Managing Summer Heat Workbook
# Contents

1. **INTRODUCTION** .............................................................................................................. 1

2. **PREPAREDNESS** ........................................................................................................... 2

   2.1 Pre-summer checklist ................................................................................................. 2

   2.2 Understanding the basics ........................................................................................... 3

      2.2.1 What is the HLI and how is it calculated? ......................................................... 5

      2.2.2 What is the AHLU and how is it calculated? ...................................................... 7

      2.2.3 How to quantify the heat load risk and relationship with HLI/AHLU ............... 9

      2.2.4 How to conduct a site risk assessment using the RAP ............................... 10

      2.2.5 How to interpret your risk using the RAP ......................................................... 12

      2.2.6 How do I reduce my risk of a heat event? ......................................................... 13

      2.2.7 What makes cattle high risk and what are high risk areas within the feedlot? ... 13

      2.2.8 What is the Cattle Heat Load Toolbox (CHLT) and how do I register? ........ 15

      2.2.9 How can I get weather warnings? ....................................................................... 16

      2.2.10 What is the HLDN and how do I get my AWS connected? .............................. 16

      2.2.11 Minimum requirements for weather stations and where to put them ............ 16

      2.2.12 What equipment needs to be serviced and when? ............................................ 18

      2.2.13 What should I include in my contingency plans? .......................................... 19

      2.2.14 What staff training should I undertake? ........................................................... 20

      2.2.15 What is a heat load ration and heat management feeding strategy? ............ 20

      2.2.16 What do I need for a mass burial site? ............................................................... 21

3. **DAILY MONITORING** ..................................................................................................... 22
CATTLE CLINICAL OBSERVATIONS ......................................................... 45

APPENDIX D  EXAMPLE TEMPLATE FOR DAILY MONITORING ............... 46

DAILY HEAT MONITORING RECORD ................................................ 47
Tables

Table 1  Pre-summer checklist........................................................................................................2
Table 2  Understanding the cattle heat balance ............................................................................4
Table 3  AHLU Risk Matrix..........................................................................................................9
Table 4  Example - RAP risk profile summary .............................................................................12
Table 5  Interpretation of risk profile ..........................................................................................12
Table 6  Example Trigger Levels for monitoring points ...............................................................24
Table 7  Breathing condition and panting score (see Appendix B for visual guide)......................27
Table 8  Daily status levels ..........................................................................................................30

Figures

Figure 1  Basic requirements for an effective Heat Management Plan........................................1
Figure 2  Heat balance. If heat generated by the animal is not balanced by the environment’s ability to cool it then heat will be stored by the animal .................. 4
Figure 3  The energy balance of a steer .........................................................................................5
Figure 4  Relationship between HLI and HLI threshold ...............................................................7
Figure 5  Relationship between HLI and heat dissipation .............................................................8
Figure 6  Graphical representation of the AHLU over 3 consecutive days .....................................8
Figure 7  Factors combined to assess risk of a heat event in feedlot cattle .....................................9
Figure 8  Flow chart for Risk Assessment Process ......................................................................11
Figure 9  Characteristics of pens with low and high risk of heat load .........................................14
Figure 10 Three areas for daily monitoring ..................................................................................23
Figure 11 HLI Threshold Calculator - Available on CHLT ..........................................................28
Figure 12 Example of heat load status levels ...............................................................................29
1. INTRODUCTION

Proper management of feedlot cattle during the summer months can result in optimised production, better conditions for animal welfare and significantly reduce mortality risk. A Heat Management Plan is essential to effective management of feedlot cattle and should be used to guide your daily activities during the summer months. A sound understanding of the factors that influence heat gain in cattle and their ability to dissipate heat is also important.

This workbook was prepared as a supporting document to the series of workshops conducted by the Australian Lot Feeders’ Association (ALFA) and Meat & Livestock Australia (MLA). Titled “Managing Summer Heat”, the workshops were delivered prior to the 2014 summer. The aim of the workbook is to be an easy to read “go to” document for current best practice for managing heat in feedlots. It is written to cover the five steps required for an effective Heat Management Plan.

1. Preparedness (Pre-summer activities, understanding your basic risk)
2. Daily monitoring (What to monitor and defining your daily Status level)
3. Event warnings (How to be informed)
4. Mitigation actions (Your actions depending on your daily Status)
5. Review (How to keep your Heat Management Plan up to date)

Figure 1 Basic requirements for an effective Heat Management Plan

It is important that management of heat in feedlots be proactive rather than reactive. Developing and implementing an effective Heat Management Plan specific to your feedlot that includes daily check lists, defined triggers and clear response actions will go a long way to minimising your risk.
2. PREPAREDNESS

Pre-summer review - be prepared

A pre-summer review of each feedlot’s site, design, infrastructure and management can provide a wealth of information to identify at-risk regions and lots; determine the adequacy of facilities such as shade, sprinklers and watering troughs; identify high and low risk pens; and prepare management plans to guide activities during the summer months. A review should be conducted to assess the preparedness and adequacy of site infrastructure and management strategies prior to the summer season.

A pre-summer check list has been prepared to help identify what needs to be done before the summer heat hits. This should be reviewed in September each year to allow time to complete preparatory actions and measures to reduce your risk of a heat event before the warmer months arrive.

2.1 Pre-summer checklist

The following table presents a list of what you should consider in your pre summer checklist. It also shows where to go for help, and provides a check list you can print off and use: http://chlt.katestone.com.au/toolbox/ or see Appendix A.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Pre-summer checklist</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activity</strong></td>
<td><strong>Where to go for more information</strong></td>
</tr>
</tbody>
</table>
| Conduct a site risk assessment using the RAP | How to conduct a site risk assessment using the RAP. See Section 2.2.4  
| Ensure risk is acceptable. If not, identify mitigations (and conduct required actions: e.g. install or repair shade/ change cattle type to heat tolerant breeds) | How to interpret your risk using the RAP. See Section 2.2.5  
How do I reduce my risk of a heat event? See Section 2.2.6
| Identify high risk cattle and high risk areas within the feedlot | What makes cattle high risk and what are high risk areas within the feedlot? See Section 2.2.7
| Register for a site specific forecast on Cattle Heat Load Toolbox (CHLT). If already registered, logon and familiarise yourself with the web site again and check your alert settings. | What is the Cattle Heat Load Toolbox (CHLT) and how do I register? See Section 2.2.8  
How can I get weather warnings? See Section 2.2.9
| Connect your Automatic Weather Station (AWS) to the Heat Load Data Network (HLDN). | What is the HLDN and how do I get my AWS connected? See Section 2.2.10  
Minimum requirements for weather stations and where to put them. See Section 2.2.11
### 2.2 Understanding the basics

All animals have a need to maintain core body temperature within a small range so that body cells and tissues can function optimally. For humans the range is 36.5 to 37.5°C, for cattle it’s in the range of 37.9 – 40.2°C depending on the cattle breed/genotype. This range needs to be maintained even when additional heat is added to the system. For feedlot cattle the major source of heat into the system is from the conversion of food into energy (called metabolic heat). This source of heat is generated in the core of the body and therefore any excess energy needs to be dissipated to the surrounding environment. A problem occurs when the environment’s ability to cool the animal is not enough to keep up with the internal heat generation (Figure 2). In this situation an animal will start to store heat.

---

<table>
<thead>
<tr>
<th>Service equipment</th>
<th>What equipment needs to be serviced and when? See Section 2.2.12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check pen conditions and undertake maintenance (manure, water troughs)</td>
<td>What makes cattle high risk and what are high risk areas within the feedlot? See Section 2.2.7</td>
</tr>
<tr>
<td>Update staff training register</td>
<td>What staff training should I undertake? See Section 2.2.14</td>
</tr>
<tr>
<td>Update contingency plans and emergency contacts</td>
<td>What should I include in my contingency plans? See Section 2.2.13</td>
</tr>
<tr>
<td>Consult with a nutritionist regarding summer feeding strategy</td>
<td>What is a heat load ration and heat management feeding strategy? See Section 2.2.15</td>
</tr>
<tr>
<td>Confirm location of mass burial site</td>
<td>What do I need for a mass burial site? See Section 2.2.16</td>
</tr>
<tr>
<td>Update Heat Management Plan</td>
<td>What should I do to review my Heat Management Plan? See Section 6.1</td>
</tr>
</tbody>
</table>

**Proactive management of heat load in cattle can result in improved feedlot productivity.** If an animal’s core body temperature is above normal the animal’s natural response is to reduce feed intake to reduce the amount of heat generated internally. This will lead to production losses and has been shown to result in cost of $10 - $30 per head over a 3 month period. Severe or prolonged elevations in body temperature during extreme weather conditions can result in tissue and organ damage and in some instances the loss of large numbers of cattle.
Figure 2  Heat balance. If heat generated by the animal is not balanced by the environment's ability to cool it then heat will be stored by the animal.

It is important to understand the basic heat balance for cattle to allow appropriate mitigation strategies to be put in place. The mechanisms associated with heat gain and loss in cattle is summarised in Table 2 and illustrated in Figure 3.

Table 2  Understanding the cattle heat balance

<table>
<thead>
<tr>
<th>Heat into system</th>
<th>Heat out of system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic (can be up to 70% of heat load into the system)</td>
<td>Conduction through contact with cool surfaces (only very minor unless cattle are lying down)</td>
</tr>
<tr>
<td>Radiation (direct sun and also reflective surfaces)</td>
<td>Air movement (convection) (either forced or natural) takes hot air away from the body surface</td>
</tr>
<tr>
<td>The air (if ambient temperature is greater than skin temperature, heat will transfer from the air to the body)</td>
<td>Radiation (only at night, and optimised if clear sky as opposed to cloudy)</td>
</tr>
<tr>
<td>Conduction through contact with hot surfaces (only very minor unless cattle are lying down)</td>
<td>Evaporation of moisture through sweating or panting</td>
</tr>
</tbody>
</table>

If heat into the system is greater than heat out of the system then heat will be stored. This is called a heat load.

