POULTRY CRC LTD

FINAL REPORT

Project No: 2.1.19

PROJECT LEADER: Dr Stuart Wilkinson

Sub-Project Title: Information, Data and Analytics System (Idas) for poultry: Using a novel technology platform to monitor poultry health and performance

DATE OF COMPLETION: 8 November 2016

ISBN 1 921010 79 7

Information, Data and Analytics System (Idas) for poultry: Using a novel technology platform to monitor poultry health and performance
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Published in November 2016

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1.0 Introduction

Broiler production and flock health are inextricably linked. Efficient broiler production is a function of bird health among many other factors while bird performance and nutrient utilisation are impaired under health challenge situations. Klasing (2007) suggests that as much as 9% of dietary nutrients may be diverted away from bird growth and maintenance when an acute immune response is mounted. However, dietary nutrients are also diverted from growth when sub-clinical health challenges are present. These conditions are less easy to identify and diagnose leading to reduced efficiency and profitability for the poultry industry.

Assessment of flock health is primarily performed by broiler-unit staff that is built upon by service technicians and avian veterinarians. By measuring feed intake and water consumption in real-time, it may be possible to use these indices as indicators of flock health and performance. For example, if feed intake and/or water consumption were to change marginally over a period of time, this may go unnoticed until an apparent problem eventuates. Changes in feed intake and water consumption may indicate that a sub-clinical health challenge is present. By measuring feed and water intake daily as well as creating an alerting system for relevant personnel to act upon, it is possible to enhance poultry production efficiency. However, changes in feed intake and/or water consumption may not only be associated with a bird health challenge and may be indicative of a mechanical break downs or equipment malfunction. By acquiring feed and water data in real time and issuing intelligent alerts, farm managers will be able to be investigate and rectify issues at the earliest stage, reducing a potential worsening of the problem and negative impact on bird performance.

This project aimed to capture data in real-time that may then be used to make key decisions related to bird management, feed milling, logistics and processing. Currently, feed inventory on farms and feed intake can be difficult and problematic to accurately report. This problem can create situations where birds are periodically left without feed or excess feed is delivered to the farm requiring reprocessing at the feed mill (at considerable expense). While some farms have load cells installed on feed silos, or bucket weighers these are prone to malfunction and/or become inaccurate over time without frequent maintenance. Previous feed management systems calculate feed delivery as a function of auger run time multiplied by the amount of feed dispensed by a full auger, however, in situations where the auger is less than half full, this calculation is erroneous. While other systems deliver feed according to the stage of growth of the birds are available, these systems dispense feed as meals and do not measure the amount of feed being delivered. Although most of the elements of measuring bird and shed performance are available, none are available that provide this information in real time and with accurate daily feed consumption data.

To solve this problem, this project installed Feed Meters onto feed lines of broiler sheds to accurately measure the amount of feed delivered over any specified period, be it hourly, daily, weekly etc. Feed Meters were installed on the feed auger lines and weighed the amount of feed being delivered. Feed Meters can detect whether the feed line is running empty, half empty or full, all of which have not been accurately performed previously. Data acquired was pushed into the internet cloud that may then be accessed by relevant personnel (those that have been granted permission) from any location that has an internet connection. Feed Meters also allow for intelligent alerting to notify personnel if the auger has not run, is excessively running as well as manage silo inventory. While some attributes of Idas are currently available, none use the same feed metering technology, provide intelligent alerting and reporting as Idas.

1.1 Project objectives

The objectives of this project were;

1. Develop novel technology to monitor feed intake, water consumption, mortality, live weight and environmental conditions in a commercial broiler grow out facility.
2. Collate the above information into an online real-time platform.
3. Generate reports for informed decision making
4. Implement an intelligent alerting function based on set performance parameters

2.0 Materials and methods

2.1 Animals

Table 2.1 Overview of birds and experimental design

Strain	Age	Sheds	Batches (in Total)
Ross 308 broilers (as hatched)	1 to market	8	4

2.2 Experimental design

This project utilised a novel technology to monitor feed delivery and feed consumption on 2 farms, each with 4 broiler sheds over successive production cycles. The proposal to monitor 8 sheds was made to provide information on 4 batches and make provisions for any unforeseen problems during the project. Feed Meters (Figure 1) were installed in each of the 8 sheds to measure daily feed delivery into sheds. Data such as water consumption was acquired from the shed water meters and automatically pushed into Idas while shed temperatures (acquired from shed controllers) were entered manually into Idas via the smart device app (Figure 2) or computer. Bird numbers, weekly body weights, culls and mortalities were recorded for calculating bird feed conversion ratio (FCR). Bird health was monitored as per routine in each shed.

2.21 Feed Meters

Feed Meters (Feed Logic Corporation, MN, USA) use proprietary technology to weigh feed passing along feed lines. Feed Meters are attached to feed lines and once calibrated are rated to >98% accuracy. Benefits of Feed Meters are that once calibrated to the auger, Feed Meters can weigh the amount of feed passing through the feed line into the shed and provide real time information to staff. Intelligent alerts can be issued informing staff when the auger is operating outside of predefined values, for example, the auger is running empty, continuously running or hasn't run within a specified period of time.

Feed Meters can be installed in multiple sheds and communicate wirelessly to each other to send information to the Farm Meter Hub which collates this data and pushes information to the cloud based software (Idas). A Feed Meter Hub communications module is installed at a central point on the farm to serve multiple Feed Meters. The Hub can also accept data from temperature and humidity probes, water meters etc. and push this information to Idas. The Hub can operate using the 3G or 4G mobile phone network or via an existing ADSL connection on farm.

2.22 Idas app for smart devices

Information such as the number of birds placed at the start of the batch, bird weights, bird numbers, ammonia concentrations and any information that cannot be automatically acquired from a shed metering device can be entered into Idas using the smart device app. The app can be tailored to meet the requirements of the farm/company with additional or less data input options available.

Information entered into the app is automatically synced with Idas in the cloud and used to calculate real time batch performance.

Figure 1 Feed Meter (left) installed on a feed line and Feed Meter Hub module (right)

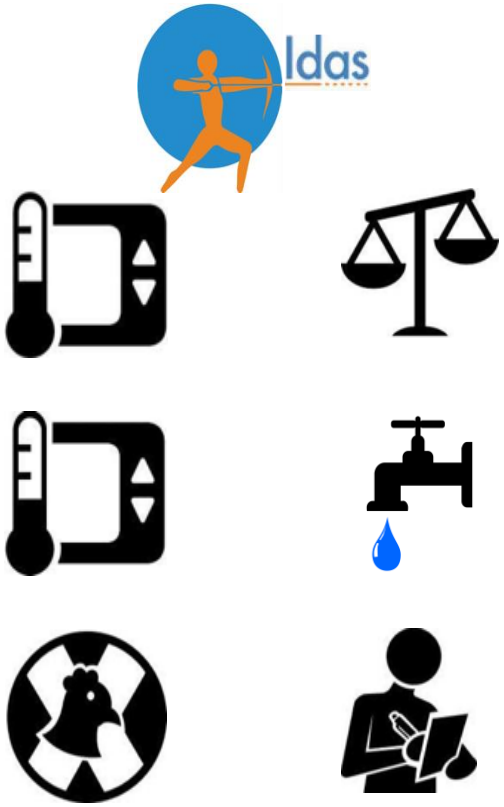

Figure 2 Idas smart device app. Information is entered into the app to replace paper based records

2.3 Parameters to be measured

Table 2.2 Performance indices measured throughout project period

Parameter	Day	Comments
Body weight	1, 14, 28, 35 42	Batch dependent
Shed feed intake	1,14, 28, 35, 42	Batch dependent
FCR	1-14, 14-28, 28-42	
Mortality	Date recorded	Record separately
Culls	Date recorded	Reason for Cull
Therapeutic/preventative treatments	As it occurs	Record each therapeutic intervention as a result of daily measurement of health status

2.3.1 Animals and housing

Birds (Ross 308 broilers, as-hatched) were housed in tunnel ventilated sheds covered with wood shavings. Shed temperature and photoperiod were maintained as per commercial practice. Feed and water were provided *ad libitum* via feed pans and nipple drinkers, respectively.

2.3.2 Performance

At day 1, birds were transported and placed in sheds. The number of birds placed and the average body weight were recorded. Feed intake was recorded daily using Feed Meter technology (Feedworks Australia, Lancefield, VIC) that were installed on each of the feed lines (2/shed). Bird body weight was recorded from a subsample of birds (100 from each corner of sheds) at days 1, 7, 14, 21, 28, 35 and at marketing as per commercial practice. Bird count was monitored daily and corrections made for mortality, culls and birds collected for processing. Flock health was monitored daily and any interventions recorded.

2.3.3 Time Line

A time line for each batch of birds placed into sheds and procedures performed is shown in Table 2.3

Table 2.3 Timeline for batches of birds placed into sheds

Batch Day	Event
< 0	Set up sheds
< 0	Feed delivered
1	Body weight, place birds
1 - end of batch	Weekly body weights, daily bird numbers, Weigh birds

3.0 Results and discussion

3.1 Bird performance

The results for daily bird feed intake, water intake, combined water and feed intake, water:feed, weekly average body weight, combined mortality and the maximum/minimum recorded shed temperatures from one batch per farm shown in Figures 3.1 – 3.7, respectively. Five batches are shown in this report to highlight performance variability between different batches of birds. Performance data from Farm 1(Batches 1-3) are typical for a commercial flock while Farm 2 (Batches 1 and 2) shows performance data from two underperforming flocks that upon investigation were shown to be compromised from the time of placement.

For reference purposes, the Ross 308 as hatched broiler performance objective (2014) for feed intake and weekly body weight are shown in addition to the recorded daily feed intake (Figures 3.1a-e) and weekly average body weight (Figures 3.2a-e), respectively. When viewing the daily feed intake where a zero value is noted at the start of a new batch, feed lines may not run until the birds have consumed feed from the chick paper and feed pans which are filled prior to placement.

Birds from Farm 1 (Figures 3.1a-c) consumed feed as expected and tended to closely align with the Ross 308 2014 performance objective, however, birds from Farm 2 (Figures 3.1d-e) show depressed feed intake during the first 28 days which was a result of feed not being delivered as per schedule. feed distributed manually onto scratch paper to encourage small chicks to consume feed and feed manually brought into the shed from another shed silo. The data presented reflects the feed measured by the Feed Meter only and this explains why apparent feed intake is low at the start of the batch. Decreases in feed intake (Figure 3.1d) may also be attributed to an intermittent power supply problem to the shed, discovered after the initial findings were presented. This explains the fluctuation in feed intake in the latter stages of the batch and may also contribute to the feed intake data at the start.

There are also notable decreases in daily feed intake as birds are removed for processing prior to the end of the batch Figure 3.1a, b. During these periods and prior to their removal, feed is withdrawn from the shed to comply with processing standards. Figure 3.1b shows a spike in feed consumption (350g/b/d) during the period of multiple pick-ups from the shed. This may be explained by the management practice of emptying the feed line prior to pick up and then having to refill the feed lines and feed pans, ostensibly increasing feed intake values. With time, daily bird feed intake returns to trend.

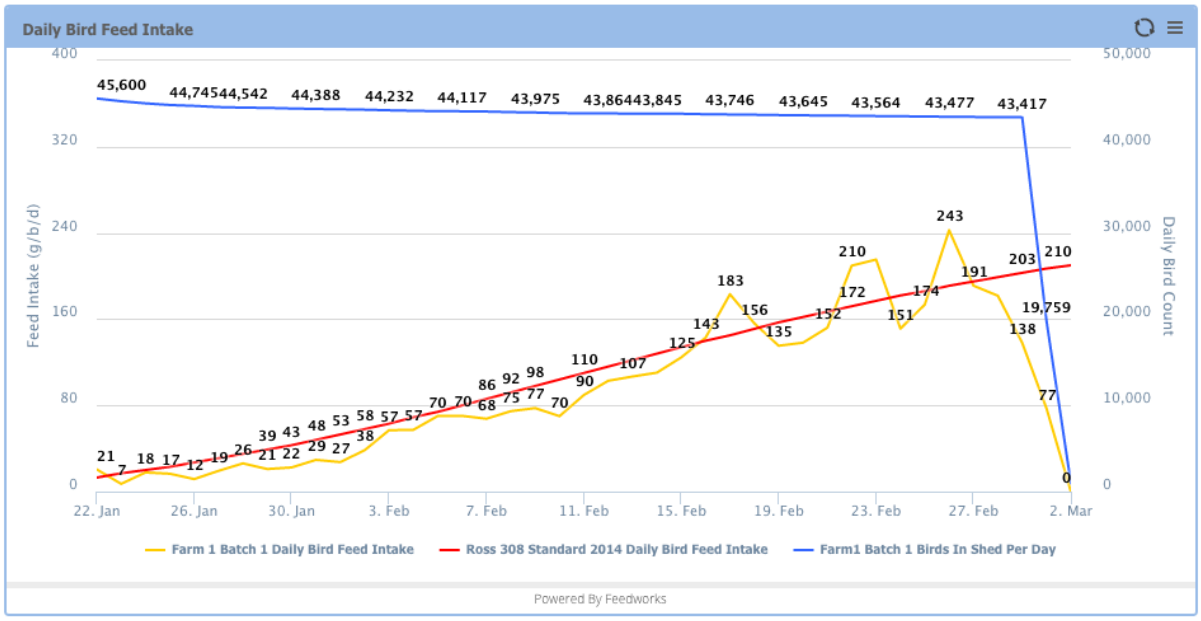

Figure 3.1a Farm 1 Batch 1 daily bird feed intake (g/b/d) and birds in shed per day

