with this integration process. For participating feedlots, when a new forecast is issued, the forecast accumulated heat load units (AHLU's) are initialised utilising the actual measurements from the onsite AWS, thereby providing more accurate forecasts.

By the end of the 2014-15 summer season a total of 28 sites were connected and using the service and a further four sites were in the final stages of becoming connected. Of the sites connected to the service, the total number of cattle covered was almost 500,000 (SCU), or just under 50% of industry capacity. A review of the benefits of the system, undertaken in June 2014, showed that sites using the HLDN to initialise their site heat load forecast had an improvement in forecast accuracy, compared to not including the site data.

Executive Summary

As a means of improving the assessment of heat load conditions at a feedlot site the Heat Load Data Network (HLDN) was developed to integrate site weather station data into the heat load forecast via the Cattle Heat Load Toolbox (CHLT).

The objective of this project was to assist participating feedlots to get connected to the HLDN. The potential benefits to users were:

- Access to site data online - Once a site was connected to the data network, they could view their AWS data on a secure web page (HLI and AHLU calculated).
- More accurate forecasts - When each new forecast was issued, the AHLU's were initialised from the actual measurements from a site, therefore providing a more accurate forecast.
- Free quality assurance of AWS algorithms and data - To ensure the equations being used to calculate the HLI and AHLUs (and BGT, if required) were correct, they were reviewed to ensure algorithms were up to date and programmed correctly.

CHLT users were invited to register for the service in June 2013. Involvement in the project was optional. By the end of the 2013/14 summer season only 14 sites were connected and using the system.

A review of the benefits of the system was undertaken in June 2014. The review showed that sites using the HLDN to initialise their site heat load forecast had an improvement over not including the site data. There was a distinct difference in the magnitude of the predicted heat load event between forecasts that were initialised from the HLDN and those that were not, with the initialised predictions being closer to the measured AHLU daily risk level.

A further push to connect sites to the HLDN was undertaken before the 2014/15 season. By the end of the season a total of 28 sites were connected and using the service; and a further four sites were in the final stages of getting connected. Of the sites connected to the service, the total number of cattle covered was almost 500,000 (SCU) or just under 50% of industry capacity.

The project demonstrated the benefits of better use of onsite weather station data and highlighted the importance of good onsite measurement to improve the understanding of heat load conditions at a site.

Contents

Tables

Figures

1. Introduction

Since 2002, MLA has funded a series of projects with Katestone to provide a heat load forecast service for the Australian feedlot sector. The service has been continually upgraded, both in terms of performance and the number of sites for which forecasts are provided.

The service currently provides forecasts for 91 town sites and site specific forecasts for 176 subscribed feedlots, with a capacity of just under one million head (over 80% of total feedlot capacity).

The 2012 upgrade of the forecast service included provision for feedlots to submit data from their automatic weather stations (AWS) so that their forecasts could be updated utilising feedlot site meteorological data. This was named the Heat Load Data Network (HLDN).

The uptake of the offer was slow even with the offer of funding to help facilitate the purchase of a weather station (if required) and to cover other costs associated with integration. The exact reason for the lack of interest is not known but could be for a number of reasons including:

- lack of resources
- no onsite weather station
- lack of knowledge and technical capability, and
- concerns about cost to implement the required data transfer systems.

This project was commissioned to assist feedlots to implement the processes and protocols necessary to allow daily data transfer between Katestone and individual interested feedlots, allowing feedlot forecasts to be updated based on actual feedlot site meteorological data. Katestone coordinated with feedlots and AWS service providers to ensure all interested feedlots were integrated into the data network.

This report establishes the current status of the HLDN and delivery of the project to meet its objectives.

2. Project objectives

The project objectives were to:

a. Implement the data transfer processes and protocols required to achieve daily transfer of site specific AWS data from all interested feedlots to Katestone, who will then:

    - Perform quality assurance on the data
    - Calculate the values of the heat load indices (HLI and AHLU) from the data
    - Integrate the HLI/AHLU values into the forecast
    - Display the AWS updated forecast data back to the feedlot on their secure page of the forecast service website

b. Implement procedures and systems to manage and store user equipment information and AWS data, which can then be used for future site specific assessments of heat load risk.