Evaporation is the major mechanism cattle use to dissipate heat. When the air is humid the ability for the air to evaporate is limited. Therefore cattle are more likely to gain heat if the conditions are humid.
2.2.1 What is the HLI and how is it calculated?

The basic weather information required to determine the capacity of the environment to cool cattle consists of:

- radiative temperature (combination of temperature and radiation called Black Globe Temperature, BGT)
- air movement (wind speed)
- a measure of the moisture in the air (humidity)

\[
\text{BGT} + \text{Wind} + \text{RH} = \text{HLI}
\]

The Heat Load Index (HLI) is an index that brings together all these weather factors into one number to allow easy interpretation of the cooling capacity of the environment. The HLI has been developed in Australia based on more than 10 years of targeted research investigating and assessing heat events in the context of Australian feedlot conditions.
The HLI is calculated from measurements of BGT (°C), relative humidity (%) and wind speed (m/s) using a simple relationship (the detailed equations are available on CHLT). A tool is available on the CHLT to calculate a HLI from the available input parameters.

The HLI is an index and therefore has no units. The HLI has a minimum value of 50 and can reach as high as 130 in very hot, humid and calm conditions.

For the most part, the HLI on its own does not indicate the likelihood of heat stress in feedlot cattle. This is achieved by calculation of the Accumulated Heat Load Unit (AHLU). The only time when heat stress may be indicated by the HLI alone is when there is a rapid change in the HLI over a short period of time. This is discussed in more detail in Section 4.
2.2.2 What is the AHLU and how is it calculated?

The AHLU is a measure of the amount of heat that may be stored in lotfed cattle. The AHLU is calculated every hour using the HLI for that hour and the HLI threshold. The HLI threshold is the level at which cattle will begin to accumulate heat. For every hour that the HLI is above the HLI threshold, heat will be stored in lotfed cattle and will progressively increase without intervention if the conditions remain the same.

In simple terms for every one hour period that the HLI>HLI threshold, heat load increases (shown by red areas in Figure 4) at a rate that is equal to the difference between HLI and the HLI threshold. Note that AHLU86 refers to the AHLU where HLI threshold=86.

When HLI threshold = 86 and HLI = 87, heat load accumulates at a rate of 1 AHLU/hr

The HLI threshold is important to understand as it tells you at what point your cattle may start accumulating heat. The HLI threshold will change for individual cattle as they go through the feeding period. To understand how the HLI threshold changes use the HLI Threshold Calculator (available on CHLT).

Heat will only begin to dissipate when the HLI decreases to below the lower threshold (current research indicates that this threshold is 77 for most breeds, but may be higher for Bos indicus). This is indicated by the areas in blue in Figure 5.

![Figure 4](image-url)

**Figure 4** Relationship between HLI and HLI threshold
Understanding the concept of AHLU will enable better management of heat in feedlot cattle because undertaking activities when the environment is cooler may not necessarily mean the cattle have a lower heat load. Figure 6 illustrates the relationship between HLI (Green line) and the AHLU (Red line) over a three day period (each red bar represents a one hour period). The high HLI on day 1 and minimal recovery time overnight means that the heat load on day 2 is actually higher than on day 1, even though the HLI is lower.
2.2.3 How to quantify the heat load risk and relationship with HLI/AHLU

The overall risk of a heat event occurring is a combination of three factors; animal, environment and weather. See Figure 7.

The interaction and change of these three factors (some on an hourly basis) influence the overall risk of a heat event. To quantify the risk you need to determine the HLI threshold for your site and type of cattle (use the HLI Threshold calculator), determine the hourly HLI from either measurements (or the forecast) and then combine these together to determine your AHLU.

**Figure 7  Factors combined to assess risk of a heat event in feedlot cattle**

Once you have calculated your AHLU you can then assess the risk using the AHLU Risk Matrix (Table 3). Note that the cattle will also tell you if they are carrying any heat through panting. Cattle indications comparable to AHLU risk levels are also included in the AHLU Risk Matrix. See Section 3.3.1 to understand how to assess heat load from cattle observations.

**Table 3  AHLU Risk Matrix**

<table>
<thead>
<tr>
<th>AHLU</th>
<th>Cattle indications</th>
<th>Heat load indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No load</td>
<td>Negligible</td>
</tr>
<tr>
<td>1-20</td>
<td>No load or panting score 1</td>
<td>Low risk</td>
</tr>
<tr>
<td>21-50</td>
<td>Panting score 1-2</td>
<td>Medium risk</td>
</tr>
<tr>
<td>51-100</td>
<td>Panting score 2-4</td>
<td>High risk</td>
</tr>
<tr>
<td>Over 100</td>
<td>Panting score 4</td>
<td>Extreme risk</td>
</tr>
</tbody>
</table>
2.2.4 How to conduct a site risk assessment using the RAP

The ability of cattle to tolerate heat load varies depending on factors such as cattle breed, health status, coat colour, degree of finish, and pen conditions (i.e. whether the pen is shaded or unshaded and the manure management practices employed). The Risk Analysis Program (RAP) has been developed to provide a simple method of determining the HLI thresholds and associated risk profiles applicable to your operation, the type of cattle you have and your local climate. The RAP can be accessed through the CHLT website (http://chlt.katestone.com.au/toolbox/).

Figure 8 presents a simple flow chart to help you navigate the RAP process. The first step in determining your HLI thresholds and associated risk profiles is to enter the characteristics of the pen or pens you are interested in.

HLI thresholds should generally be calculated at a pen level to be most representative. Therefore, you may need to use the RAP multiple times to assess your entire feedlot. Record the information in your Heat Management Plan (an example RAP log template is available on CHLT, http://chlt.katestone.com.au/toolbox/).

**HEALTH STATUS CONSIDERATION:** As indicated, the HLI threshold is dependent on the ‘health status’ of the cattle under consideration. Given that for each pen of cattle there will always be some that may be either sick, recovering or unacclimatised, it is recommended that the HLI threshold be calculated on this basis as both a conservative approach and for comparative purposes. Selecting the ‘health status’ of ‘Sick, recovering or unacclimatised’ reduces the HLI threshold by 5. If cattle are both sick and unacclimatised, then this threshold may be reduced by up to 10 units.

Once you have assessed all your cattle you then need to determine the highest risk cattle. These will be the cattle with the lowest HLI threshold. These should be noted in your Heat Management Plan and you may also wish to set up your heat alerts for the highest risk cattle (via the CHLT). See Section 2.2.9 for more information on how to set up your alerts.

The HLI thresholds for your operation provide the reference point for interpreting AHLU forecasts relevant to your site. For example the AHLU80 forecast refers to the AHLU where the HLI threshold = 80. Forecasts are provided for AHLU80, AHLU83, AHLU86, AHLU89, AHLU92 and AHLU95. Where your HLI threshold falls between to AHLU reference points you need to either estimate the AHLU or, for a conservative approach, refer to the AHLU for the HLI threshold that is closest to, but less than, the calculated HLI threshold.
Figure 8  Flow chart for Risk Assessment Process
2.2.5 How to interpret your risk using the RAP

Table 4 is an example of the risk profile generated by the RAP. The columns are, from left to right, the duration of the event, the probability of observing a high risk event and the probability of observing an extreme risk event.

The results consist of probabilities of specific types of heat events occurring. The events are classified firstly by the intensity of the event (high or extreme) and secondly by the duration of that event. The intensity is categorised as high risk (daily maximum AHLU is between 50 and 100) or extreme risk (daily maximum AHLU exceeds 100). The duration is the number of consecutive days that the AHLU maintains the specified intensity. These are classified as events of 2 day duration, 3 day duration, etc. All events exceeding a duration of 7 days are combined into a ’7 or more days’ category. It should be noted that events are counted on an individual basis and do not overlap. That means that a 4 day event is not also counted as two 2 day events.

Table 4 Example - RAP risk profile summary

<table>
<thead>
<tr>
<th>Event duration (days)</th>
<th>High-event frequency</th>
<th>Extreme-event frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 days</td>
<td>1-2 events in 2 years</td>
<td>Less than 1 event in 6 years</td>
</tr>
<tr>
<td>3 days</td>
<td>1-2 events in 7 years</td>
<td>1-2 events in 7 years</td>
</tr>
<tr>
<td>4 days</td>
<td>Less than 1 event in 6 years</td>
<td>1-2 events in 4 years</td>
</tr>
<tr>
<td>5 days</td>
<td>1-2 events in 3 years</td>
<td>Less than 1 event in 6 years</td>
</tr>
<tr>
<td>6 days</td>
<td>1-2 events in 4 years</td>
<td>Less than 1 event in 6 years</td>
</tr>
<tr>
<td>7 or more days</td>
<td>1-2 events in 2 years</td>
<td>1-2 events in 2 years</td>
</tr>
</tbody>
</table>

So what does that all mean? To count the total number of events that are likely to occur over a period you need to add the events together. This is easier done by assuming a 10 year period and then counting how many events of each type are possible (rounded to the nearest number). The Risk Profile presented in Table 4 is reworked in Table 5 to determine the annual risk of an event. Please note that the RAP is going to be changing over the next year to make this process easier.