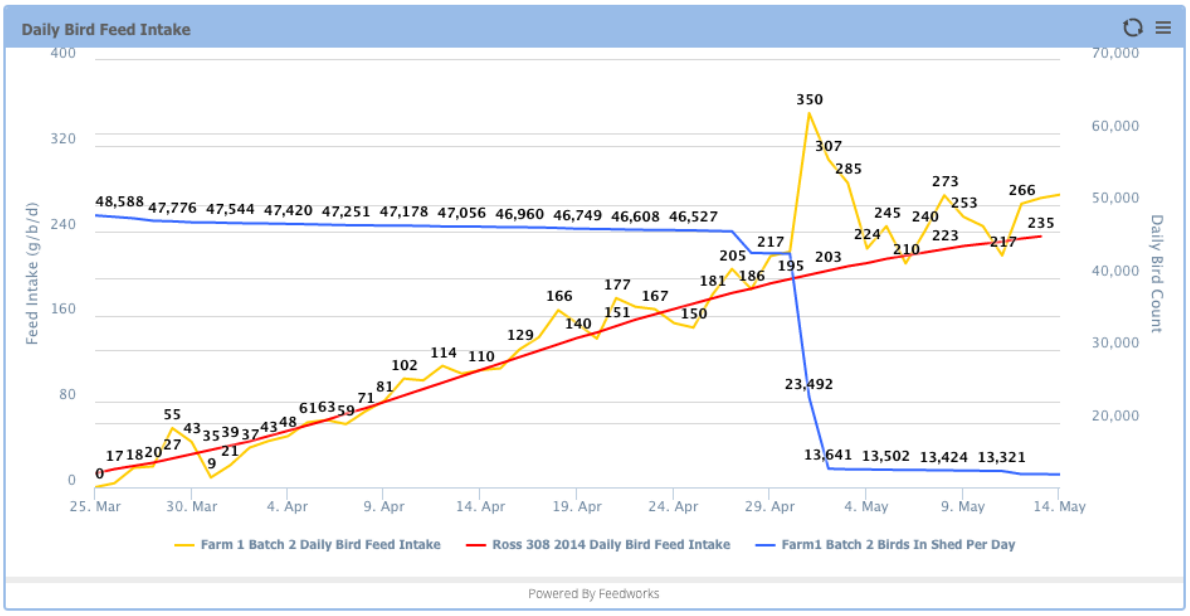

Figure 3.1b Farm 1 Batch 2 daily bird feed intake (g/b/d) and birds in shed per day

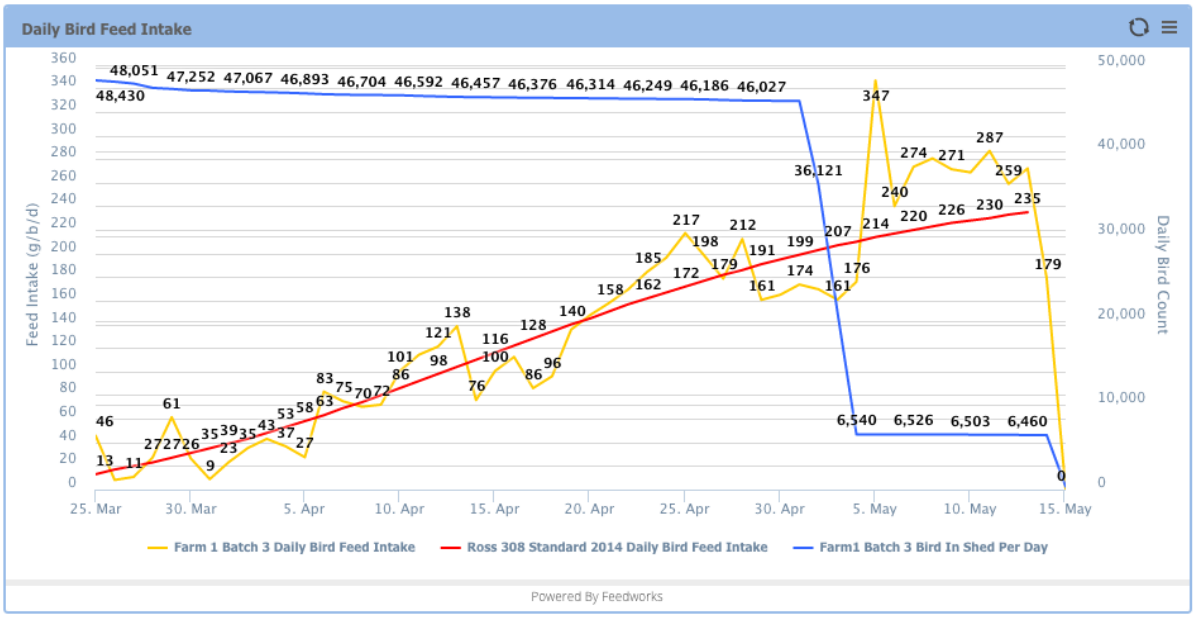

Figure 3.1c Farm 1 Batch 3 daily bird feed intake (g/b/d) and birds in shed per day

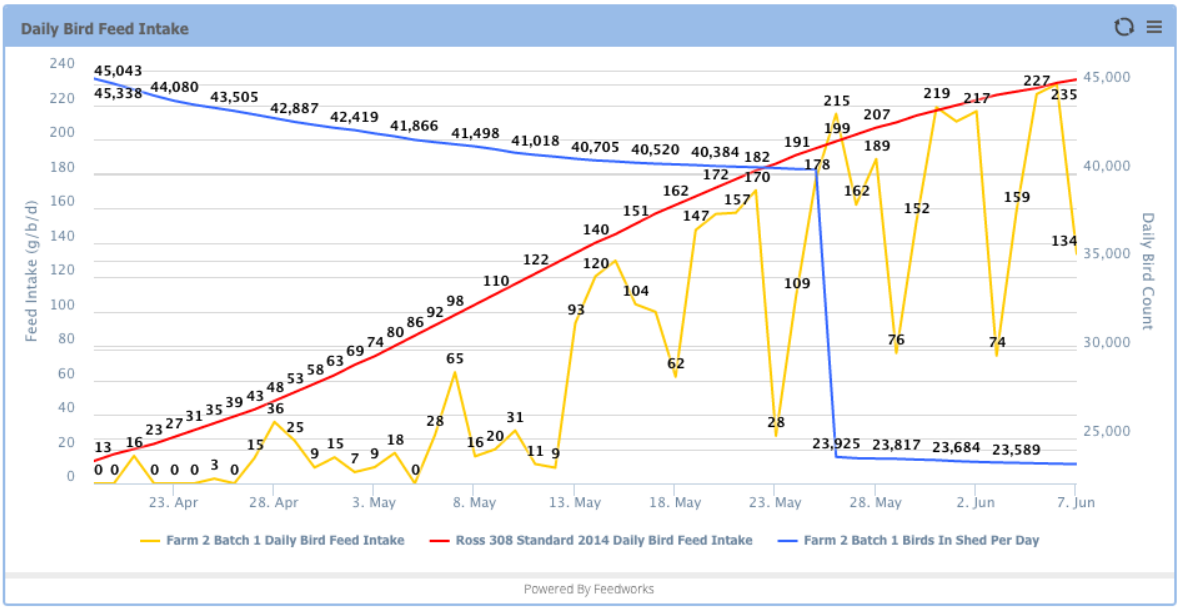

Figure 3.1d Farm 2 Batch 1 daily bird feed intake (g/b/d) and birds in shed per day

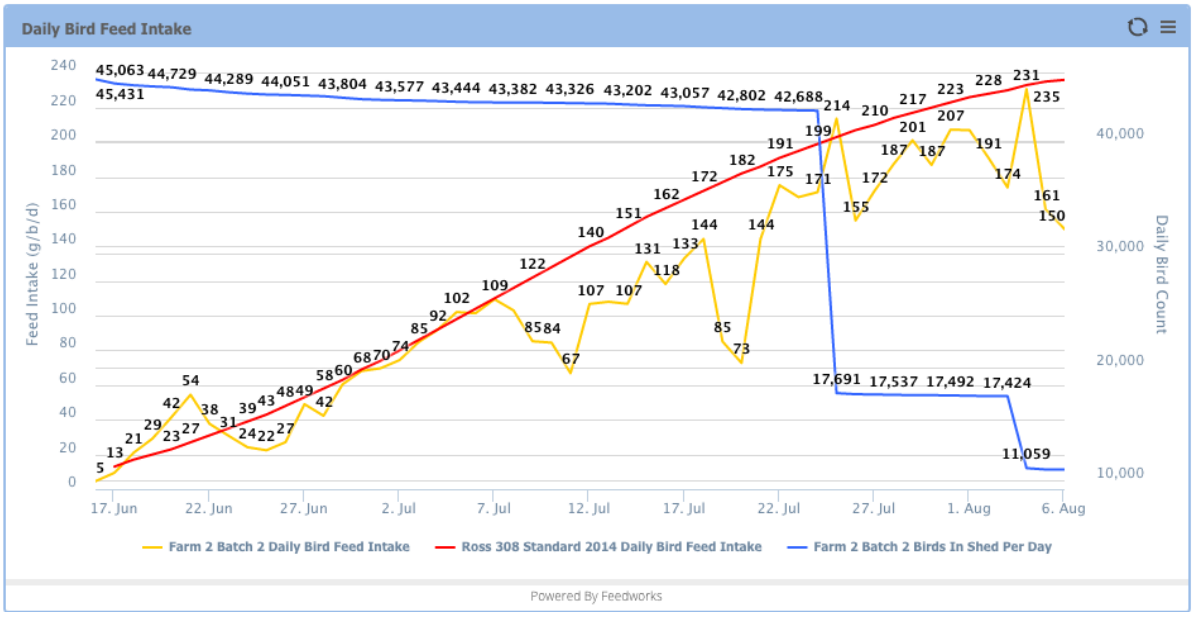

Figure 3.1e Farm 2 Batch 2 daily bird feed intake (g/b/d) and birds in shed per day

Daily water intake is shown in Figures 3.2a-e. The data shows that water intake, apart from 2 notable decreases for Farm 1, increases almost linearly with time. The apparent drop in water intake (Figure 3.2a) is a result of a malfunctioning water meter that was detected as a part of Idas reporting a problem. This meter was replaced immediately. Spikes in water consumption may also reflect the flushing of water lines. When water consumption is above what is expected, Idas will send an alert to the farm management to investigate. Fluctuations in daily water consumption are also apparent on days coinciding with pick-ups from the sheds.

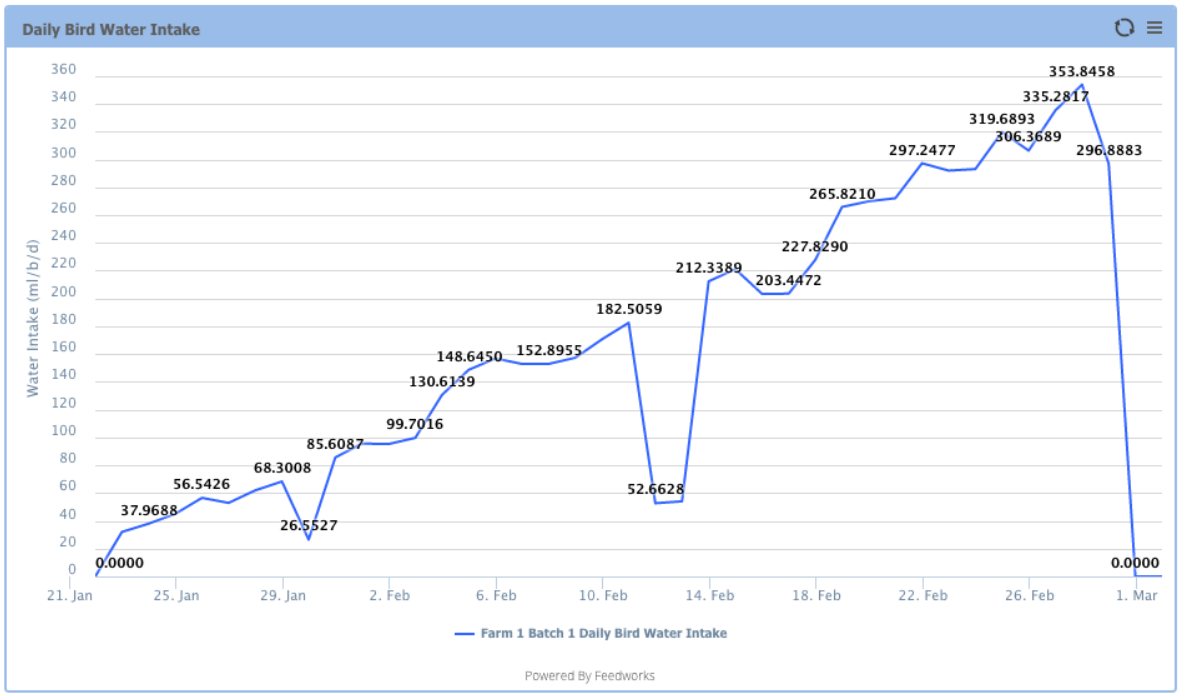

Figure 3.2a Farm 1 Batch 1 daily bird water intake (ml/b/d)

Figure 3.2b Farm 1 Batch 2 daily bird water intake (ml/b/d)

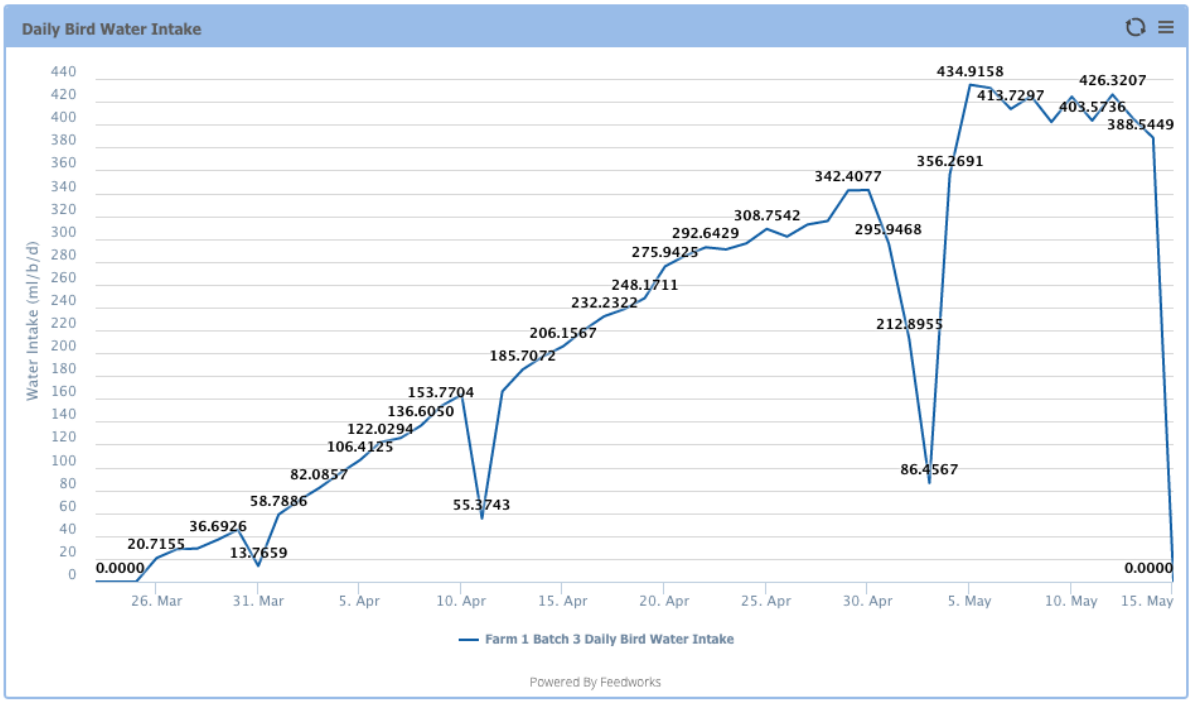

Figure 3.2c Farm 1 Batch 3 daily bird water intake (ml/b/d)