3. System design

3.1 Database and storage

The underlying data structure for the HLDN sits within the main forecast service database. Each forecast site is issued with an AWS identification number which is associated with the data stream and the meta-data for that site. The meta-data is the AWS specifications supplied for each AWS active in the HLDN, and consists of make and model of the receiving station and each sensor installed. These specifications allow Katestone to customise the format and quality assurance process for each AWS; as reporting structures, the variables reported and the variable units are different across the different brands of stations and installers.

This data is presented on the Cattle Heat Load Toolbox (CHLT) under the Account-Manage AWS tab in the navigation menu. The Manage AWS page displays the make, model and anemometer height of the AWS as well as an overview of the AWS's upload status (Figure 1).

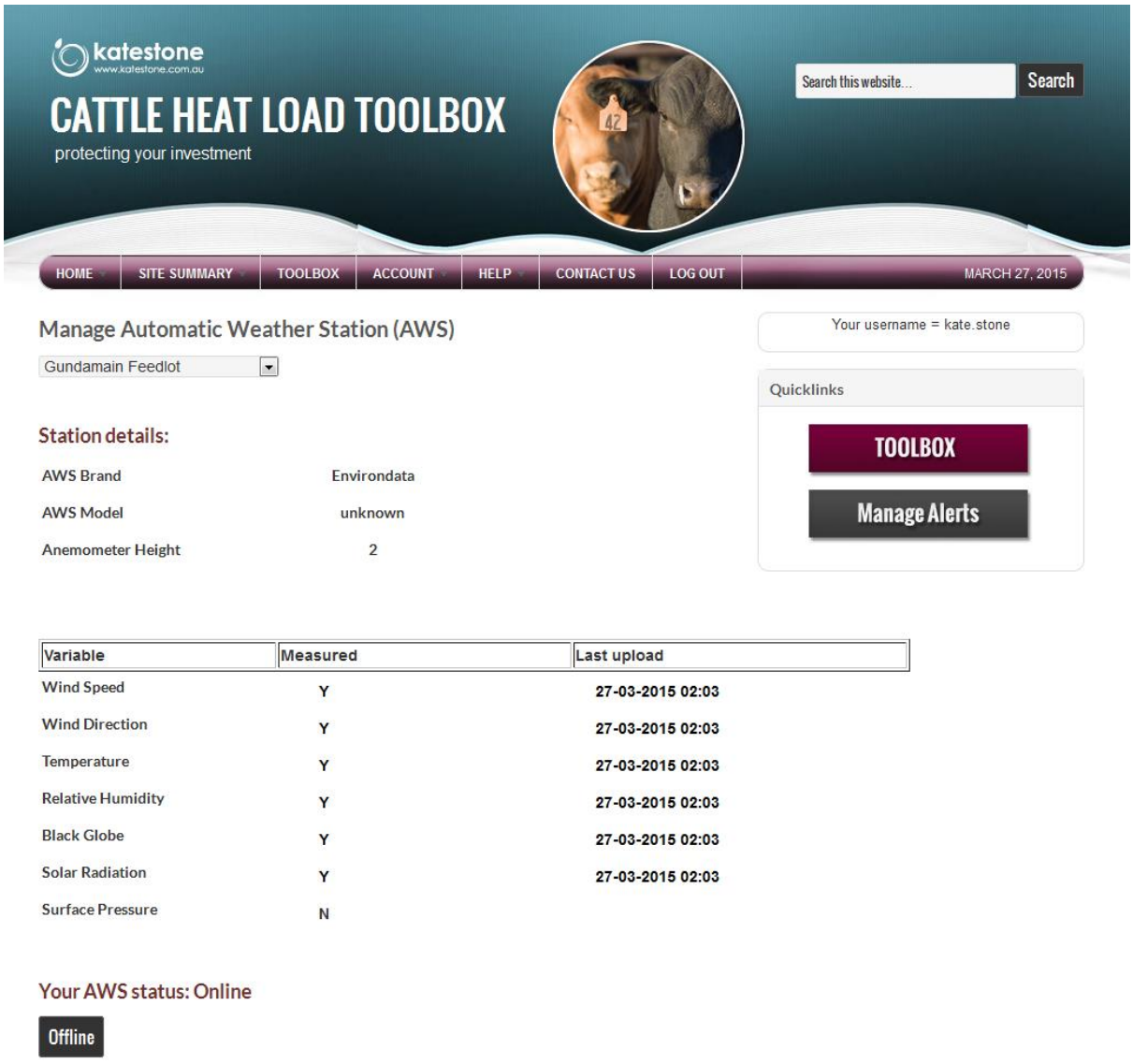

Figure 1 Manage AWS summary page

All the uploaded data is stored in the main forecast service database. The data can be retrieved for any period since the connection was first established. Currently only the last 7 days of the data holding is presented on the CHLT web site (See Figure 2).

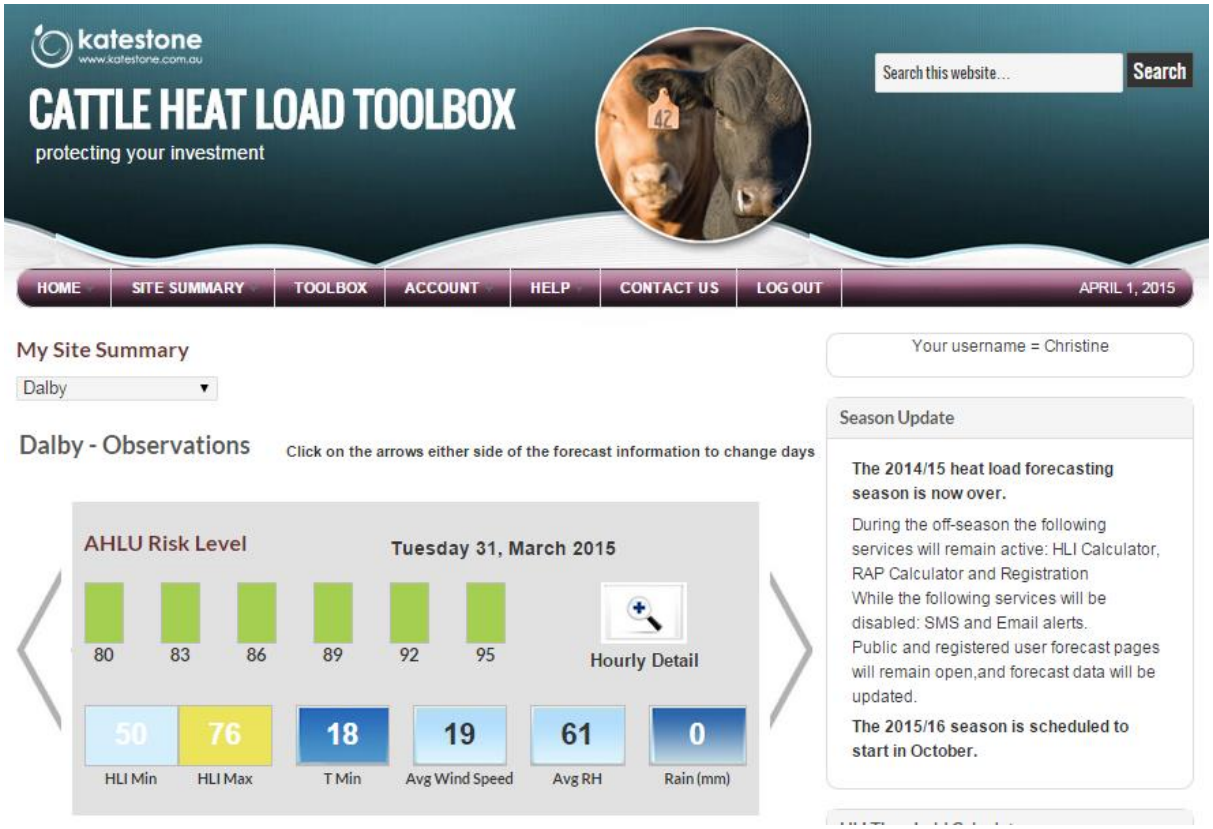

Figure 2 AWS observations accessed via the My Site Summary page

3.2 Quality assurance

All AWS data pushed to the Katestone servers from the feedlots is reformatted into a uniform data format ready for integration into the forecast service. Once formatted each measured variable is checked for outliers (values outside a defined range (Table 1)) and then the Heat Load Index (HLI) and Accumulated Heat Load Units (AHLU) are calculated.