Table 5 Interpretation of risk profile

<table>
<thead>
<tr>
<th>Event duration (days)</th>
<th>Number of HIGH events in a 10 year period</th>
<th>Number of EXTREME events in a 10 year period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>7 or more</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>36</td>
</tr>
</tbody>
</table>

Generally it is up to you to determine what is an acceptable risk. However, we recommend that mitigation measures are taken to reduce your risk of an extreme event to less than one event per year.
2.2.6 How do I reduce my risk of a heat event?

There are many things you can do to reduce your risk of a heat event occurring. Understanding your risk from the RAP is a good start and provides a method to determine what measures need to be in place for your site. For example, if the RAP indicates an annual risk of more than 2 extreme events you may decide to reduce your risk by installing shade or alternatively not run high risk cattle genotypes at your feedlot during the summer months.

Preparing a Heat Management Plan and training your staff to identify the early signs of cattle experiencing heat stress can also reduce your risk of an event occurring. Monitoring the weather and using the Daily Monitoring Tool (available on CHLT, http://chlt.katestone.com.au/toolbox/) to keep track of conditions during the summer will also reduce your risk.

2.2.7 What makes cattle high risk and what are high risk areas within the feedlot?

**HIGH RISK CATTLE**

The groups of cattle most vulnerable to heat are:

- heavily finished cattle approaching market specifications (fat score 4.5 – 5);
- newly received cattle (including respiratory virus challenged starter cattle); and
- hospitalised cattle, particularly those suffering from respiratory illness.

*Bos taurus* breeds (e.g. Angus, Shorthorn, Hereford) of cattle are more susceptible to heat than *Bos indicus*, (e.g. Brahman) while black animals are more vulnerable compared to lighter coloured animals.

Vulnerable animals may be assisted by allocating them to pens which provide maximum cooling effects such as pens with shade, sprinklers, multiple water troughs and maximum natural air movement.

**HIGH RISK AREAS IN FEEDLOT**

A review of the feedlot will usually identify individual pens that are higher risk. Knowledge of individual pen risk can be used to advantage to improve the care of the most vulnerable animals to best effect.

Characteristics of high risk pens:

- **reduced airflow areas** - location of pens within the feedlot, (e.g. centre versus edge), obstructions to airflow of individual pens such as buildings, natural structures and crops
- **wet pens** - Pens may have a differing ability to dry out due to factors such as aspect, presence of shade structures, overflow from water troughs and pad depth. Wet pads have a darker surface, absorb more solar radiation and become hotter than dry pads, which are a light brown to grey colour. Wet pads can also increase the humidity within the pen, reducing the ability of cattle to cool their bodies by evaporative cooling.
- **pens with high stocking rate per area** - pens with more cattle in them are at higher risk as the cattle radiate heat and obstruct airflow, and compete for shade if provided. Pens that have stocking rates such that cattle have less than 11m²/hd available in the general home pen, and/or less than 1.5m²/hd shade (if provided), are increasing their heat load risk.
- **dirty pens** - pens with deep manure greater than 50mm (as measured above the soil/manure interface layer). It is recommended that manure not be allowed to exceed an average depth of 50mm under any circumstances during the summer period, remembering that a depth of 50mm of dry, compact manure
can store about 140mm of water in what will become more than 150mm of wet manure. Note also the effect of physical exertion to move through muddy pens will add heat load risk to cattle

- **restricted water supply** – feeders have less than 75 mm (3")/hd water trough access space in their home pen and re-fill of troughs is slow (gravity fill and/or low pressure pumps)

Characteristics of **low risk pens** are essentially opposite features to the above for high risk pens and may consist of the following:

- **shade** - determine if shade is installed and correctly maintained or requires fixing and, if so, it’s likely effectiveness in assisting vulnerable animals. For further information on the design and management of shade structures for feedlots refer to FL12: Feedlot shade structures.

- **adequate, reliable water** - assess water quality, adequacy and efficiency. This will include trough numbers, length, supply capability, location, backup supply and distribution and wastewater controls.

- **clean pens** - pens regularly cleaned to NFAS requirement to remove excess manure. Pens with low manure loads will have a lower risk of contributing to cattle accumulating heat.

- **sprinklers** - during a heat event when the humidity is low (less than 20% RH over a 24 hour average), sprinklers can cool the cattle during an event.

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**Figure 9**  **Characteristics of pens with low and high risk of heat load**
2.2.8 What is the Cattle Heat Load Toolbox (CHLT) and how do I register?

The Cattle Heat Load Toolbox, otherwise known as CHLT, is a purpose web-built system designed to assist the Australian feedlot industry to manage cattle heat stress by providing feedlot operators with the tools they need to assess, monitor and manage the exposure of lotfed cattle to a heat load event. Operated by Katestone Environmental, CHLT currently provides weather and heat load forecasts for any location in Australia. Location-specific weather predictions are run twice daily to produce hourly forecasts for a 7 day outlook.

CHLT is designed for proactive management of heat load in cattle by providing location specific weather and heat load forecasts for any feedlot across Australia. It provides a practical approach to predicting a heat load event, allowing the opportunity to implement practical management strategies in advance to better manage health and welfare of lotfed cattle.

Location specific weather forecasts are only available to registered users of the CHLT.

To register a site with the CHLT, the following details are required:

- NFAS accreditation number
- Site name
- Name
- Email address
- (Optional) Mobile number

Site registration is free and only takes a few minutes. By registering your feedlot you will receive:

- Twice daily, seven-day forecasts of maximum heat load, accumulated heat load and weather specific to your location. This is of particular benefit to feedlots that are some distance from the closest major town, as the meteorological parameters that influence the HLI and the AHLU forecasts can vary significantly over relatively short distances.
- Optional automated alert system to warn you of up-coming high heat load events by SMS or email.
- The option to up-load and view meteorological data and calculated HLI and AHLUs from your own weather station through the Heat Load Data Network (HLDN).

After filling out the registration form, your information will be added to CHLT’s secure forecast database and your site location added to the weather model. This may take 24 to 48 hours, longer if the request is sent over a weekend or public holiday. You will then be emailed a username and password. Once you have received these, you can login to the registered users’ part of the website, where you can view your site specific heat load and weather forecasts information and full access to the other tools in the toolbox.

The first person to register a site is the default nominated CHLT site administrator. CHLT site administrators are able to view, add, update, and delete contact details and alert preferences of subscribers registered to the site.

Advantages of registering for CHLT

1. **Receive site specific forecasts** (site summary page and access to detailed hourly forecast)
2. **Receive heat event warnings through your site alerts** (sms or e-mail) and issued heat advisories
3. **Sign up your veterinarian or nutritionist** to receive heat event warnings for your site
4. **Get your site weather station connected** to view your data online and integrate it into your forecast
5. **Get access to various tools and documents** (RAP, Daily Monitoring Tool, check lists and lots more
6. **Be kept informed of any changes and latest best practice** for managing heat in lotfed cattle

December 2014
Managing Summer Heat
Page 15
2.2.9 How can I get weather warnings?

Alerts (or weather warnings) can be set up for you, plus your veterinarian and nutritionist, to notify of impending poor heat load conditions. Alerts are only available to registered users. The alerts are simple to set up and only require an e-mail address or mobile phone number. The alerts are set up via the CHLT (http://chlt.katestone.com.au/account/manage-alerts/).

The alerts are sent out every morning and review the forecast conditions for the next seven days.

Before you set up your alerts you need to understand which alert level to set. These are based on the AHLU and the HLI threshold that is important for your site. Once you have assessed all your cattle in your pre-summer check (using the RAP), and determined the highest risk cattle (these will be the cattle with the lowest HLI threshold), you can select alerts for the AHLU level appropriate for your site. Note that if your conditions change through the summer you should think about checking that you have your alerts set on the correct level.

2.2.10 What is the HLDN and how do I get my AWS connected?

Katestone and MLA are building the Heat Load Data Network (HLDN) to allow you to integrate your site AWS data into your forecast. By registering with CHLT and requesting to be part of the HLDN, Katestone will work with you to have your onsite data automatically sent to their High Performance Computing Facility for initialisation of your site specific forecast. Once you have been set up in the HLDN, data uploaded from your AWS will be used to refine the forecasts in your site specific display on the CHLT. In addition to providing more accurate site weather forecasts, members of the HLDN can also access their AWS data via a secure webpage located on the CHLT.

The benefits of being part of the HLDN are:

- Access to your data online: Once your site is connected to the data network you will be able to view your site’s AWS data via a secure web page.
- More accurate forecasts: When each new forecast is issued (6am and 6pm), the AHLU’s will be initialised from the actual measurements from your site, therefore providing a more accurate forecast for your site.
- QA of your AWS: To ensure the equations being used to calculate the HLI and AHLUs (and BGT if required) are correct they will be reviewed to ensure the most up to date algorithms are being used and are programmed correctly.

Participation in the HLDN is optional. There is no fee associated with the service and limited funding is available from MLA if upgrades to your site AWS are needed.

2.2.11 Minimum requirements for weather stations and where to put them

The sensors listed below are required to calculate HLI and AHLU. These sensors should be mounted approximately 2m above the surface.

- Black Globe Temperature (BGT) or solar radiation and free air / dry bulb temperature
- Wind speed
- Relative humidity or wet bulb temperature

The above parameters need to be logged with an interval of no longer than 1 hour.

Calculation of the HLI (and AHLUs) within the data logger is an advantage as immediate information will be available to assess the heat load situation.
The weather station should be sited so the variables measured are representative of the general surrounds. Subtle variations in the environment may mean that the data are not representative. For example, a tree shadow falling across a BGT sensor will result in HLI and AHLU values that are lower than they should be for as long as that shadow is on the sensor.