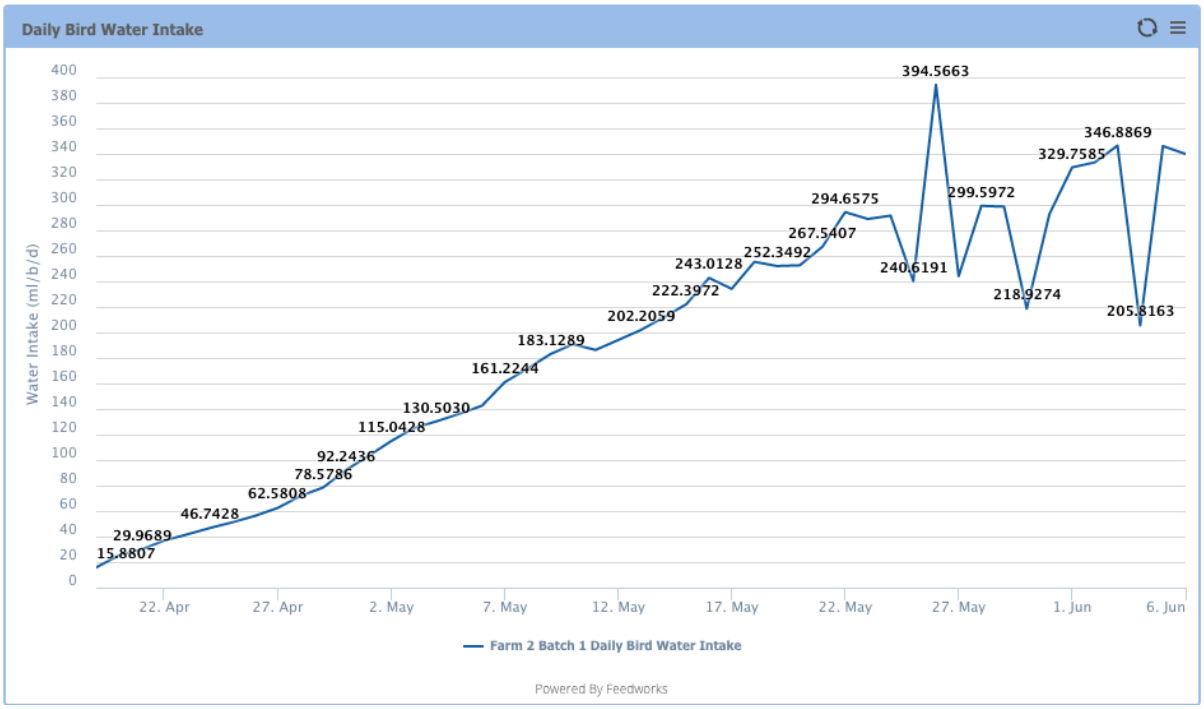

Figure 3.2d Farm 2 Batch 1 daily bird water intake (ml/b/d)

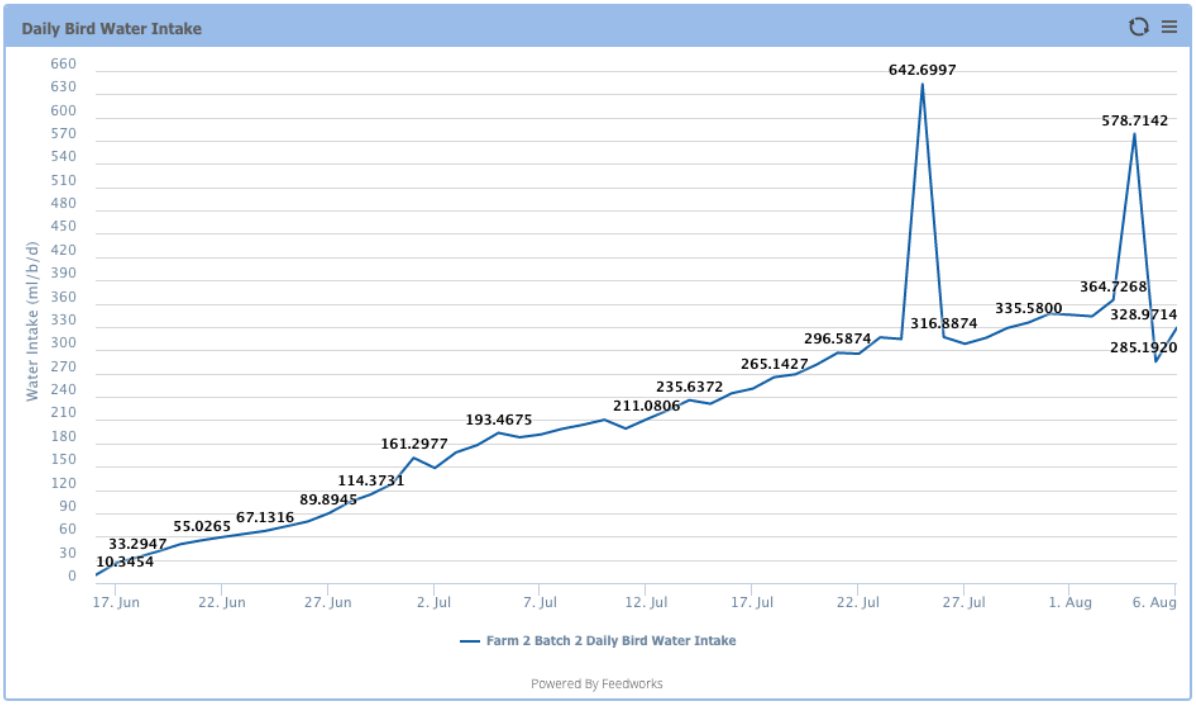

Figure 3.2e Farm 2 Batch 2 daily bird water intake (ml/b/d)

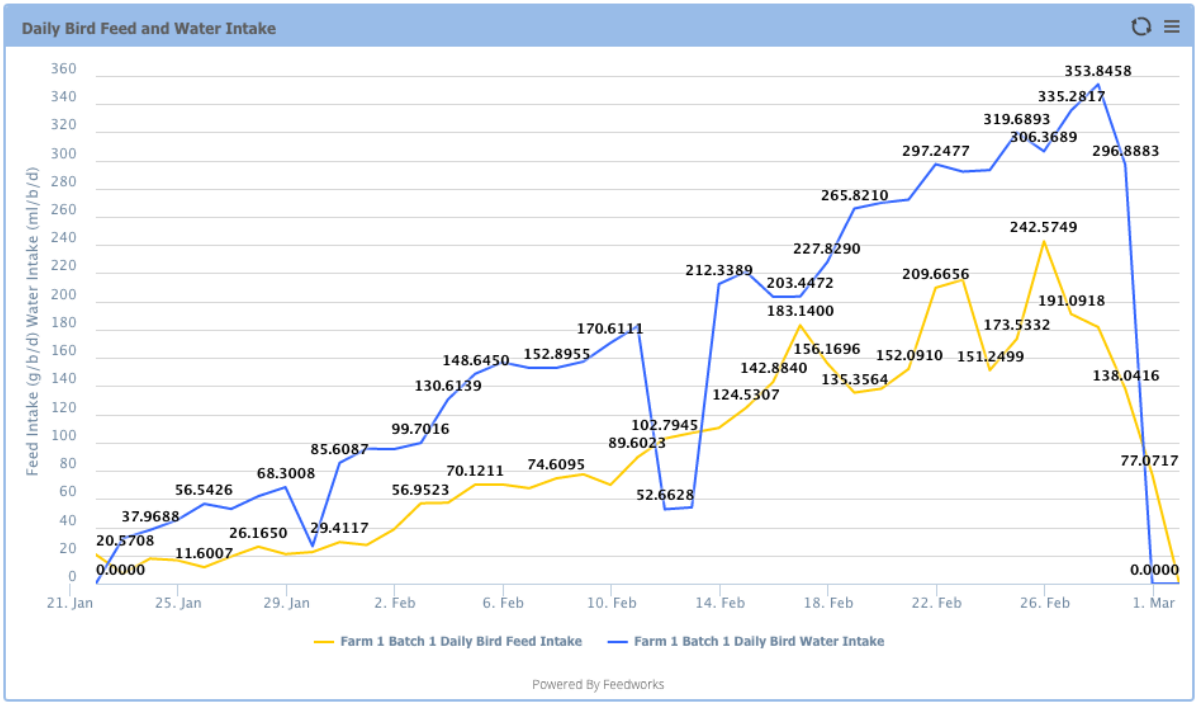

Figure 3.3a Farm 1 Batch 1 average daily bird feed intake (g/b/d) and water intake (ml/b/d)

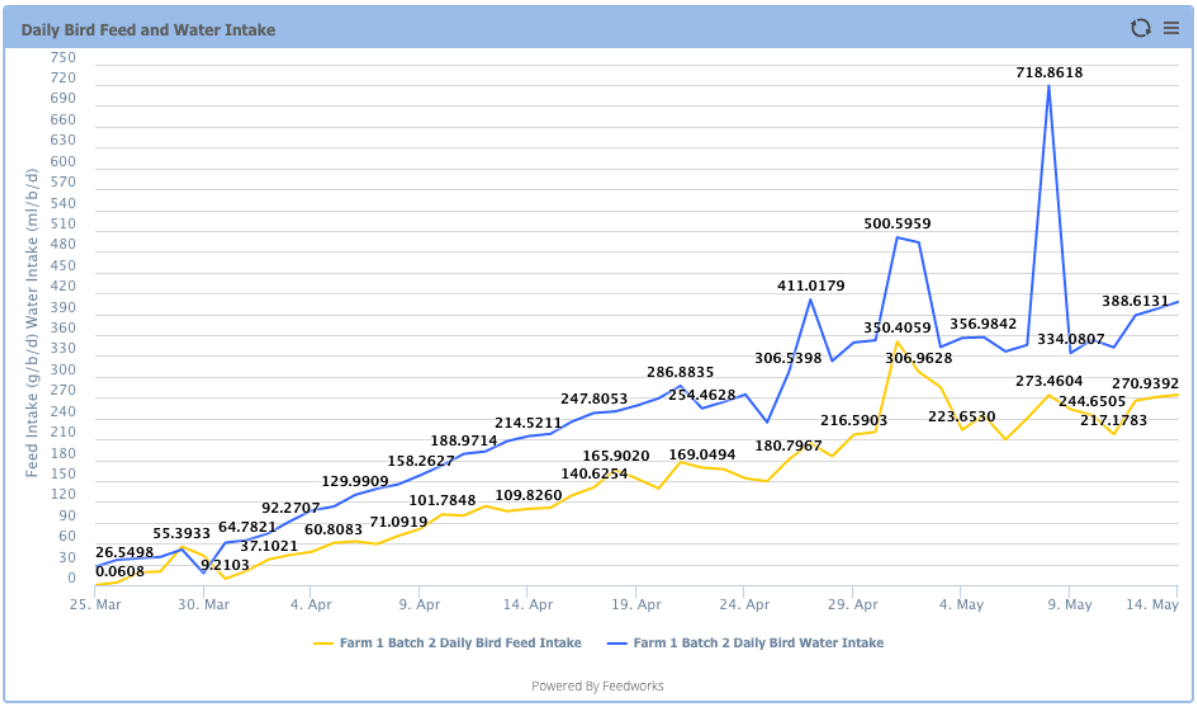

Figure 3.3b Farm 1 Batch 2 average daily bird feed intake (g/b/d) and water intake (ml/b/d)

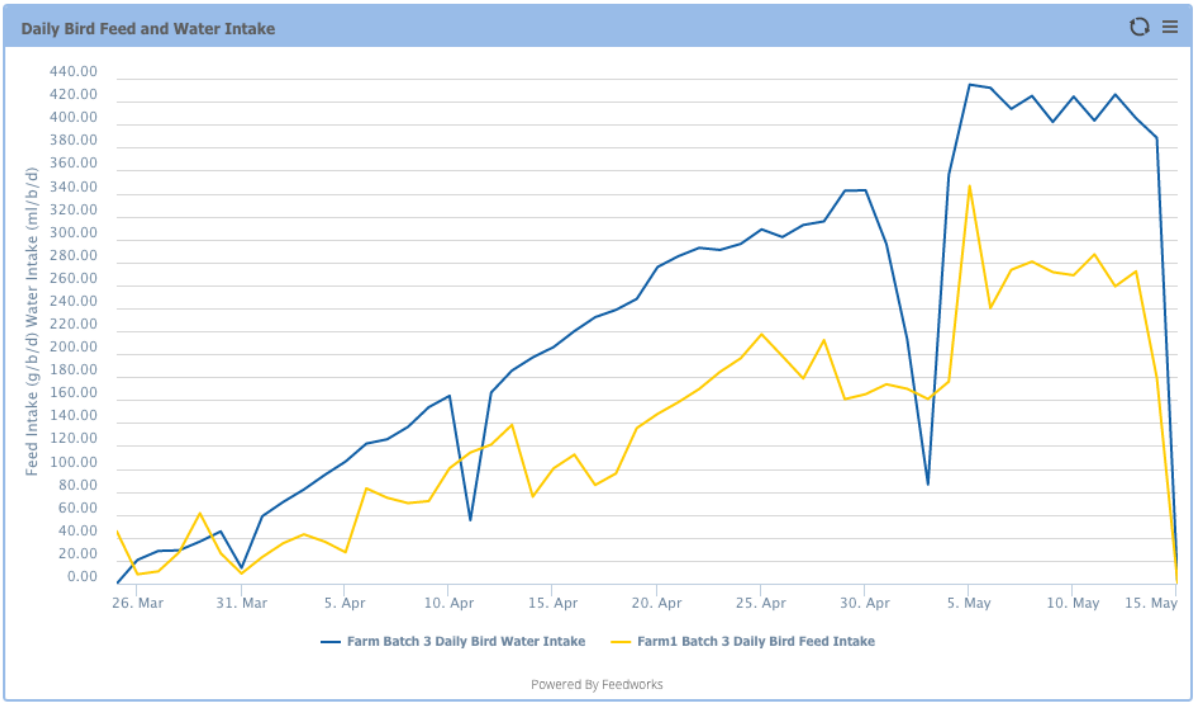

Figure 3.3c Farm 1 Batch 3 average daily bird feed intake (g/b/d) and water intake (ml/b/d)