Table 1 Quality assurance ranges for measured variables

Variable	Minimum	Maximum
Temperature °C	-25	60
Relative Humidity %	0	100
Wind speed m/s	0	85
Solar radiation W/m2	0	1400
Black Globe Temperature °C	-15	75

Calculating the HLI and AHLU once the data has been processed by Katestone ensures that the appropriate algorithm is applied and that the newly arrived data will integrate seamlessly with the data store. Katestone also calculates the Black Globe Temperature (BGT) even if the variable is measured to check the accuracy of the BGT equation. The measured variables always take precedence over any calculated variable within the system; such that if a measured BGT is supplied then it is used in the HLI equation.

The quality assurance process flags any outliers and issues a warning to one of Katestone's CHLT Operations Managers for follow up. The error is then assessed as being either an:

- Internal error such as a process failure with Katestone's data structure
- External error such as a faulty sensor or a change in the source data

The Katestone Operations Manager will then contact the feedlot AWS Administrator to resolve the issue. The Operations Manager also performs daily checks of the entire CHLT system including the data uploaded through the HLDN. These non automated checks can identify situations when the data simply does not "look right". In these situations the AWS Administrator is contacted and the issue is discussed until a resolution is found. Two actual examples of the automated and non-automated QA process in action are described below.

1. A feedlots AWS was pushing an empty data file to Katestone over the Christmas Holiday break. Once the AWS Administrator was contactable it was relayed that the AWS was struck by lightning and while it was still operating they weren't surprised it didn't contain any useful data. Once a new system was installed the connection to Katestone was re-established; however the source data format had changed from the previous installation causing spurious results in the HLI and AHLU algorithms. This was flagged and corrected.

2. The CHLT Operations Manager noticed that the wind speeds for a particular site had remained at 0.0 m/s for three consecutive days. While the value is technically within the allowable range, the likelihood of this actually occurring in the real world is very small. The AWS administrator was contacted and it was found that the anemometer was stuck, hence the zero wind readings. The impact this had on the forecast was that the AHLU calculated from the observations was spuriously high due to the elevated HLI. The integration of this spurious AHLU into the forecast caused alerts to be issued when there was actually no heat event occurring.

4. Service uptake

4.1 Active

There are currently 26 feedlots regularly pushing data to the HLDN (Table 2). An additional two feedlots have suspended uploading due to technical issues with the sensors in their AWS. The total head of cattle in feedlots that are connected to the system is approximately 470,000 SCU or nearly 50% of current feedlot capacity.

Table 2 Active participants in the Heat Load Data Network

Feedlot	Lat	Lon	Data start	Data end	Head SCU
Gundamain Feedlot	-33.45	148.34	21/09/2013	26/03/2015	6,000
JBS Mungindi Feedlot	-28.77	149.12	21/09/2013	26/03/2015	22,240
Rangers Valley Feedlot	-29.5	151.73	13/09/2013	26/03/2015	40,000
Coonamble Feedlot	-30.96	148.37	21/09/2013	26/03/2015	10,000
JBS Riverina Beef Feedlot	-34.64	146.47	21/09/2013	26/03/2015	53,333
JBS Prime City Feedlot	-34.11	145.73	21/09/2013	***11/03/2015***	35,000
Kerwee	-27.39	151.57	21/09/2013	27/03/2015	11,100
Teys Feedlot Condamine	-26.9	149.85	21/09/2013	***13/03/2015***	28,944
Pakaderinga Feedlot	-26.43	151.93	21/09/2013	27/03/2015	2,000
Wonga Plains Feedlot	-27.18	151.52	21/09/2013	26/03/2015	5,350
JBS Beef City Feedlot	-27.52	151.61	21/09/2013	26/03/2015	26,500
AACo Goonoo Feedlot	-23.76	148.53	21/09/2013	26/03/2015	20,000
Mort & Co Pinegrove Feedlot	-27.76	151.2	21/09/2013	26/03/2015	6,111
ACC Brindley Park Feedlot	-26.31	148.9	21/09/2013	26/03/2015	23,000
Whyalla Feedlot	-28.74	151.04	21/09/2013	26/03/2015	50,000
Stanbroke Feedlot	-26.8	150.41	21/09/2013	26/03/2015	25,000
Mort & Co Grassdale Feedlot	-27.4	151.14	21/09/2013	24/03/2015	30,672
Wanderribby Feedlot	-35.75	139.35	21/09/2013	26/03/2015	4,980
Teys Charlton Feedlot	-36.35	143.4	21/09/2013	26/03/2015	20,000
JBS Caroona Feedlot	-31.3877	150.37	17/09/2013	26/03/2015	28,000
Mort & Co Gunnee Feedlot	-29.6148	150.862	3/06/2014	26/03/2015	10,000
Lotus Park Feedlot	-22.309	149.069	14/11/2014	26/03/2015	6,000
Pakaderinga Feedlot	-26.4296	151.94	16/12/2014	27/03/2015	2,000
Terence Vale Feedlot	-25.0079	150.207	30/04/2014	28/05/2014	499
Oxview Feedlot	-25.1427	150.186	28/08/2014	26/03/2015	500
Wieambilla Feedlot	-26.8798	150.436	1/12/2014	26/03/2015	5,000
				Total	**472,229**