Weather stations operated by the Australian Bureau of Meteorology have strict siting requirements and have to meet an Australian Standard (AS 3580.14). The siting requirements from the Australian Standard for wind, temperature, relative humidity and solar radiation are summarised below.

**Wind sensors:**
- measurements at a height of 10m over a flat open area clear of obstructions
- to be clear of obstructions, this means there should be a distance of at least 10 times the height of the obstruction for wind sensors

**Temperature and relative humidity:**
- mounted over a plot of open level ground at least 9m in diameter free of obstructions, and freely exposed to sunshine and wind
- to be clear of obstructions, this means a distance of at least four times the obstruction height
- located at least 30m from large paved areas and not close to hollows or ridges or other changes in terrain
- area should ideally be unwatered short grass, or natural earth (not concrete)
- should not be located close to artificial or natural sources of moisture
- measurements at 2m or higher above ground

**Solar radiation and black globe temperature:**
- an upward-looking solar radiation sensor should be free from any obstructions above the sensor
- no shadows should be cast on the sensor
- should be located away from light-coloured walls or other objects likely to reflect sunlight

It is sometimes not practical to meet these standards at a particular location. In these instances, the station should ideally be located:
- on a flat cleared area - either a grassy surface, or one that is similar to the feedlot
- clear from obstructions such as buildings and trees (a rule of thumb would be to locate the weather station ten times the height of the obstruction away)
- The station should not be:
  - in a gully or other depression
  - on a geological formation such as a rock outcrop
  - on or near steep slopes, cliffs, or ridges
  - on a veranda or under an awning
- If there is a solar panel, this should face north.

As an indication the purchase cost of a weather station that meets the above minimum requirements will be in the order of $2,000 to $9,000 depending on the quality of sensors, accuracy and additional features.
NEED MORE INFORMATION?

Katestone Environmental undertook an MLA funded review of available weather stations in November 2013. The aim of the review was to provide feedlot managers with one document that details suitable weather stations to meet the requirements of monitoring heat load at a site. The review covered the full range of stations and identifies units that, as a minimum, meet the accreditation requirements. The review also looked at and ranked suitable stations for functionality, durability, maintenance requirements and operating costs to determine units that provided the best value for money. A copy of the report can be downloaded from the MLA website or the CHLT (http://chlt.katestone.com.au/toolbox).

2.2.12 What equipment needs to be serviced and when?

Make sure all equipment that is essential to your feedlot heat load management practices are inspected and if needed, serviced before the summer. This may include:

- Weather station as described below: per supplier recommendations – completed by September
- Internet connectivity and computer hardware – completed by September
- Mechanised equipment for pen cleaning, carcass removal and earth moving for burial pit, water trough deployment and transport / deployment of special pen bedding or water delivery system for pen wetting – completed by October
- Water pumps – November
- Sprinkler system – November
- Emergency power generators – October

WEATHER STATION

In general equipment service should be based on supplier recommendations. Maintenance requirements vary significantly depending on the AWS configuration and technology used to measure key parameters.

Basic maintenance for all AWS is regular inspection and keeping the components clean and free of dust and spider webs. Battery life can be prolonged by regularly inspecting and keeping the solar panel clean. Some sensors require regular recalibration. Most sensors need to be replaced periodically, every 2-5 years. In the majority of cases sensor replacement can be undertaken by the operator.

The recommended maintenance schedule is unique to the AWS selected. The ability of the supplier to rapidly dispatch replacement sensors to your location should also be discussed as part of your AWS selection process and Heat Management Plan.
2.2.13 What should I include in my contingency plans?

A contingency plan is a document that details what to do in an emergency. This could be an emergency during a cyclone, bush fire or flood. Contingency plans details the actions to be taken in situation such as what to do if the site loses power including potential impact on water supply. It should include emergency contacts. Important components of the contingency plans are summarised below.

- **Weather monitoring:**
  - Alternative internet access (eg 4G dongle) to weather sites such as CHLT, BOM etc
  - Neighbours and/or nearest feedlot weather data and AHLU monitoring

- **Portable water:**
  - Source of portable vessels / troughs off-site that can be accessed at short notice
  - Alternate water source if site water is compromised (e.g. local council)

- **Mechanised equipment / vehicles:**
  - Neighbours, nearest feedlot, contractors, local council earthmoving equipment, etc.

- **Veterinarians / nutritionists:**
  - Contact details of alternative consultants if required at short notice

Specifically you should review your Heat Management Plan and determine if there are any areas that may cause additional risk during an emergency.

**Remember** - Significant cattle losses have been experienced following the passage of significant rain events. If you can't access the CHLT to determine if a heat event is imminent, be safe and assume there might be. This may mean feeding heat load rations until you are sure there is no heat event likely. Note that cattle observations will guide this discretionary action.

**TIP:** Keep a close eye on the cattle. They are the ultimate heat load indicator!
2.2.14 What staff training should I undertake?

It is important that all employees, staff members and management have an appreciation of the strategies in place to reduce the occurrence of heat events as well as recognise the warning signs and steps to be taken during a heat event. Being unaware of requirements can worsen a potential heat event. Pen riders and feed truck drivers need to have appropriate training to detect animals that may be approaching or carrying a high heat load by monitoring their behavioural and physiological changes such as bunching activity and panting. Feedback from the pens to management is an essential link.

Your Heat Management Plan should include a training register to keep track of all your staff and what training they have done to understand management of heat at a feedlot. This could include as a minimum:

- Review and understand the site Heat Management Plan
- Review and understand the Daily Monitoring Tool and how to use it

### Heat affects people too:
During extreme weather conditions, staff are also susceptible to heat stress if they don’t take precautions. Some points to consider:

- **Hydration** - regular water should be consumed as a minimum (500 ml per 30 minutes). This may mean that pen riders carry water on their bodies
- **Cool area for rest** - regular breaks in a cool area will allow the core body temperature to recover. In extreme cases air conditioning may be required
- **Buddy system** - It is often hard to identify the signs of heat exhaustion by yourself. A buddy

2.2.15 What is a heat load ration and heat management feeding strategy?

Metabolic heat produced during digestion and metabolism of food is the primary source of body heat load in cattle. The proactive management of cattle nutrition and diet during hot weather conditions can help to reduce the impacts of heat events and its effects on production and mortality. There are two main components to summer nutrition programs:

- A routine seasonal review of diets and feeding practices in order to achieve optimum summer productivity whilst minimising animal heat load to reduce the incidence of heat load; and
- Preparation of a heat load event feeding strategy that can be implemented just prior to, or during, an event to try to reduce the impact of the adverse conditions.

**Cattle dietary management during heat load event conditions**

While remaining somewhat globally controversial, there is published literature as well as significant opinion and field experience on the value to intensive livestock facilities in the utilisation of nutrition to assist in management of livestock health and welfare when exposed to heat loading conditions.

Principles of managing heat load through dietary management include:

1. Reduce heat increments of production
2. Maintain gastrointestinal mobility and total dry matter intake
3. Manage cellular dehydration and prevent/minimise impact of tissue hypoxia and metabolic acidosis
4. Protect against increased antioxidant demand
Mechanisms for accomplishing these objectives are varied, but in general encompass:

a. 24 – 48 hours before a heat load event changing to an heat load ration, either partially (i.e., part of daily feed allowance) or completely, and then holding this ration in place for a period 48-hrs after the heat load event to assure dry matter intake and acute gut inflammation is settled prior to transitioning back onto normal finisher rations.

b. Heat load rations can be constructed using the following criteria:
   - Increase inert roughage inclusion to maintain cattle rumination and stimulation of rumen papillae
   - Increase dietary lipid (fat and oil) content, reduce dietary grain inclusion, to reduce digestive heat increments
   - Increase supplement concentration to increase antioxidant (vitamin and mineral) and ionophore (enhanced rumen fermentation stability)

c. Increase dietary potassium concentration. This can be accomplished via increasing potassium chloride inclusions in supplements during summer, addition of potassium chloride to water troughs (although care must be taken to assure toxicity is not induced) and/or increasing molasses inclusion in diets during and around periods of heat load

d. Another methodology (less commonly utilised) includes reducing heat load by reducing total feed availability during period entering heat load. During this procedure, removing 20% of daily feed allocation prior to the heat event and holding off this feed volume, until 24 – 48 hrs after. During the recovery period, feed can only be re-introduced at a steady rate to facilitate rumen microbial population adaption, and prevent inducement of metabolic acidosis.

A more detailed investigation of summer feeding strategies is outlined in FL11: Summer feeding of feedlot cattle.

2.2.16 What do I need for a mass burial site?

Guidelines for location and requirements of a mass burial site can be found in the National Guidelines for Beef Cattle Feedlots in Australia and the National Beef Cattle Feedlot Environmental Code of Practice. Essentially, a mass burial site needs to be nominated as part of the Heat Management Plan and typically this is adjacent the normal carcass disposal site. In the event of needing to utilise the mass burial site, a minimum of 3 cubic metres per carcass is required, and, the relevant contact in the Environment Protection Authority should be notified.
3. DAILY MONITORING

The purpose of daily monitoring is to facilitate early recognition of a potential heat event and allows action to take place to reduce the impact or mitigate it all together. Activities around managing summer heat should not be confined to only those times when heat load conditions are being forecast or experienced. Managing summer heat should be viewed as a DAILY activity in summer no matter what the conditions of the day. A feedlot’s Heat Management Plan should include certain “proactive” components that get performed continually.

This chapter examines how the three related concepts of daily monitoring, triggers and status should form part of an effective Heat Management Plan.