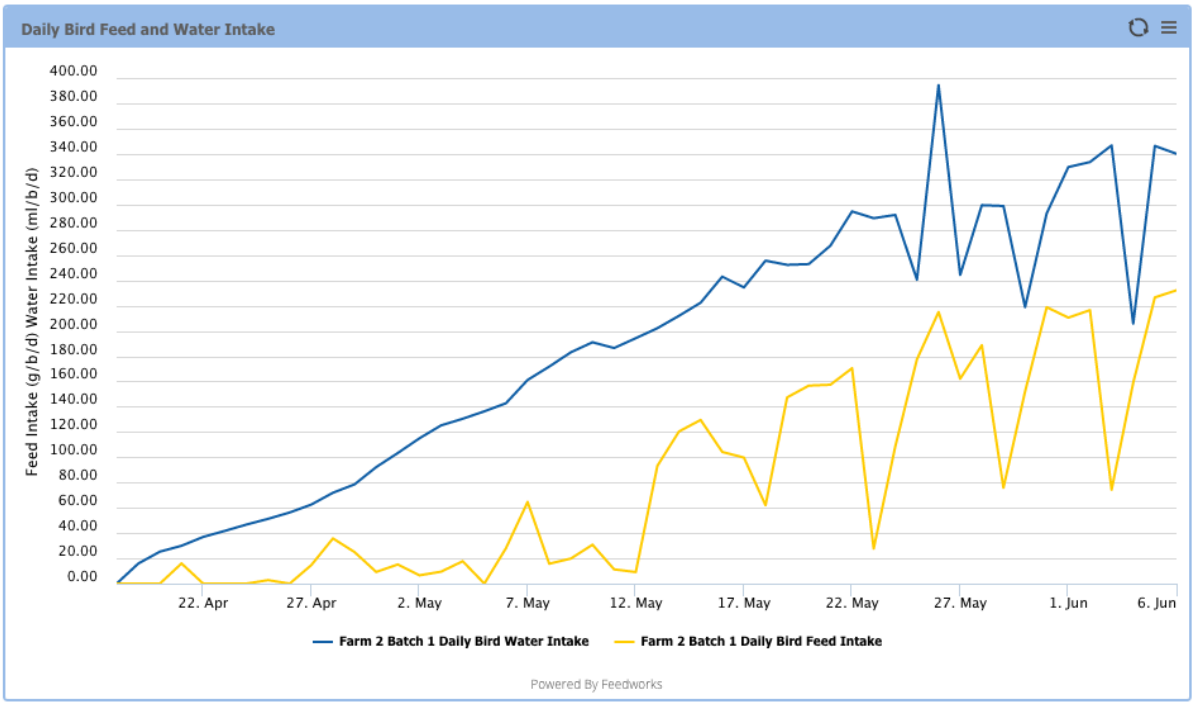

Figure 3.3d Farm 2 Batch 1 average daily bird feed intake (g/b/d) and water intake (ml/b/d)

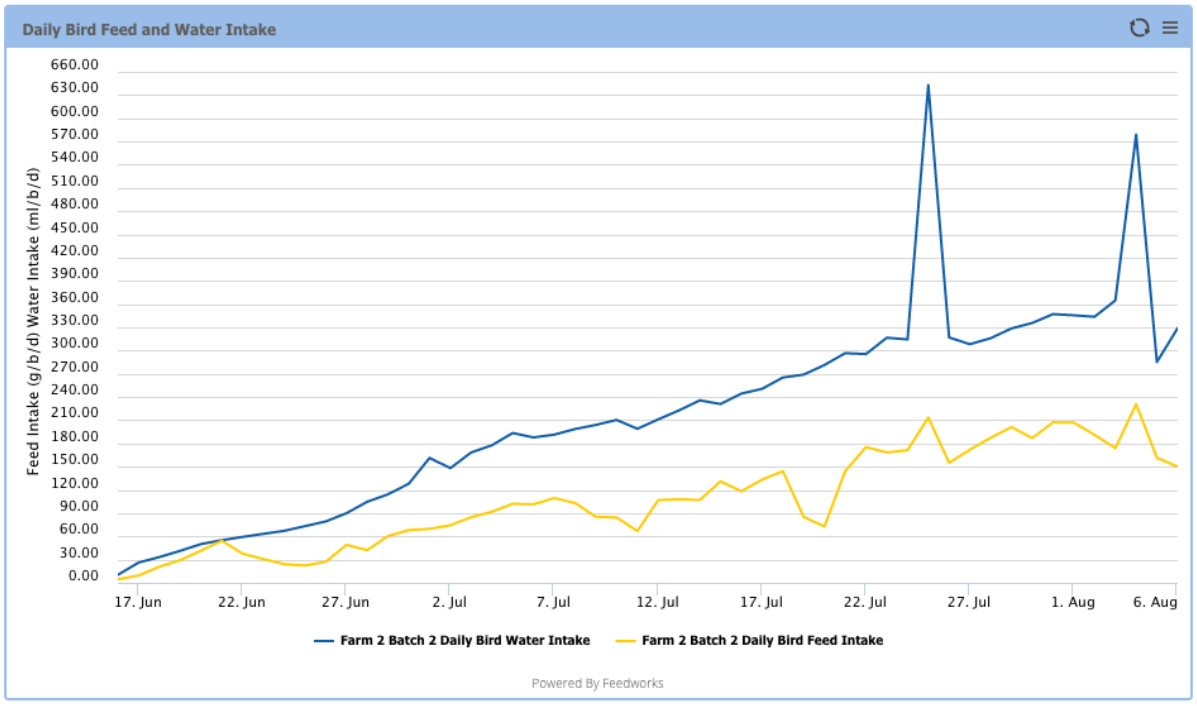

Figure 3.3e Farm 2 Batch 2 average daily bird feed intake (g/b/d) and water intake (ml/b/d)

Feed and water consumption are closely correlated and when bird water intake changes, variances in feed intake are highly likely to occur. Water consumption is influenced by several factors including stocking density, temperature, ventilation, nutrition and health factors. It is theorised that a ratio of approximately 1.8-2.0:1.0 water:feed ratio is considered normal for broilers. However, if this ratio becomes wider, i.e. greater than 2.0:1.0, then this may be indicative of several problems such as; an impending health challenge as broilers increase their water intake relative to feed, problems with the

feed formulation or manufacturing and mechanical malfunctions within the shed. It has been shown that for each degree above 20°C, water consumption increases by 6% and feed intake reduces by 1.23% (Manning et al., 2007). As the water:feed ratio broadens, shed moisture increases which may potentially impact litter quality and lead to foot pad dermatitis. By recording water:feed ratio daily, this metric may then be able to be used as one indicator of litter quality and welfare. Should the ratio begin to widen over a number of successive time periods, then this may indicate that the litter may becoming wetter and possibly lead to wet litter conditions.

Figure 3.4a Farm 1 Batch 1 average daily water consumption to feed intake ratio

Data in Figures 3.4a-c show that at the start of the growing cycle the water:feed ratio was higher than 2.0:1.0. However, this is typical as birds drink water for rehydration when they are placed after having been without feed or water for up to 72 hrs post-hatching. With the exception of a few peaks above 2.0:1.0, the water:feed ratio (Figures 3.4a-c) were within expectations and there were no reported litter quality or foot pad dermatitis issues. Data in Figure 3.4d shows that birds from Farm 2 Batch 1 were consuming considerably more water to feed for the first 28 days and reflected their relatively poorer liveability during this period as well as the manual interventions of feed delivery that contributed to distorting these values. Birds placed in the next batch (Figure 3.4e) in the same location as those in Figure 3.4d show water:feed ratios more in keeping with management guidelines.