4.2 Pending

There are four feedlots currently in the process of connecting to the HLDN. The main obstacles encountered with getting these feedlots in to the HLDN are:

- Configuring the office computer to automatically push the data to Katestone
- Waiting for installation of all components
- Organising a suitable time for the feedlot operator to work with Katestone to set up the connection

Katestone has implemented the use of the free Team Viewer software to facilitate an automated push to Katestone's server. Katestone organises a time with the feedlot operator where both are located at their computer terminals, the feedlot allows Katestone to work remotely on their computer through the Team Viewer software. Katestone then configures the task scheduler in Microsoft Windows to push the AWS data to Katestone at a specified time.

Although funding of the service has ended, Katestone will work with the sites that are still pending to get them fully operational in the system.

4.3 Interested

A further 23 feedlots have expressed interest in participating in the HLDN project. These have been contacted and supplied with the AWS briefing paper and followed up with a phone call by Katestone. The main obstacles encountered with the interested HLDN members are:

- Not answering their phones or responding to emails
- Have not progressed to the point of purchasing an AWS
- Have purchased an AWS but have not installed it
- Have purchased an AWS and installed it, but are not receiving any data from it
- Have purchased an AWS and installed it, but do not respond to communications
- Have purchased an AWS and installed it, but do not have NFAS accreditation

4.4 Target feedlots

A review of large feedlots not currently in the system has identified a further seven sites with a capacity of over 15,000 SCU. Two of these sites are not CHLT users and will be difficult to contact. The final five sites showed initial interest in the service in 2013 but have not responded to communications since that time.

4.5 Reimbursements

A total of 7 feedlots that have connected to the HLDN have applied for and received the $1,000.00 MLA reimbursement. All of these reimbursements were for new AWS's purchased and installed at their feedlot.

5. Discussion/conclusion

The development and implementation of a service to integrate site automatic weather station data into the assessment of future heat load conditions at a feedlot has successfully been completed.

All sites interested in using the service have been contacted and a total of 28 are successfully using the system, with a further four in the final stages of becoming integrated into the HLDN. The feedlots using the system cover almost 500,000 head of cattle or nearly 50% of the current Australian feedlot capacity.

Katestone will continue to provide ongoing support to feedlot operators who purchase or upgrade an AWS system and integrate into the service through the HLDN. While Katestone makes every attempt to ensure the measured data is accurate and representative through automated and human interaction, data quality remains a constant issue.

The key areas where data quality is compromised are:

- BGT sensor data does not correlate well with the outputs from the existing BGT equation

- Spurious sensor readings that pass the automated checks can go undetected for several days until a pattern is identified by Katestone's Operation Manager during the course of their daily checks
- Changes to the AWS's source data format without informing Katestone can cause spurious results to propagate through the system as each AWS has a custom format template developed for it when they first connect. Changes to the source data needs to filter through to the custom template.