Monitoring is central to adopting a proactive approach to heat load management and provides the basis for more informed decisions over the duration of a heat load event.

The behaviour of cattle ultimately tells the story, particularly within a heat load event. However, prior to the actual event, behavioural response may be subtle or nil depending on the nature of the event and the lead time. The routine daily monitoring of several critical control points is a useful discipline to implement at the feedlot to:

- ensure key forward looking “proactive” indicators of heat events are being reviewed daily so that further planning and mitigation actions can be implemented,
- provide supportive data that can be helpful in further defining what is being seen at a ground level in the pens to drive decisions and actions, and
- build an historic picture of what is normal, or not, at the feedlot with respect to heat; and hence establish at what HLI and AHLU levels negative impacts are normally seen, to enable improved proactive management in the future.

Daily monitoring should be performed first thing in the morning as close to sun-up as possible since any potential overnight cooling has occurred and the cattle are at minimum load. In the event that monitoring points toward heat load conditions, mitigation actions can begin to be implemented on a proactive basis.

3.1 What should I be monitoring?

Your daily monitoring needs to cover the three basic areas of cattle comfort and behaviour as illustrated in Figure 10.

1. Cattle observations (see Section 3.3 Cattle behaviour and Section 3.3.1 "How to undertake cattle observations and what to record"),
2. Current weather situation – pen environment and current accumulated heat load (See Section 3.4 "Why is it important to look at my weather station?")
3. Forecast weather situation – future forecast heat load

Some example useful monitoring points are provided below.

1. Percent of finisher phase cattle exhibiting panting score >2.5 at early am.
2. Average per head consumption change from yesterday actual to today’s feed call.
3. Pen floor moisture and manure levels.
4. Number hours overnight with AHLU at zero.
5. Forecast maximum AHLU for today.
6. Forecast maximum AHLU for tomorrow.
7. Forecast maximum AHLU for the remainder of the week.
It is important that feedlots develop their own monitoring points. Available consulting veterinarian and nutritionist resources should be utilised for this.

**Figure 10** Three areas for daily monitoring

**Cattle observations**
What are the cattle saying?
- Are cattle panting?
- Is feed intake reduced?
- What are the cattle telling you? Recognise the early signs of heat stress.

**Onsite weather station data**
What's happening now?
- Are cattle carrying a heat load overnight?
- Have you had recent rain and are the pens wet?

**Weather forecast**
Is there an event coming?
- What can I expect to add to my current situation?
- Is it getting worse or better?
- What planning can I undertake now?
3.2 Triggers

The concept of “Triggers” goes hand in hand with the daily monitoring. It is useful to establish defined trigger levels for the various monitoring points as an instigator for further action or investigation at least.

Establishing trigger levels is normally difficult since heat load at a practical level is a variable science with many conflicting factors at play. To say that “this population of cattle shows negative effects of heat load when they get to 90 accumulated heat load units” may or may not be correct at a particular feedlot depending on the climatic, cattle and environmental variables at the time.

For the above reasons the concept of trigger levels should be implemented on a conservative basis. They should provide:

1. the impetus for further investigation and or preparedness actions prior to a heat load event, and
2. provide supportive information to behavioural observations in a heat load event to improve decision making.

Some example trigger points for the monitoring points identified earlier are provided below in Table 6.

It is important that feedlot operators set their own site and cattle type based trigger levels for their individual monitoring points. This is something best done in conjunction with consulting veterinarian and/or nutritionist help. Trigger levels should be reviewed at least annually and this process in itself is invaluable in establishing a deeper understanding of the broader heat load complex as it applies to any particular site.

Table 6 Example Trigger Levels for monitoring points

<table>
<thead>
<tr>
<th>Monitoring Point</th>
<th>Potential Trigger Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&gt;10% exhibiting &gt;2.5 panting score</td>
</tr>
<tr>
<td>2</td>
<td>&gt;10% fall yesterday actual to today call (forecast)</td>
</tr>
<tr>
<td>3</td>
<td>&gt;50mm deep &amp; wet</td>
</tr>
<tr>
<td>4</td>
<td>&lt; 6 hours</td>
</tr>
<tr>
<td>5</td>
<td>&gt;50</td>
</tr>
<tr>
<td>6</td>
<td>&gt;50</td>
</tr>
<tr>
<td>7</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>
3.3 Cattle behaviour

During hot weather, cattle often change their behaviour in an attempt to maintain acceptable comfort levels. These behaviour changes should be used together with panting scores to assess the level of heat load and the impact of heat load on the animals.

The following list shows some of the behavioural signs that may be seen in cattle as they are progressively exposed to heat load conditions. In most cases cattle will usually cope up to symptom 9. The onset of open-mouthed and laboured breathing (symptom 10) is an indication that the animal’s system is failing to cope with the hot conditions.

1. Body alignment with solar (sun) radiation.
2. Shade seeking.
3. Increased time spent standing.
4. Reduced dry matter intake (DMI).
5. Crowding over water trough.
7. Agitation and restlessness.
8. Reduced or absent rumination.
9. Bunching to seek shade from other cattle.

Cattle Coping

10. Open-mouth and laboured breathing.
11. Excessive salivation.
12. Staggering or inability to move.

Cattle NOT Coping

Feedlot cattle often crowd around water troughs when they are exposed to heat load. This is not necessarily an indicator of increased water intake. It is believed that cattle place their heads over water troughs in order to cool their heads, as water evaporating from the trough will lower the air temperature immediately above it. Cattle may also dunk their muzzles into the water without drinking in an attempt to shed body heat. During heat load conditions, cattle also have higher hydration requirements as a consequence of sustained periods of exertion due to panting and increased standing time. Crowding around troughs can cause problems as it restricts water access for less dominant or able animals.

3.3.1 How to undertake cattle observations and what to record

It is important to remember that cattle observations are key to recognising a heat event – they will tell you when they are getting hot by their appearance and behaviour.

A number of observations and measurements can be used to assess the impact of weather conditions on feedlot cattle. These include:

- Respiration rate and panting score;
- Cattle behaviour in the pen throughout the day and night; and
- Dry matter intake changes

Ideally, all cattle in the feedlot should be assessed. However, higher heat load risk cattle, as identified in your Heat Management Plan (Section 2.2.7), should be prioritised for assessment. For pen level observations to be indicative of the feedlot situation, at least 10% (and preferably more) of the pen population needs to be assessed.

Assessment needs to be undertaken a number of times daily during the summer period, and the frequency of observations during the day will need to increase before and during a predicted event.
Feedlot cattle dissipate existing heat load principally during the night (in the absence of high winds or cold fronts that may arrive during daylight hours as part of a weather change). Sometimes, this can be as late as after midnight and approaching dawn, and as such, clinical observations of cattle in receival, dispatch, home and hospital pens is particularly useful in the first sunlight hour after dawn to assess the presence of existing or increasing heat load. Backing up these observations with repeat assessment and comparison at 08:00 hrs is particularly useful to determine early morning heat load before the onset of peak heat conditions for the current day. **As example**, further observations could be conducted at 13:00 hrs, 17:00 hrs and dusk, particularly if heat load is starting to increase.

**Respiration rate and panting score:** Respiration rate and panting score are very useful indicators of heat load in cattle. They are closely associated with the known behavioural indicators of heat load as listed above. Panting score can be quickly assessed and recorded by sufficiently trained feedlot personnel.

A visual photo guide for panting scores has been developed as a result of MLA funded research and can be utilised when recording pen level pant scores (See Appendix B). Consistent with recommendations above on behaviour observations, a mean (average) pant score across more than 10% of the pen, and not just the worst or best individual, should be determined in order to be truly representative. Panting scores range from 0 (normal) to 4.5 (animal severely stressed) and are described in Table 7. Recent research suggests that an additional pant score of 1.5 could be utilised whereby cattle are observed to be fast panting, but do not yet display drooling or mouth foam.

It’s important to note that, consistent with heat dissipation that may occur in the hours preceding dawn as discussed above, panting scores and respiration may increase during this period and carry through to the post-dawn assessment. Therefore, the panting score recorded near 08:00 hrs is very useful as a comparison in order to get a more complete picture of heat load by cattle observations. Cattle with a panting score of 3.5 or greater are in danger of death if they do not receive some form of relief from the hot conditions. The transition from 2.5 to 4.5 can happen quickly (less than 2 hours) under extreme conditions.

A template for recording cattle observations and pant scores is provided in Appendix C. This can be used for each cattle population and should be documented in your Heat Management Plan.

**Suggested trigger:**

**More than 10% of cattle population exhibiting > 2.5 pant score** *(based on morning assessment conducted 1 hour after sun rise)* -
Table 7  Breathing condition and panting score (see Appendix B for visual guide)

<table>
<thead>
<tr>
<th>Breathing condition</th>
<th>Panting score (PS)</th>
<th>Associated Respiration Rates (breaths/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No panting – normal. Difficult to see chest movement</td>
<td>0</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Slight panting, mouth closed, no drool or foam. Easy to see chest movement</td>
<td>1</td>
<td>40 - 70</td>
</tr>
<tr>
<td>Fast panting, drool or foam present. No open mouth panting</td>
<td>2</td>
<td>70 - 120</td>
</tr>
<tr>
<td>As for 2 but with occasional open mouth, tongue not extended.</td>
<td>2.5</td>
<td>70 - 120</td>
</tr>
<tr>
<td>Open mouth + some drooling. Neck extended and head usually up.</td>
<td>3</td>
<td>120 - 160</td>
</tr>
<tr>
<td>As for 3 but with tongue out slightly &amp; occasionally fully extended for short periods.</td>
<td>3.5</td>
<td>120 - 160</td>
</tr>
<tr>
<td>Open mouth with tongue fully extended for prolonged periods + excessive drooling.</td>
<td>4</td>
<td>&lt; 160</td>
</tr>
<tr>
<td>As for 4 but head held down. Cattle “breath” from flank. Drooling may cease.</td>
<td>4.5</td>
<td>Variable ~ RR may decrease</td>
</tr>
</tbody>
</table>

3.4 Why is it important to look at my weather station?

Your onsite weather station is an important part of your daily monitoring plan as it can provide information on the level of heat load currently being carried by various types of cattle. The key to understanding the information from your weather station is knowing what HLI threshold to monitor. As detailed in Section 3.5 you can use the HLI Threshold Calculator to determine your HLI threshold.