Figure 3.4b Farm 1 Batch 2 average daily water consumption to feed intake ratio

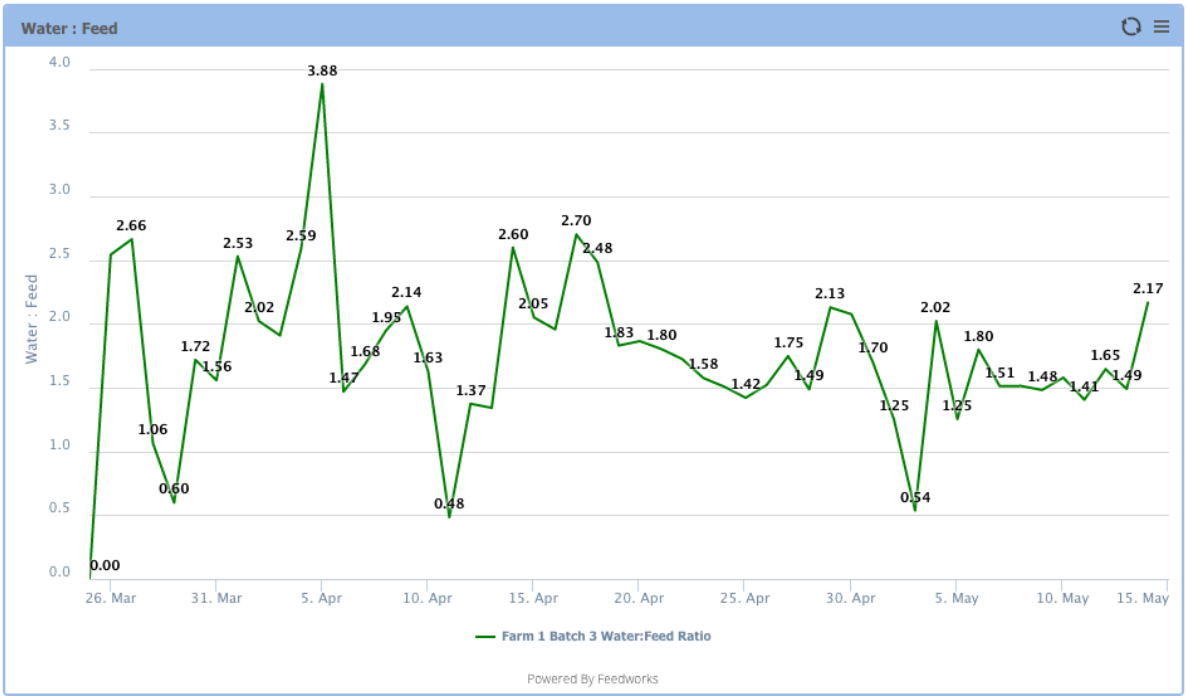

Figure 3.4c Farm 1 Batch 3 average daily water consumption to feed intake ratio

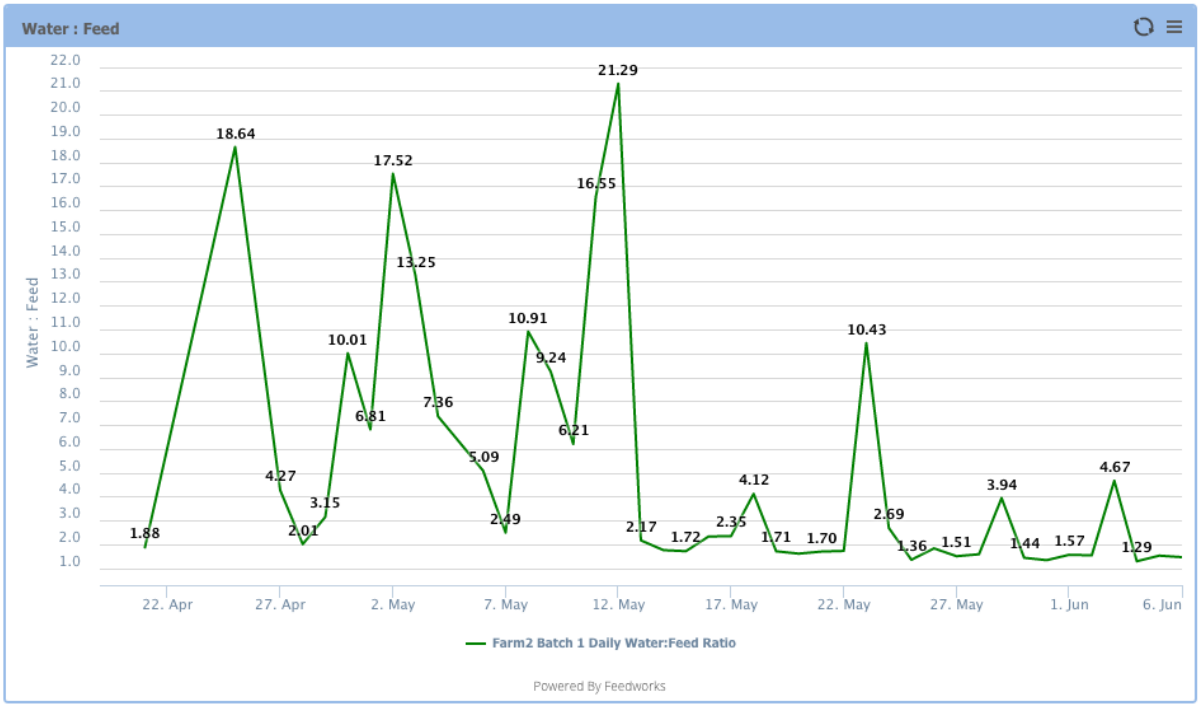

Figure 3.4d Farm 2 Batch 1 average daily water consumption to feed intake ratio

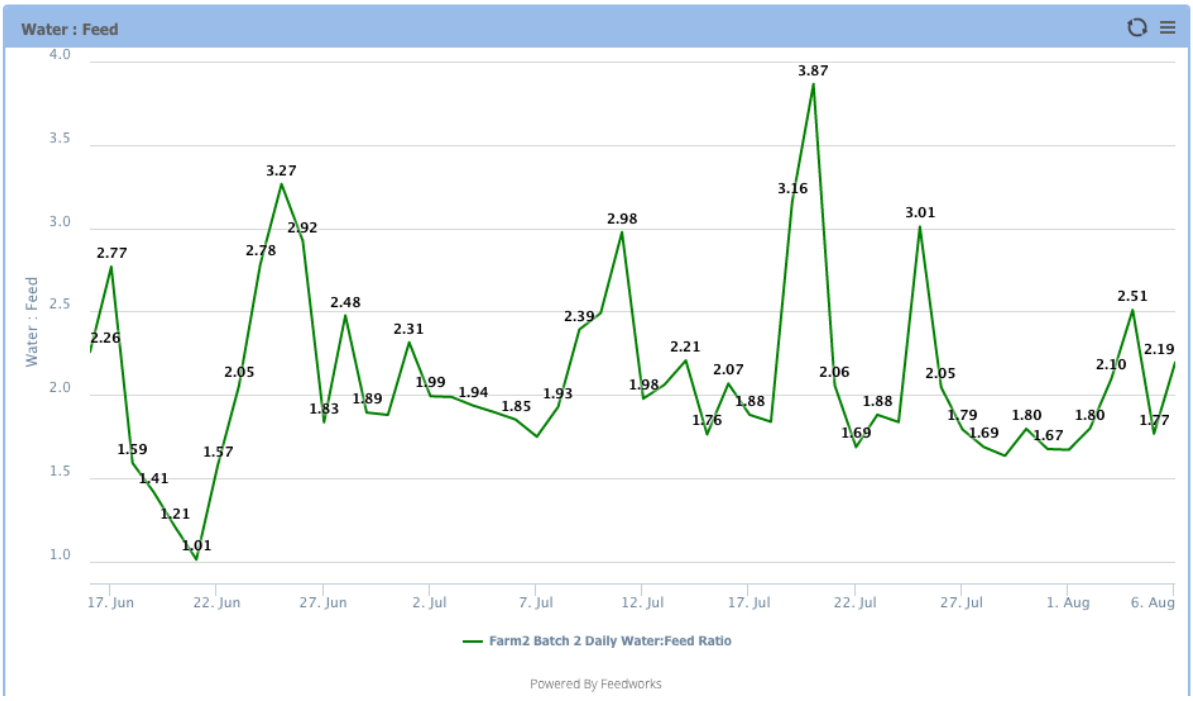

Figure 3.4e Farm 2 Batch 2 average daily water consumption to feed intake ratio

Average weekly bird body weights (day1-35) for Farms 1 and 2 are shown in Figures 3.5a-c and 3.5d-3, respectively. The Ross 308 Performance Objectives (2014) suggests that the target body weight of birds at day 35 is 2113g. The results for birds from Farm 1 (with perhaps the exception of Batch 3) are generally within acceptable commercial margins of the Ross 308 performance objective, however,

birds from Farm 2 Batch 1 were approximately 300g lower in bodyweight at day 35 than the Ross target and 125 g lighter than birds from Farm 1 Batch 1. This outcome was to be expected given the relatively poor performance and heightened mortality during the early stages of the growing cycle.

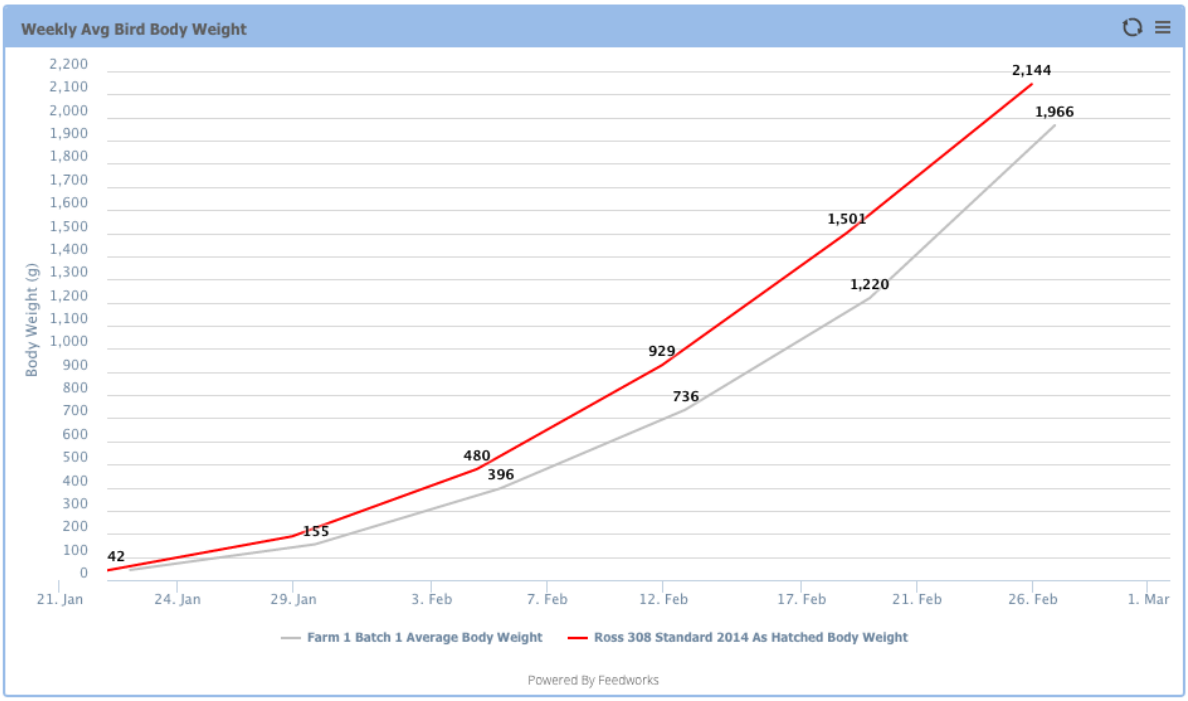

Figure 3.5a Farm 1 Batch 1 Weekly Average Body Weight (g)

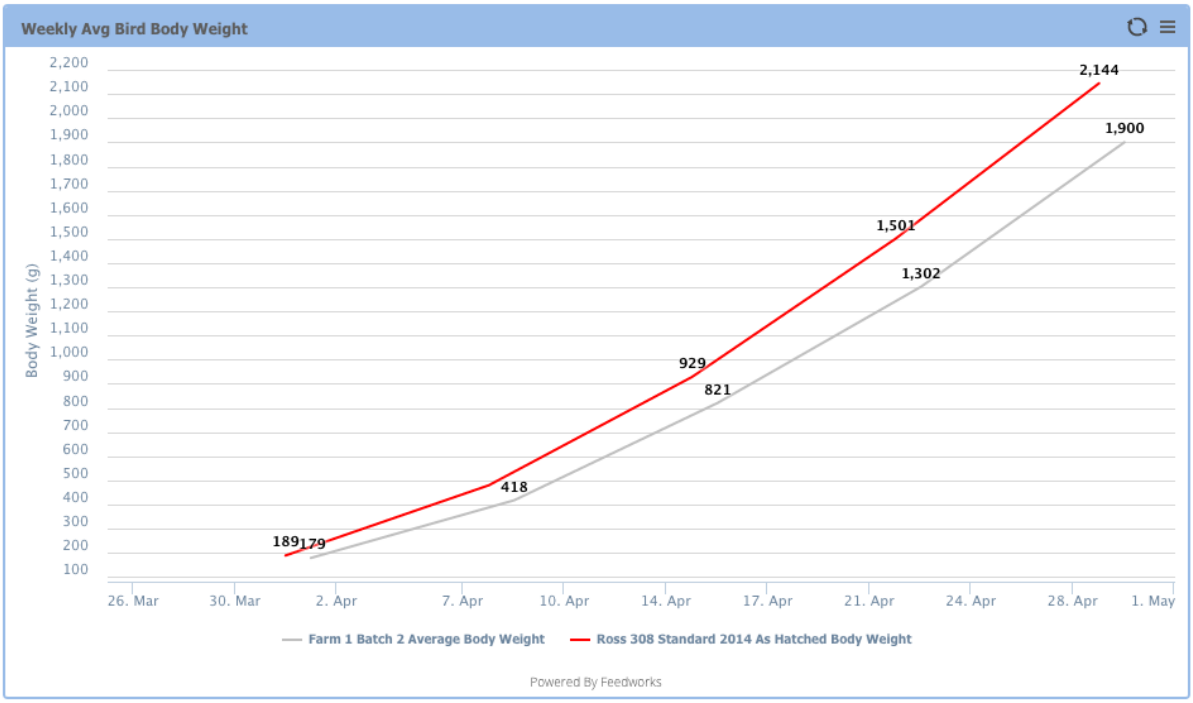

Figure 3.5b Farm 1 Batch 2 Weekly Average Body Weight (g)

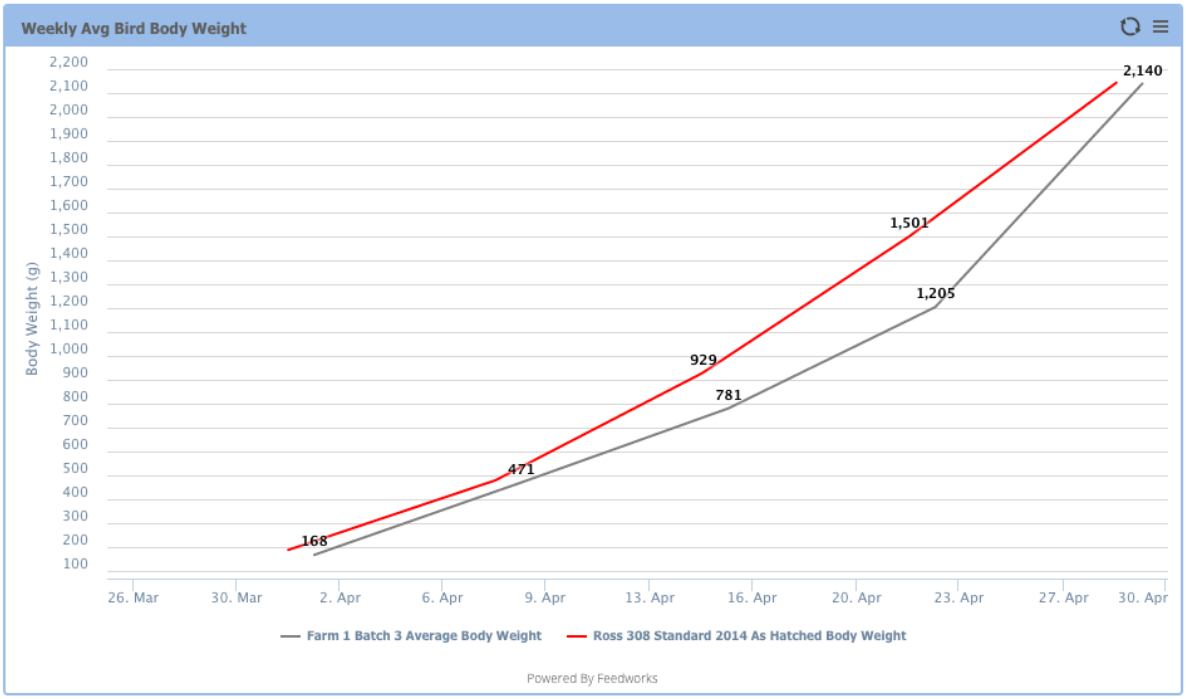

Figure 3.5c Farm 1 Batch 3 Weekly Average Body Weight (g)

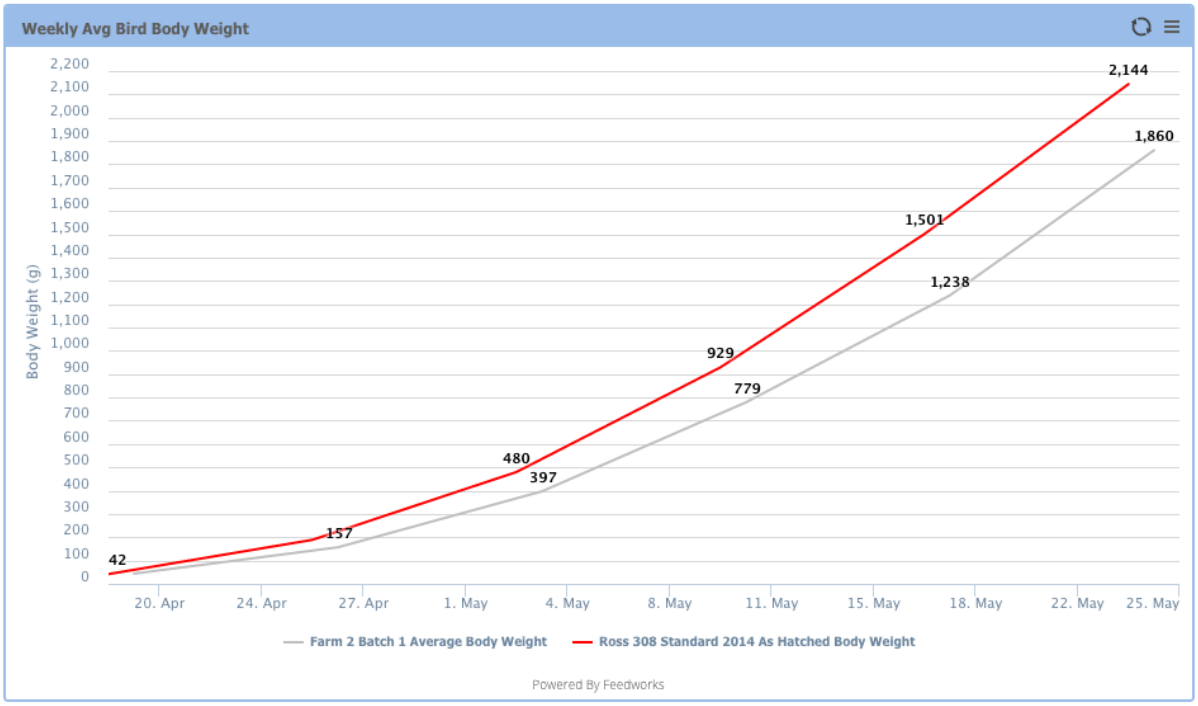

Figure 3.5d Farm 2 Batch 1 Weekly Average Body Weight (g)

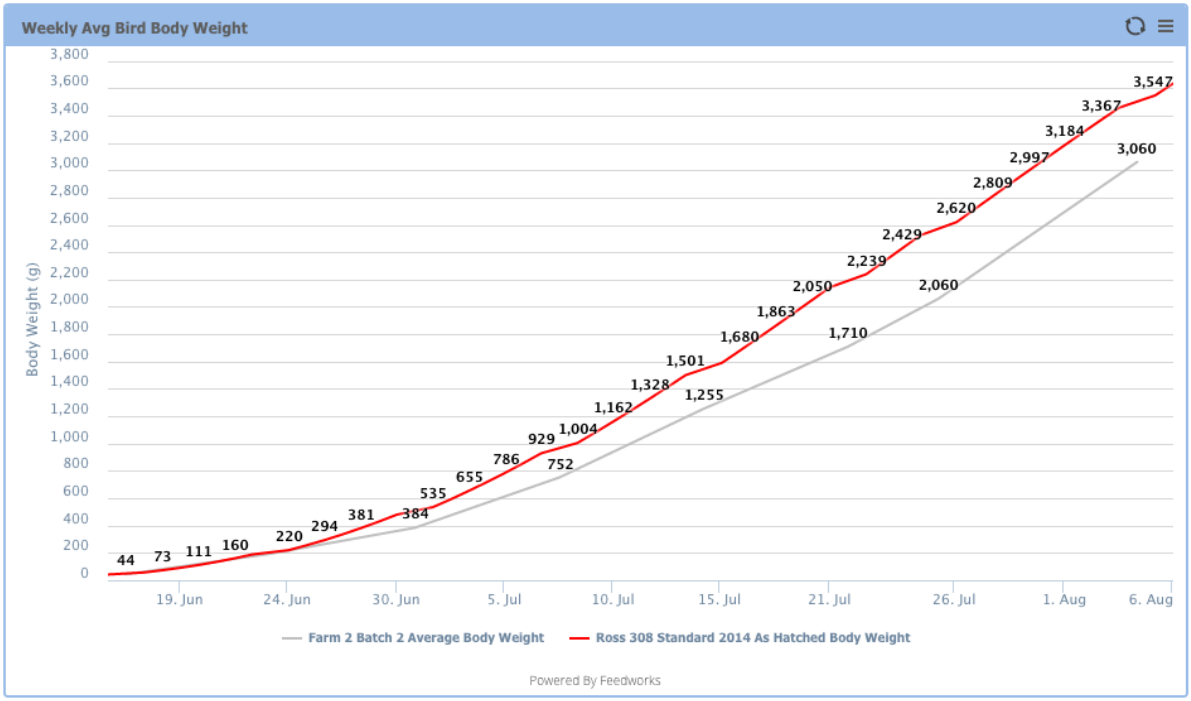

Figure 3.5e Farm 2 Batch 2 Weekly Average Body Weight (g)

3.2 Bird mortality

Daily mortality data for Farms 1 and 2 are shown in Figures 3.6a-c and 3.6d-e, respectively. Mortality data for Farm 1 Batches 1 and 2 are within commercial expectations and no significant health challenges were encountered during the project period. A spike in mortality is shown for Farm 1 Batch 3 (Figure 3.6c) on the 4th May which is one day after daily water consumption is reported as being significantly lower than expected. This time period also coincides with pick-ups from the shed and it may be possible that the water remained unavailable at the conclusion of the pick-up. Farm 2 mortality remained high after the initial expected peak (circa day 3) and continued to remain higher than expected for approximately 28 days into the batch cycle. This is reflective of the compromised chicks that were received at placement.

Figures 3.7a-e show the number of live birds for each day of the batch cycle. All sheds started with similar numbers of birds at placement but the rate of decline of live bird numbers in Farm 2 Batch 1 (Figure 3.7d) for the first 28 days reflects the higher mortality and culls as a consequence of their compromised start. Sharp declines in bird numbers are also indicative of the number of birds collected for processing.

Bird mortality is critical to welfare and production efficiency. Although daily counts are currently, conducted, the ability to review previous flocks on farms, within sheds and seasons can be difficult. By entering this data into one platform, it is possible to report on the expected performances of farms, sheds and even seasons and could be incorporated into charts such as how the Ross 308 standard feed intake and body weight objectives were presented in this project. Information will be readily accessible from smart devices within the sheds and allow growers to track their real time performance, something that is not widely available currently. This information will enhance decision making and enable management to make informed decisions in real time.

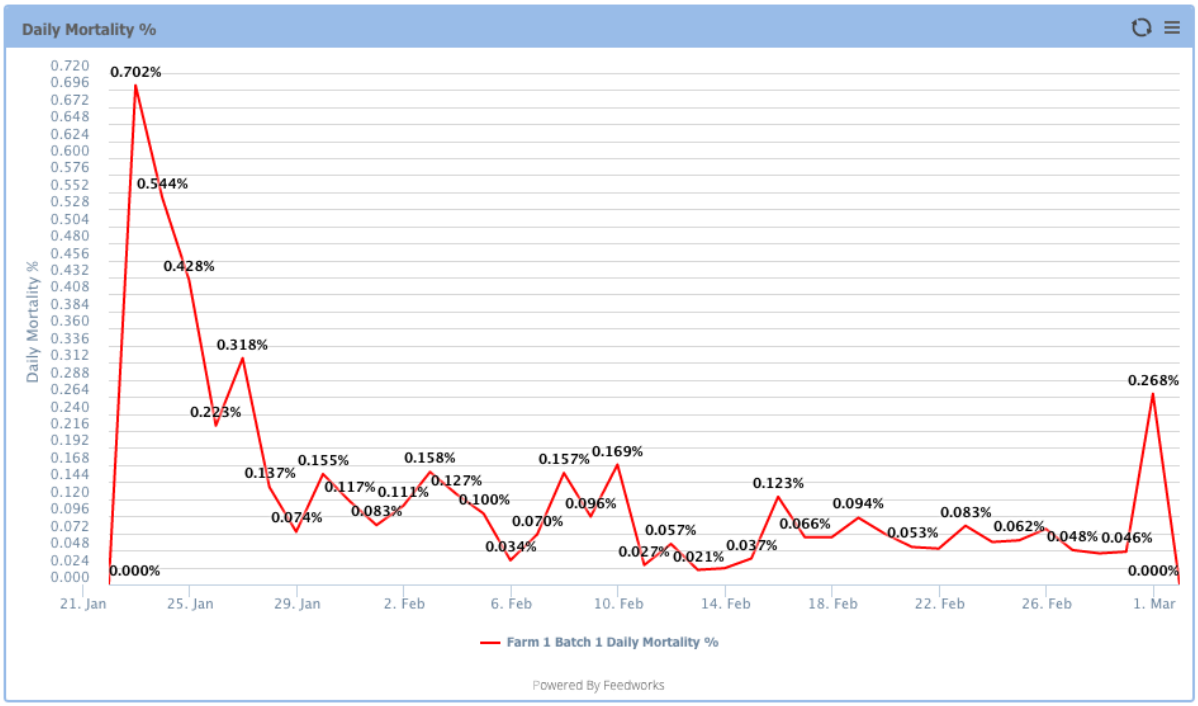

Figure 3.6a Farm 1 Batch 1 Daily Mortality (found deceased and culls) expressed as a % of flock count

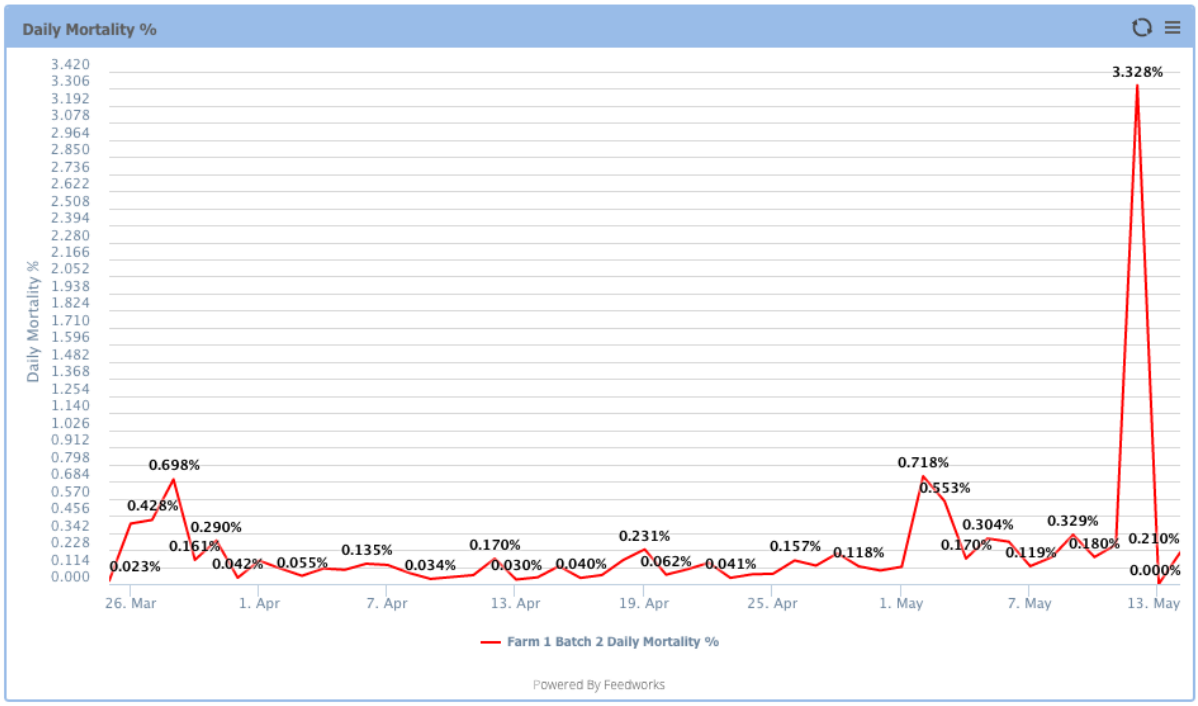

Figure 3.6b Farm 1 Batch 2 Daily Mortality (found deceased and culls) expressed as a % of flock count

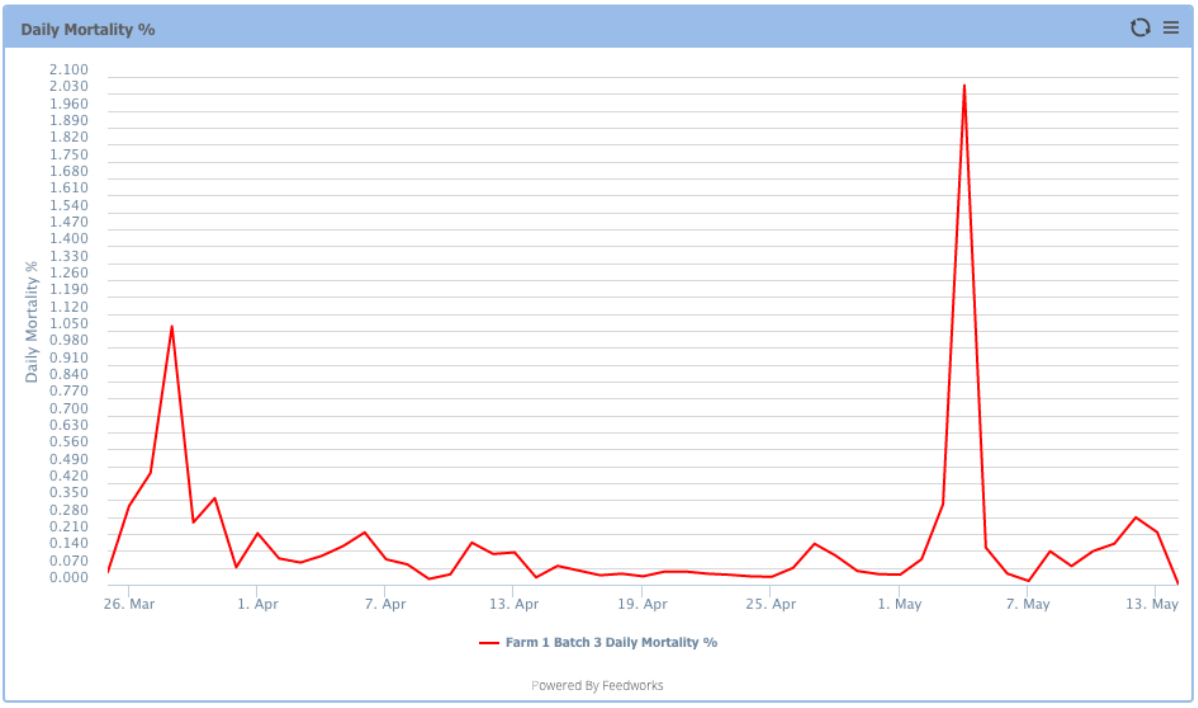

Figure 3.6c Farm 1 Batch 3 Daily Mortality (found deceased and culls) expressed as a % of flock count