WARNING - if your weather station is poorly located, not well maintained or does not record the parameters required to calculate the HLI then it may be unreliable. See Section 2.2.11 for more information about how to locate weather stations.

Suggested triggers:

Insufficient night-time recovery - AHLU needs to be at zero for six hours for cattle to fully dissipate heat load and recover from the previous event.

Recent rain event – can increase the relative humidity locally.
3.5 How and when to use the HLI Threshold Calculator

The HLI Threshold Calculator is a tool available on the CHLT. It appears on the right-hand side of any page where you may need to use it. It has been developed to take the guess work out of determining your HLI threshold. It is based on the same factors that are used in the RAP to understand your site risk. It can be used to determine your HLI threshold on a daily basis to allow you to:

- Interpret your forecast
- Understand your weather station data
- Determine which cattle are at high risk

Figure 11 HLI Threshold Calculator - Available on CHLT

TIP: Make sure you are looking at the correct AHLU – use the HLI Threshold Calculator daily to see what might have changed
3.6 Putting it all together - your daily monitoring plan and status levels

The concepts of monitoring points and trigger levels can be further extended into establishing a heat load “status” for a particular feedlot and/or any particular population of cattle in the feedlot.

As outlined prior, heat load is a multi factorial and variable complex. It is difficult to make decisions around any single monitoring point and trigger level apart from those that are purely based on cattle behaviour. For example, it is highly probable that action is required in the event that cattle are exhibiting panting scores of greater than 2.5 at 7am. However, it’s more difficult to make definitive decisions purely based on a high AHLU forecast for today without looking at other factors at play.

Individual monitoring points and trigger levels can be grouped together in such way to categorise the “status” of the feedlot in relation to heat load.

Status is a useful concept to help communicate the current heat load threat to staff and help drive the implementation of actions, particularly prior to a heat load event when behavioural responses are not present or in the early stages of developing.

Four status descriptions that would normally apply to a feedlot and/or cattle population on any particular day include; normal, possible, imminent and occurring (see Figure 12).

![Figure 12 Example of heat load status levels](image)

Identification of the particular events and/or conditions associated with feedlot heat load status should be determined by the feedlot operator with the help of veterinarian and nutritionist support. Daily monitoring points and their associated trigger levels should be included as part of determining the feedlots daily status.

An example of what triggers may define your status level is presented in Table 8 below. These triggers could be applied to help define where the feedlot is at (its status) in relation to heat load in addition to purely behavioural observations.
### Table 8  Daily status levels

<table>
<thead>
<tr>
<th>Status</th>
<th>Example triggers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>• Cattle displaying normal behaviour                                                                                          • Current weather indicates normal and manageable AHLU, cattle have shed heat during recent nights and will shed heat tonight, next few nights</td>
</tr>
<tr>
<td></td>
<td>• Forecast weather not hitting alert levels</td>
</tr>
<tr>
<td>Possible</td>
<td>• Forecast weather is hitting alert levels Day 3 - 7 (i.e. not today or tomorrow)</td>
</tr>
<tr>
<td>Imminent</td>
<td>• Cattle behaviour is consistent with heat load: early shade seeking, early water hugging.                                                                 • Consumption has dropped (&gt; 10% from yesterday), pant scores are &gt; 2.5 in &gt; 10% of cattle</td>
</tr>
<tr>
<td></td>
<td>• Current weather indicates AHLU has carried from previous day(s) – cattle have not shed heat last night; AHLU has not been zero (0) for more than 6 hours in last 24-36 hours</td>
</tr>
<tr>
<td></td>
<td>• Forecast weather is hitting alert levels for tomorrow (AHLU max &gt; trigger level)</td>
</tr>
<tr>
<td>Occurring</td>
<td>• Cattle behaviour is consistent with heat load</td>
</tr>
<tr>
<td></td>
<td>• Consumption has dropped (&gt; 10% from yesterday), pant scores are &gt; 2.5 in &gt; 10% of cattle (early am)</td>
</tr>
<tr>
<td></td>
<td>• Current weather indicates AHLU has carried from previous day(s) – cattle have not shed heat for last consecutive 48 hours: confirmation of heat load event occurring – confidence to enact high level mitigation or crisis actions</td>
</tr>
<tr>
<td></td>
<td>• Forecast weather is hitting alert levels today and tomorrow: confirmation of heat load event occurring – confidence to enact high level mitigation or crisis actions</td>
</tr>
</tbody>
</table>

**TIP: Daily monitoring and defining a status levels is a means of reducing the subjective nature of heat load management**

It's important to note that where daily monitoring and trigger levels are indicating imminent and occurring status it's expected that additional behavioural responses would be being observed in the cattle at ground level. At this point, monitoring, triggers and status should be utilised as a supportive tool in determining necessary actions alongside behavioural observations.

The use of routine daily monitoring and associated trigger levels to define status levels is a systematic technique that increases the rigour of heat load management. It’s a tool that can help reduce the subjective nature of heat load management and provide a more objective assessment to support what is being observed at a ground level. It’s a particularly effective tool to drive a proactive management approach prior to a heat load event. As a heat load event unfolds observation of cattle behaviour is ultimately the key component. However, monitoring, triggers and status remain relevant in the decision making and forward planning process.
3.7 **Daily monitoring tool**

A whole feedlot daily heat monitoring program incorporates the three major determinants of establishing heat status levels on the site – cattle observations, current weather data and weather forecasting. By extending the cattle observation recording as above to include the current weather station and weather forecasting data, a Daily Monitoring Tool can be developed.

An example template is presented in Appendix E. This can be used as a guide to help you determine your own site Daily Monitoring Tool. A template spreadsheet is also available to download from CHLT (www.CHLT.katestone.com.au/toolbox).

**TIP:** Feedlots should develop and implement their own site specific monitoring, triggers and status models with the help of consulting veterinarians and nutritionists to improve the rigour and effectiveness of heat load management at their site
4. EVENT WARNINGS

4.1 Types of heat events - what to look out for

INTENSITY EVENT

Feedlot cattle are highly vulnerable where there is a rapid onset (over 4 – 7 hours) of an extreme heat event where the HLI exceeds 100 units. Under these conditions cattle are highly vulnerable even where the AHLUs are not excessive (e.g. 25 – 50 units).

These types of events sometimes follow significant rain events such as cyclones when poor weather conditions are followed by hot, humid and still weather.

ACCUMULATED EVENT

Feedlot cattle are very susceptible where they don’t have the opportunity to dissipate their accumulated heat load during the night or have the opportunity to recover sufficiently, and enter the next day with a pre-existing heat load. This is reflected as a ramping up of AHLU over subsequent days.

REPEATED EVENT

There is also a time effect, (i.e. the number of consecutive days that cattle are exposed to AHLU in excess of 25, even where they receive night time relief). This appears to be a major determinant in terms of susceptibility to the effects of subsequent excessive heat load events.

4.2 CHLT Alerts – what they mean

Setting up your alerts at the beginning of the summer will help warn of an impending event if you are not looking at the forecast daily. However, the alerts will only work if you have set them up correctly. See Section 2.2.9 on how to correctly set up your alerts.

Once you have selected to receive alerts (for the AHLU selected) they will have the following form:

- **AHLU event today** - AHLU > 50 units for today
- **AHLU event tomorrow** - AHLU > 50 for tomorrow and AHLU = 0 for less than 6 hours
- **Extended AHLU event** - AHLU > 50 units for more than 3 consecutive days
- **Incomplete nighttime recovery** - AHLU = 0 for less than 6 hours for more than 3 consecutive days in 7 day forecast period
- **Rapid HLI change** - change in HLI > 40 units over 4 hours (Note: this alert is likely to change when more research becomes available)

REMEMBER - a forecast is only one tool to help you understand your risk but it can be helpful to warn of an impending situation.

**TIP:** If you are receiving too many or too few alerts you may want to reassess your HLI threshold and select a different AHLU level.
5. PRACTICAL MITIGATION ACTIONS

Practical mitigation actions exist for all heat status levels above “normal”. It is important to recognise, and identify in your Heat Management Plan, the actions that your site can practically and readily implement in the case of your heat status levels increasing towards an actual “occurring” event and also what deficiencies you may have in responding to a heat load event and rectifying these as part of the pre-summer and ongoing review process.

Note that depending on the type of heat load event being a cumulative / accumulated episode versus a repeated or intensity event – transition through the heat event status levels and the mitigation actions required can be accelerated or sudden and, as such, feedlot staff may need to move from a heightened state of readiness to affirmative action very quickly. Good pre-summer preparation and proactive staff training will ensure that staff can handle this requirement effectively and efficiently.

5.1 What options do I have at the separate status levels?

The following sections detail suggested actions that can be implemented at various heat load status levels to minimise the impact of an event. They are suggestions only and should be reviewed for your site depending on your circumstances. They should be clearly defined in your Heat Management Plan with a person responsible for each action.