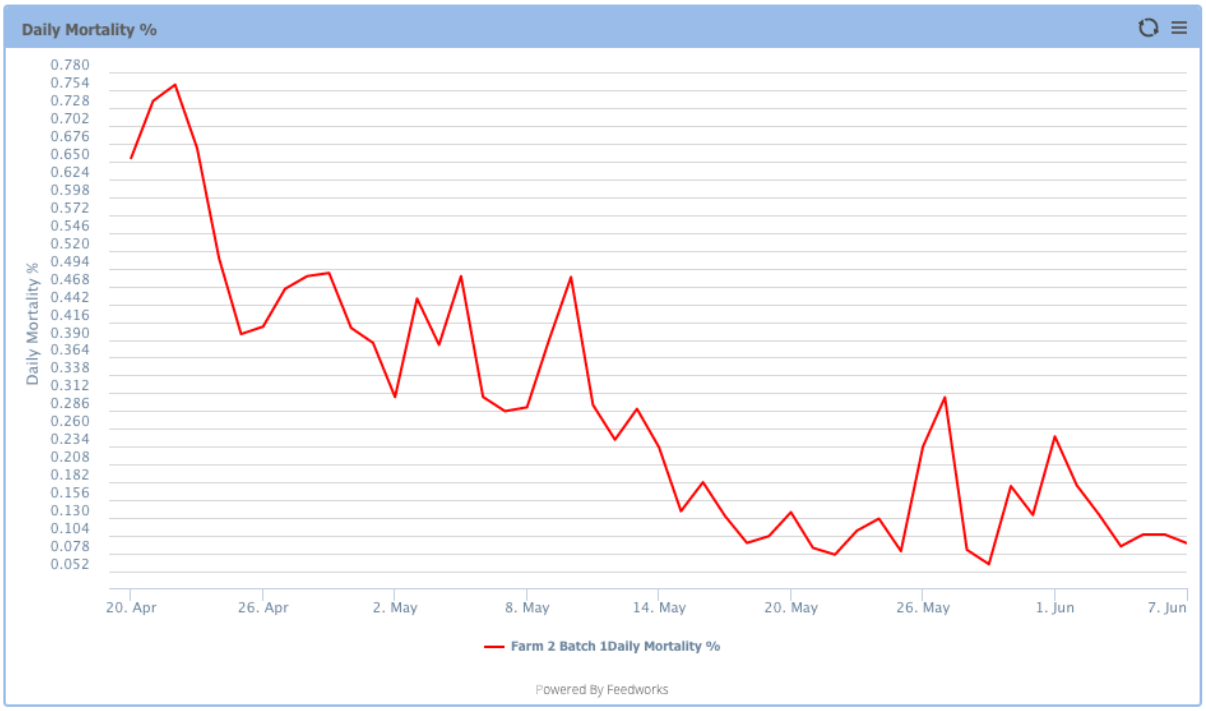

Figure 3.6d Farm 2 Batch 1 Daily Mortality (found deceased and culls) expressed as a % of flock count

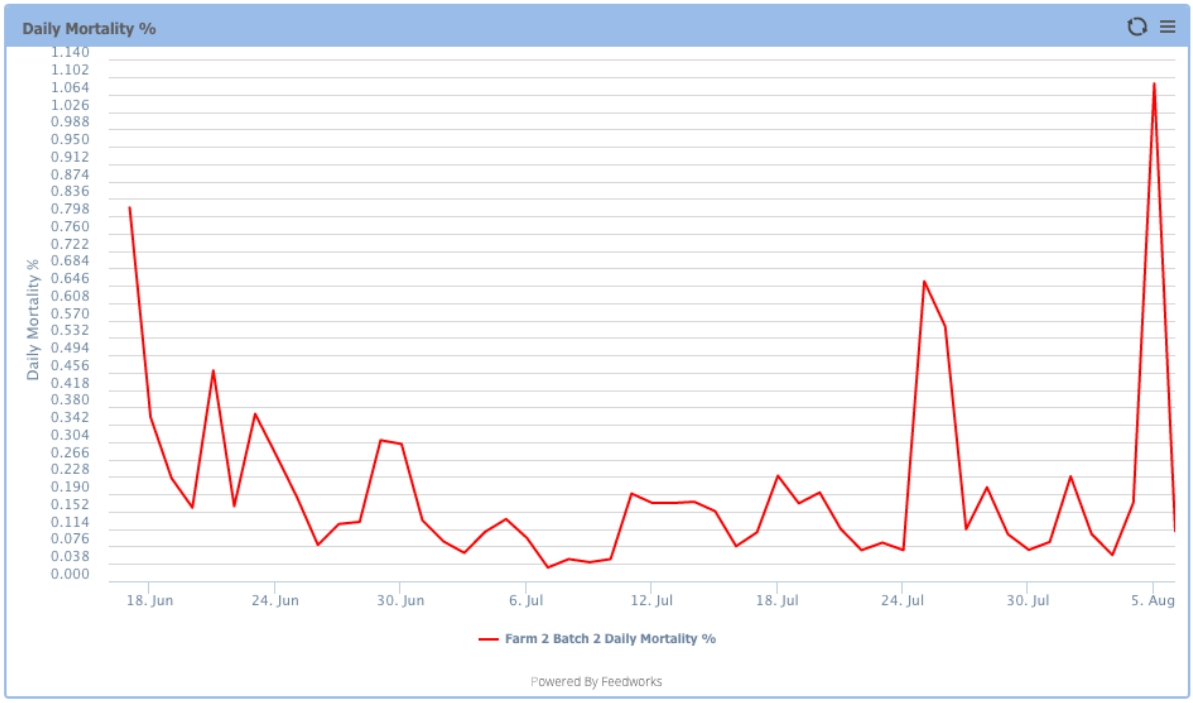

Figure 3.6e Farm 2 Batch 2 Daily Mortality (found deceased and culls) expressed as a % of flock count