5.1.1 Heat Load Status “POSSIBLE”

Actions at this status level can focus on preparation for a potential heat event. Activities such as identification of pens holding high risk cattle, scheduling of activities such as transportation of finished cattle, ensuring trained staff availability if additional cattle monitoring is required and any pen maintenance requirements. The following presents a list of potential actions:

- Modify livestock staff hours
- Ensure Daily Monitoring Tool is thoroughly completed in all sections – specifically longer range AHLU forecasts and panting scoring
- Delay dispatch / exit to cooler hours – be cognisant of heat load conditions at destination
- Delay new cattle arrivals to cooler hours and/or later days with $\text{AHLU}_{\text{max}}$ below trigger thresholds
- Complete induction / processing / re-implant / drafting and similar procedures before 8:00 am
- Complete pen riding and treatments and also pen moves before 9:00 am
- Ensure all water troughs are cleaned and re-charge reliably
- Notify consultant veterinarian and nutritionist, also group feedlot manager, if applicable, of “possible” heat status
- Liaise with consultant nutritionist re: implementation of heat ration
5.1.2 Heat Load Status ‘IMMINENT’

Actions at this status level can focus on risk reduction and preparation for an event. Activities such as extra water troughs in high risk pens and feed modifications. The following presents a list of potential actions:

- Modify livestock staff hours and notify cattle transporters that schedule will have to be modified
- Increase frequency of monitoring inspections to 2-3 hourly and ensure that all sections of the Daily Monitoring Tool are thoroughly completed
- Cease all daily internal and external cattle movements – move cattle to dispatch and load for exit only if AHLU = 0 for > 4-6 hours and only after this period has elapsed. Be cognisant of heat load conditions at destination. Receive new feeders only under the same conditions as safe exit and transfer immediately to home pen pre-dawn with no processing conducted
- Cancel scheduled cattle handling procedures such as processing, drafting, re-implant etc
- Pen ride only critical pens and complete treatments < 7:00 am
- Ensure all water troughs are clean and re-charge reliably; clean and re-charge troughs < 7:00 am
- Mobilise supplementary water troughs to be located at ends of lanes, turn-arounds and similar – if AHLU has not been = 0 for 24-36 hours, ready staff and equipment to deploy water troughs in high risk pens at dawn after the second night of no heat load dissipated. If supplementary water troughs are deployed – ensure that these troughs are spread throughout the pen so that cattle are not encouraged to “bunch” yet are still within easy access to re-fill as necessary. Water volumes required are up to 5 litres / hour for every 450 kg feedlot animal
- If available – utilise cattle sprinklers as outlined below on high risk cattle
- If resources available – utilise pen wetting of high risk pens: applying water to the feedlot pen surface pre-dawn or post-dusk reduces the pen surface soil temperature, and, increases thermal conductivity of the pen surface such that when cattle lie down they transmit (and dissipate) more heat to the soil. Ensure that pre-dawn and post-dusk relative humidity is < 20% when applying pen wetting, and, that next day relative humidity is forecast < 20%
- If resources available – utilise light coloured, reflective pen bedding (such as straw) in high risk pens to reduce soil pen surface temperature. Note that this input requires removal after the event and is less desirable than pen wetting which necessarily evaporates during the event
- Notify consultant veterinarian and nutritionist, also group feedlot manager, if applicable, and any livestock owners of “imminent” heat status
- Liaise with consultant nutritionist as to the duration of heat ration feeding and if modifications to ration composition – such as added potassium chloride or other supplements – are required. Suspend all normal ration transitions
- Scrape wet material and manure from feedlot pens, and remove carcasses from feedlot pens during night hours, preferably pre-dawn.
5.1.3 Heat Load Status ‘OCcurring’

Actions at this status level can focus on mitigation and crisis management during an event. The following presents a list of potential actions:

- Modify livestock hours and notify cattle transporters that schedule cancelled
- Cease all internal and external cattle movements
- Cancel scheduled cattle handling procedures such as processing, drafting, re-implant, etc.
- Cease pen riding and cattle hospital treatments until “occurring” status abates
- Ensure all water troughs are clean and re-charge reliably; clean and re-charge troughs pre-dawn
- Ensure all supplementary water troughs have been deployed and filled pre-dawn, source and deploy additional troughs if insufficient number to deliver volume as above
- Consider adding potassium chloride to supplementary and existing water troughs as part of rehydration therapy but liaise directly with consultant nutritionist and veterinarian as toxicity states are relatively simple to induce if concentration incorrectly calculated.
- If available – utilise cattle sprinklers as outlined below on high risk cattle
- If resources available – utilise pen wetting of high risk pens: applying water to the feedlot pen surface pre-dawn or post-dusk reduces the pen surface soil temperature, and, increases thermal conductivity of the pen surface such that when cattle lie down they transmit (and dissipate) more heat to the soil. Ensure that pre-dawn and post-dusk relative humidity is < 20% when applying pen wetting, and, that next day relative humidity is forecast < 20%
- If resources available – utilise light coloured, reflective pen bedding (such as straw) in high risk pens to reduce soil pen surface temperature. Note that this input requires removal after the event and is less desirable than pen wetting which necessarily evaporates during the event
- Notify consultant veterinarian and nutritionist, also group feedlot manager, if applicable, and any livestock owners of “occurring” heat status
- Liaise with consultant nutritionist as to the duration of heat ration feeding and if modifications to ration composition – such as added potassium chloride or other supplements – are required. Suspend all normal ration transitions
- Scrape wet material and manure from feedlot pens, and remove carcasses from feedlot pens during night hours, preferably pre-dawn.

If multiple deaths occurring then extreme mitigation measures can include:

- Conduct euthanasia(s) as directed by the animal welfare policy of the feedlot site at night
- Prepare mass burial site as outlined in Heat Management Plan
- Conduct autopsies at mass burial site, record findings and collect heart / lung / liver / kidney / rump meat and aqueous humour samples from a representative group of carcasses
- Collect samples of last ration fed
- Consider releasing high risk cattle from feedlot pens to the immediate proximity environment around the feedlot if some or all of the following conditions exist:
  - Ground surface has increased thermal conductivity and/or less surface temperature than feedlot pen surface
Heat Load Status ‘OCCURRING’ continued

- Additional shade is available supplied by trees, physical structures, etc.
- Additional water is available – potentially of lower temperature than supplied in feedlot pens
- Increased air-flow / wind speed is available out of the feedlot pens
- Cattle can be released from feedlot pens safely during the night hours, preferably pre-dawn, and not travel far to the above relief features
- Cattle can be retrieved easily after the event

- Notify consultant veterinarian, nutritionist and group feedlot manager if applicable of daily death loss sustained
- Initiate NFAS incident reporting procedure

CAUTION IF USING SPRINKLERS. Sprinklers, like rain, can contribute to local feedlot humidity, pad moisture and ammonia levels. Sprinklers appear to be most effective when used to periodically wet cattle with large droplet sprays that penetrate through to the skin surface, assisting with evaporative cooling. Misting or fogging is not recommended as it can add to humidity problems, while providing little cooling benefit to the cattle, as only the hair coat is wetted. The following recommendations have been suggested if sprinklers are used.

- Sprinklers should produce large water droplets of at least 150 micron diameter.
- Provide a minimum of two and preferably three sprinklers per pen.
- Sprinkler range should avoid areas adjacent to water troughs, shades and feed bunks and cover at least 2.5 to 3.0 m² per Standard Cattle Unit (SCU).
- Sprinklers should be supplied by a stand-alone water supply that does not compete with water trough requirements.
- It is believed that sprinklers are best applied for 5-10 minutes on and 15-20 minutes off (to allow cooling by convection to be most effective), rather than continuously and their use should be guided by observing the cattle's response and the pen environment.
- Night sprinkling has been found to be more effective than daytime sprinkling in reducing body temperatures in some situations. The respiratory rate of cattle should always be assessed one hour after sprinklers have been turned off. If respiratory rates increase sprinklers should be turned back on.
- If sprinklers are used, particular attention must be paid to good pad management.

CAUTION! Before using sprinklers contact your feedlot consultant

Sprinklers should only be used when the relative humidity is low. Studies have identified a 24 hour average relative humidity of less than 20% to be optimal
5.2 Recovery from heat load event

Repeated or sustained heat load events that submit cattle to extended periods of standing and high respiration rate / panting, results in considerable fatigue. As heat dissipates, these feeders need to normalise not only hydration, but also repair inflamed intestinal lining and skeletal muscle. Muscle repair can take up to one week and a principle of recovery is to avoid handling procedures such as drafting, re-implant etc shortly after a significant heat load event. Gut inflammation can recover in a shorter time period, typically around 48 hours, and this is a guide to the minimum duration before transitioning from heat ration back to normal pre-heat load ration. Consumption needs to be monitored closely to avoid large swings from reduced to high intake which may induce clinical acidosis. In some instances, gut lining inflammation is severe and permanent, and, rumen microbes never fully recover from the depressive effects of a significant heat load event; in these cases, pre-heat load consumption may never return and average daily gain at close out is typically reduced.
6. REVIEW

Annual review of your Heat Management Plan is critical to learning, developing and maintaining a document and process that works for your site.

6.1 What should I do to review my Heat Management Plan?

Some questions to consider and address are:

- What worked well and what could be improved in your Heat Management Plan?
- Do you have a daily monitoring plan that is working? For example: Are there appropriate triggers and actions? Were triggers and corresponding actions all recorded and reported to the feedlot manager? Were actions implemented in a timely manner?
- Were you sufficiently pre-warned about any heat load events either through the CHLT web site or alert, industry communications or through observing weather and animal behaviour changes on the feedlot? If not, were your alerts set up correctly? If you have an automated on-site weather station, consider uploading it to CHLT to improve your forecast?
- In the lead up to, and during an event, was it clear who was responsible for what? Can a sufficient number of feedlot staff undertake risk assessments, calculate HLI and AHLU, and assess cattle panting scores? Is more training required?
- Were your contingency plans for power, water and communications used? If so, did the contingencies work? If not, why not? (e.g. were there enough spare water troughs and working generators if required?)
- Were the heat load ration changes implemented? If not, why not?
- Were there any cattle deaths? Did cattle deaths exceed the NFAS threshold and was ALFA alerted?
- Even if heat load events were not experienced this summer, were there any pens where animals seemed to be more affected than others? Consider how to reduce the impact in these areas? i.e. through use of shade, reducing stocking density, additional water troughs or reserving use of the pen during such periods for more heat tolerant cattle (e.g. Bos indicus breeds).

CHLT

As part of the weather forecasting service run by Katestone an annual review of the forecast performance is undertaken to ensure that it is kept on track. This review is available on the CHLT website in May each year. With more data now coming in from site weather stations, Katestone can now understand better the conditions at your site. If you are worried about your AWS, or think the forecast is not performing at your site, contact Katestone and ask them to review your site.

At the end of the summer season, a survey is also sent out to all CHLT registered users to get valuable feedback to improve the service. This is a good way to get involved and have your say. If there is something that you think could be done better, provide feedback.
7. WHERE TO GO FOR MORE INFORMATION

The following publications have additional information that may assist in the management of summer heat, and are available from Meat & Livestock Australia:

- Tips & Tools: Heat load in feedlot cattle
- DVD: Heat load in feedlot cattle
- National Guidelines for Beef Cattle Feedlots in Australia, 3rd Edition
- National Beef Cattle Feedlot Environmental Code of Practice, 2nd Edition

Contact:

Des Rinehart
MLA Feedlot R&D Project Manager

Phone: 07 3620 5236
Mobile: 0417 728 785
Email: drinehart@mla.com.au
APPENDIX A

EXAMPLE PRE-SUMMER CHECKLIST
**PRE-SUMMER CHECKLIST**

<table>
<thead>
<tr>
<th>Feedlot name</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Date completed</td>
<td></td>
</tr>
<tr>
<td>Prepared by</td>
<td></td>
</tr>
<tr>
<td>Approved by</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Location</th>
<th>Sign when complete</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conduct a site Risk Assessment using the RAP and document risk</td>
<td>CHLT</td>
<td></td>
</tr>
<tr>
<td>2. Identify high risk cattle (from RAP using HLI Threshold) document strategies used to mitigate risk</td>
<td>HMP</td>
<td></td>
</tr>
<tr>
<td>3. Check your CHLT registration. Write down your password. Update contact numbers and e-mail address. Remove any users from your account who are not longer working for you.</td>
<td>CHLT</td>
<td></td>
</tr>
<tr>
<td>4. Reset your heat warning alerts on CHLT using latest RAP results</td>
<td>CHLT</td>
<td></td>
</tr>
<tr>
<td>5. Check your AWS is uploading correctly to the HLDN (or sign up for HLDN if not already)</td>
<td>CHLT</td>
<td></td>
</tr>
<tr>
<td>6. Service equipment</td>
<td>Service register</td>
<td></td>
</tr>
<tr>
<td>7. Check pen conditions and undertake maintenance (manure, clean water troughs)</td>
<td>HMP</td>
<td></td>
</tr>
<tr>
<td>8. Undertaken staff training for managing heat and daily monitoring</td>
<td>Training register</td>
<td></td>
</tr>
<tr>
<td>9. Review contingency plans and emergency contacts</td>
<td>HMP</td>
<td></td>
</tr>
<tr>
<td>10. Consult with a nutritionist regarding summer feeding strategy and formulate heat load ration and have it on standby</td>
<td>HMP</td>
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</tr>
<tr>
<td>11. Register your veterinarian or nutritionist with CHLT for alerts</td>
<td>CHLT</td>
<td></td>
</tr>
<tr>
<td>12. Confirm location of mass burial site</td>
<td>HMP</td>
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<tr>
<td>13. Sign off updated Heat Management Plan</td>
<td>HMP</td>
<td></td>
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</tbody>
</table>
APPENDIX B

PANTING SCORE REFERENCE CHART
**PANTING SCORE REFERENCE CHART**

**Panting Score 0**
- No panting
- Difficult to see chest movement

**Panting Score 1**
- Slight panting, mouth closed, no drool or foam
- Easy to see chest movement

**Panting Score 2**
- Fast panting with drool and foam
- No open mouth panting

**Panting Score 2.5**
- Fast panting with drool and foam.
- Occasional open mouth panting.

**Panting Score 3**
- Open mouth, drooling and neck extended.
- Head usually up.

**Panting Score 3.5**
- Open mouth, drooling and neck extended.
- Tongue out slightly.

**Panting Score 4**
- Open mouth, drooling and neck very extended.
- Tongue well out.

**Panting Score 4.5**
- Open mouth, drooling and neck very extended.
- Tongue out, and head down. Flanks often heave with forced breathing.
APPENDIX C

EXAMPLE TEMPLATE FOR RECORDING CATTLE BEHAVIOUR AND PANTING SCORES DURING SUMMER MONITORING
# CATTLE CLINICAL OBSERVATIONS

<table>
<thead>
<tr>
<th>Feedlot name</th>
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<tr>
<td>Date completed</td>
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<td>Approved by</td>
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<table>
<thead>
<tr>
<th>Inspection 1</th>
<th>Inspection 2</th>
<th>Inspection 3</th>
<th>Inspection 4</th>
<th>Inspection 5</th>
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<tr>
<td><strong>TIME:</strong></td>
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</table>

**Cattle Type Observed:**

**HLI threshold:**

**Pens observed:**

- Feed left?
- Shade seeking?
- Standing or lying down?
- Hugging water troughs?
- Bunk presence (%)
- Bunching in pen or spread out?
- Agitated? / restless?
- Downers or deaths?
- **Mean pant score (>10%)**

- Other general observations
APPENDIX D

EXAMPLE TEMPLATE FOR DAILY MONITORING
### Daily Heat Monitoring Record

**Todays Date:** ___________________  **Person conducting this daily monitoring:** ____________________________________________________________

**Cattle Population Description:**

Does the site currently have access to CHLT forecasting services (Y or N): [ ]

Does the site have access to the sites CURRENT LOCAL HLI and AHLU levels (Y or N): [ ]

#### Daily Weather & Behavior Monitoring Data

<table>
<thead>
<tr>
<th></th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of finishing cattle with pant scores &gt;2.5 at early AM monitoring:</td>
<td></td>
</tr>
<tr>
<td>Percent change in consumption yesterday fed to today call:</td>
<td></td>
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<tr>
<td>Current pen conditions:</td>
<td></td>
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<tr>
<td>Hours overnight with AHLU Zero</td>
<td></td>
</tr>
<tr>
<td>Forecast maximum AHLU for today (forecast day 1):</td>
<td></td>
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<tr>
<td>Forecast maximum AHLU for tomorrow (forecast day 2):</td>
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<tr>
<td>Forecast maximum AHLU over forecast days 3,4,5,6 &amp; 7:</td>
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<tr>
<td>Note re current cattle behavior:</td>
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#### Site & Population Specific HLI & AHLU Risk Thresholds

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<table>
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<tbody>
<tr>
<td>HLI at which sites cattle type begins to accumulate heat (HLI threshold):</td>
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<tr>
<td>AHLU at which sites cattle type become stressed (Site AHLU Trigger Point):</td>
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#### Trigger Items (identify any triggers that have been activated)

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<thead>
<tr>
<th>Trigger 1</th>
<th>Trigger 2</th>
<th>Trigger 3</th>
<th>Trigger 4</th>
<th>Trigger 5</th>
<th>Trigger 6</th>
<th>Trigger 7</th>
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<tbody>
<tr>
<td>&gt;10% Cattle Exhibiting Panting Score &gt;2.5 Early AM Today?</td>
<td>Consumption Drop of &gt;10% Yesterday Fed To To Today Call?</td>
<td>Current Pen Conditions Are Wet/Muddy?</td>
<td>Hours Overnight With AHLU Zero Was &lt;6</td>
<td>Max AHLU Forecast Today (Forecast Day 1) Greater Than Site AHLU Trigger Point?</td>
<td>Max AHLU Forecast Tomorrow (Forecast Day 2) Greater Than Site AHLU Trigger Point?</td>
<td>Max AHLU Forecast Though Remainder Of Week (Forecast Days 3,4,5,6,7) Greater Than Site AHLU Trigger Point?</td>
</tr>
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</table>

#### Today's Heat Status Guidline

<table>
<thead>
<tr>
<th>Trigger 1 Only</th>
<th>Trigger 2 Only</th>
<th>Trigger 3 Only</th>
<th>Trigger 4 Only</th>
<th>Trigger 5 Only</th>
<th>Trigger 6 Only</th>
<th>Trigger 7 Only</th>
<th>Note Actions Taken In Response</th>
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<tbody>
<tr>
<td>Occurring</td>
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**WARNING:** FORECASTS AND GUIDELINES ARE PROACTIVE MANAGEMENT TOOLS. THEY SHOULD BE USED IN CONJUNCTION WITH CATTLE BEHAVIOR MONITORING.