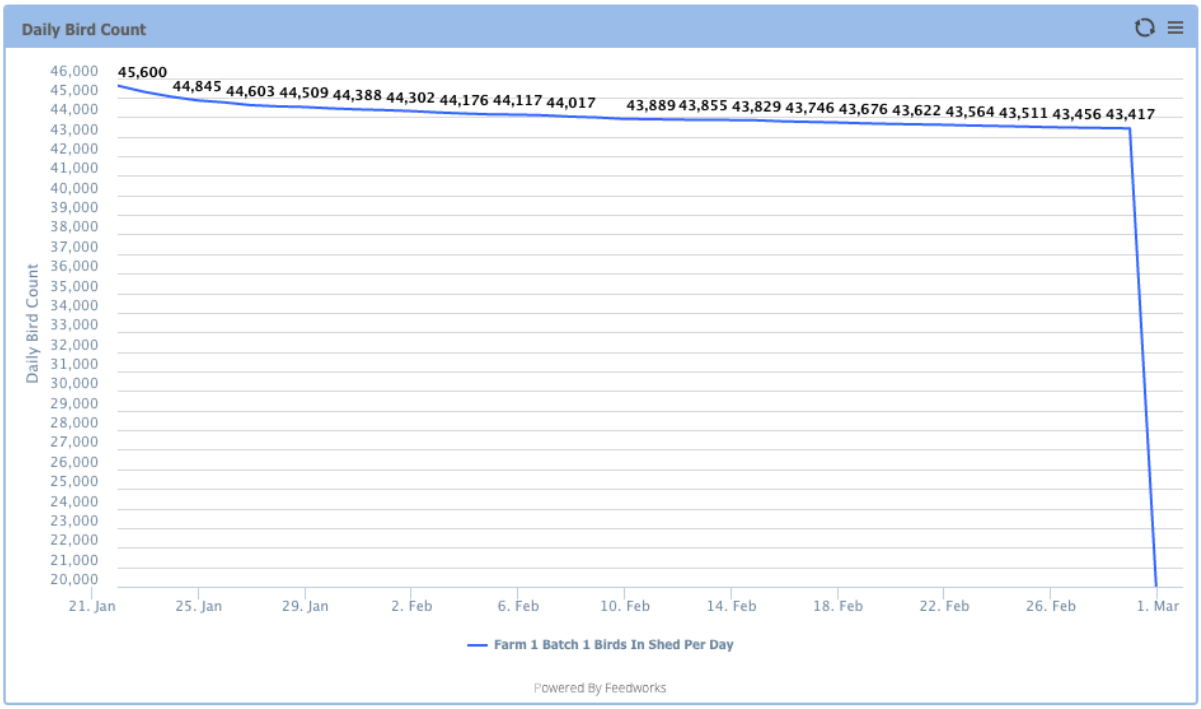

Figure 3.7a Farm 1 Batch 1 Birds in shed per day

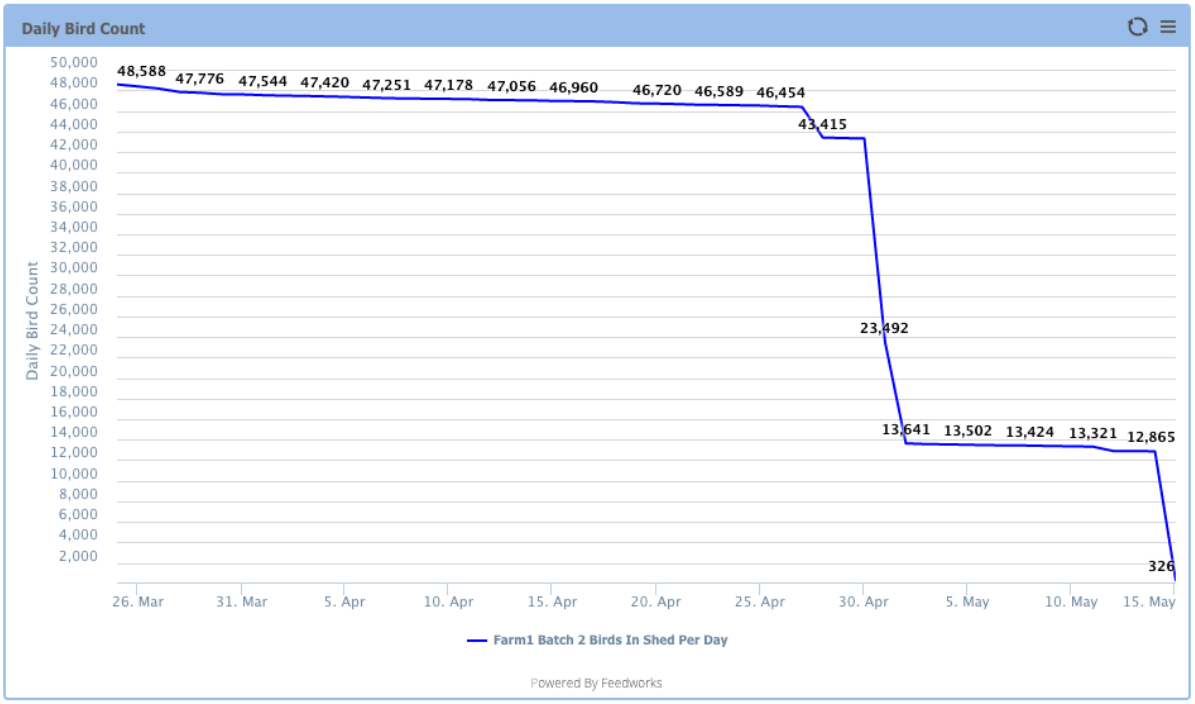

Figure 3.7b Farm 1 Batch 2 Birds in shed per day

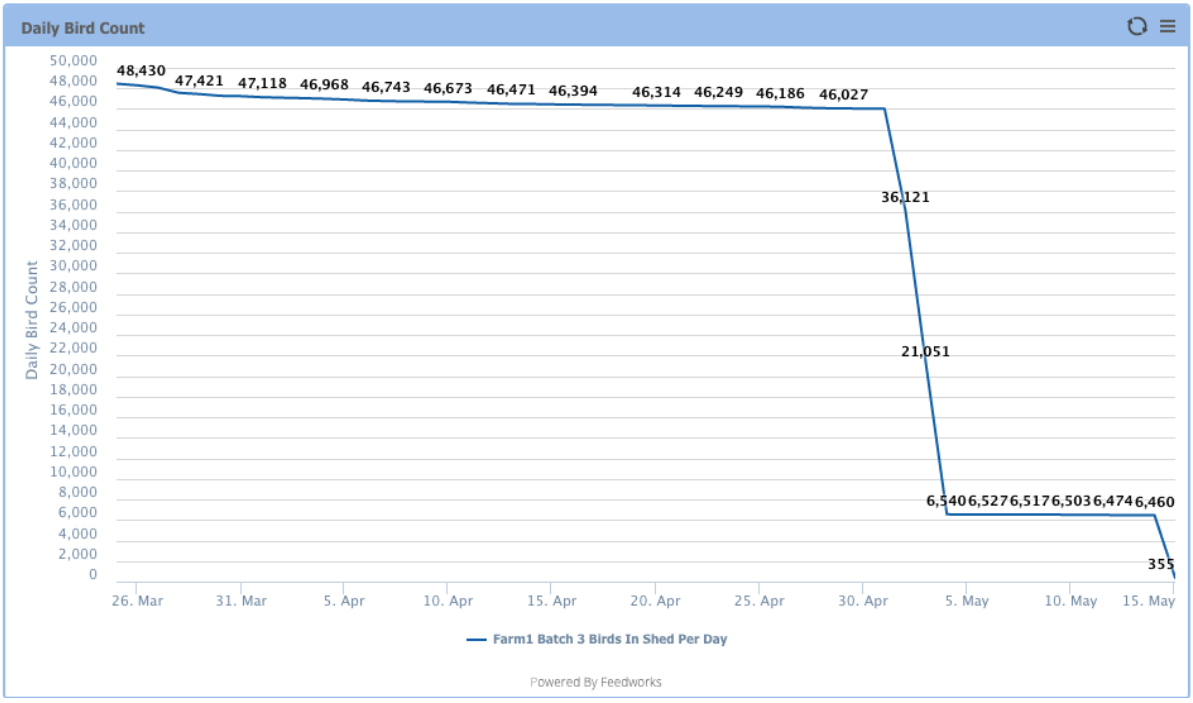

Figure 3.7c Farm 1 Batch 3 Birds in shed per day

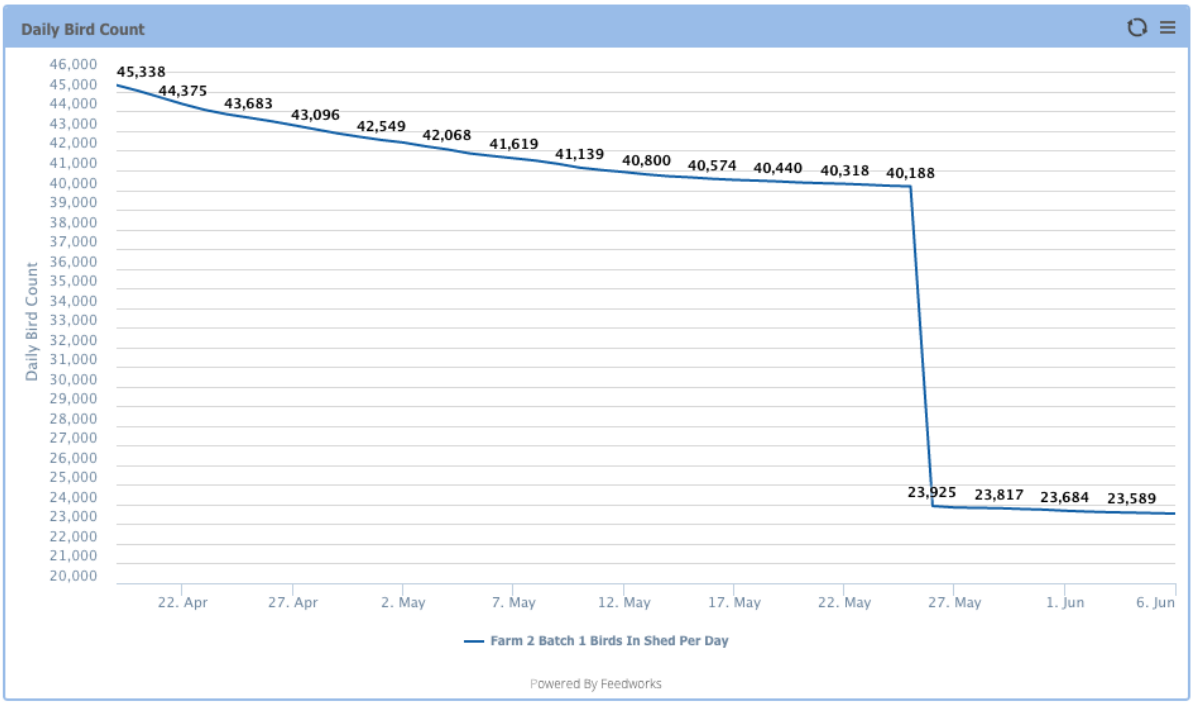

Figure 3.7d Farm 2 Batch 1 Birds in Shed Per Day

Figure 3.7e Farm 2 Batch 2 Birds in Shed Per Day

The daily maximum and minimum temperatures shown in Figures 3.8a-e are those recorded by the temperature probes at the inlet end of the shed with no corrections for ventilation and wind chill. It would be possible to incorporate the calculated perceived temperature by the birds in future iterations of Idas. By recording and reporting data in the one platform, shed performance will be able to be benchmarked against other sheds on the property and/or within the company, affording more

effective management. Feed intake and water intake would also be able to be evaluated in relation to shed temperatures.

Figure 3.8a Farm 1 Batch 1 daily air intake maximum and minimum temperatures (°C)

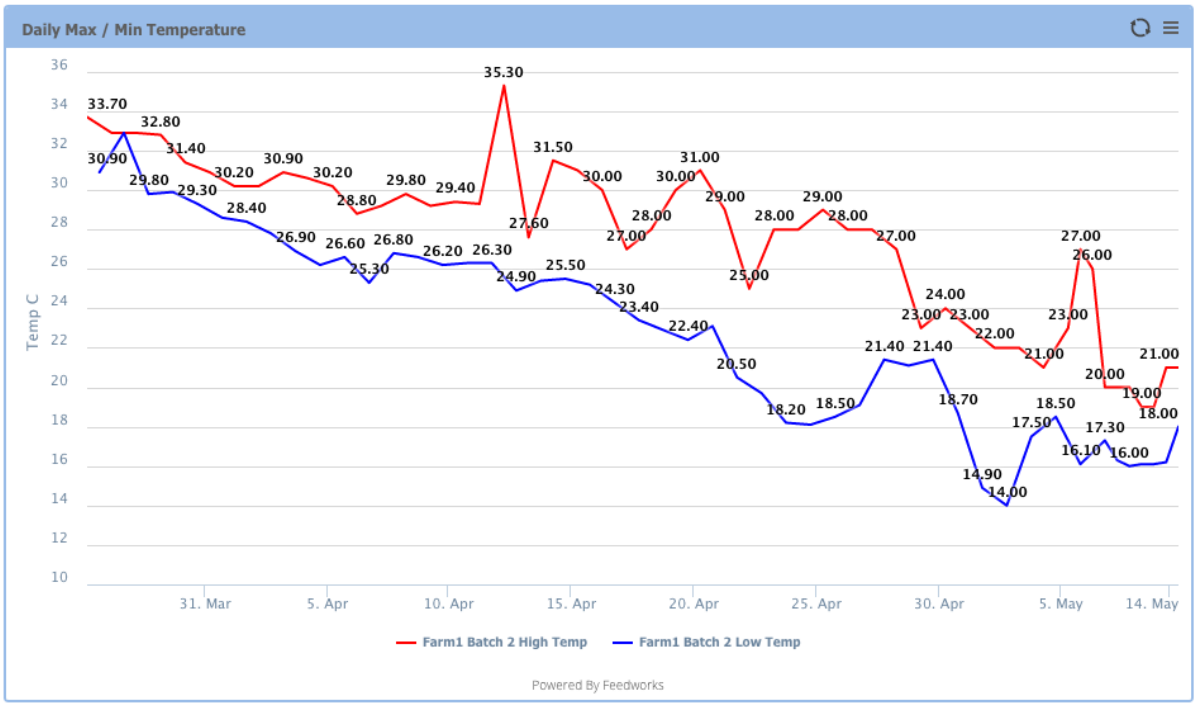

Figure 3.8b Farm 1 Batch 2 daily air intake maximum and minimum temperatures (°C)

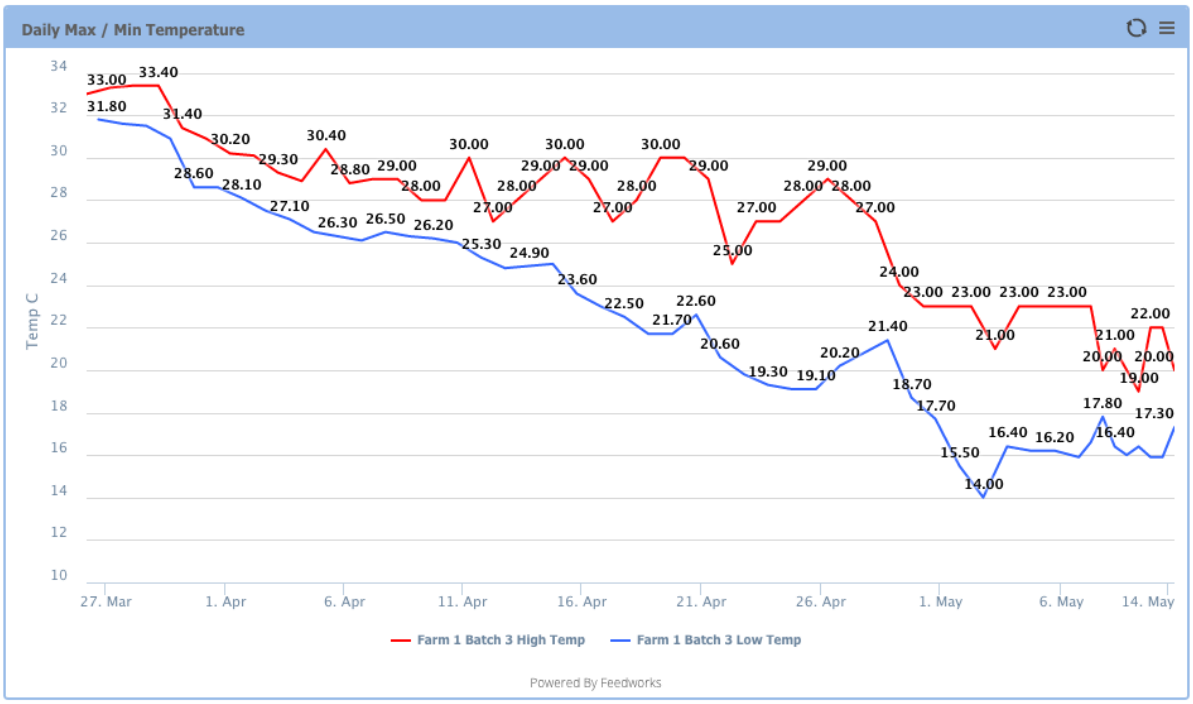

Figure 3.8c Farm 1 Batch 3 daily air intake maximum and minimum temperatures (°C)

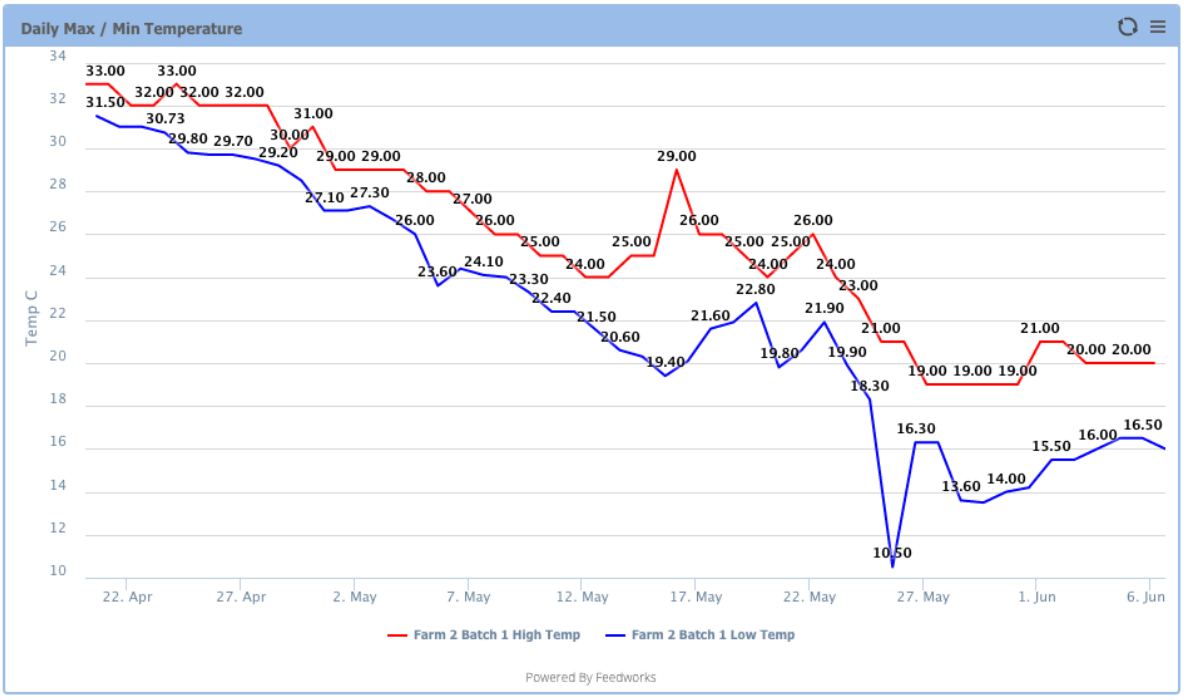

Figure 3.8d Farm 2 Batch 1 daily air intake maximum and minimum temperatures (°C)

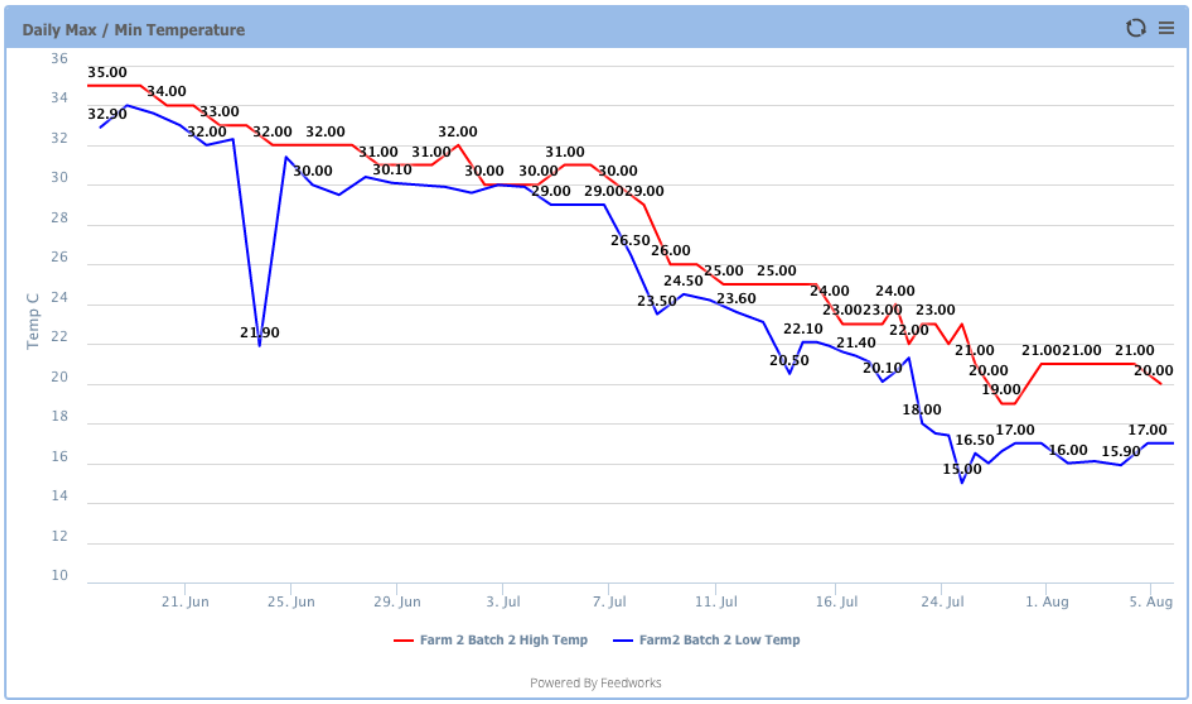

Figure 3.8e Farm 2 Batch 2 daily air intake maximum and minimum temperatures (°C)

4.0 Future development

The project was successful in achieving its objectives of developing and installing novel technology to accurately monitor feed intake as determined by weighing feed along the auger line, a first of its kind. While other systems are available to report feed intake and shed parameters, none utilise the same Feed Metering technology or have the same accuracy. By accumulating data from other sensors within the shed in combination with the feed intake data acquired using Feed Meters, there is a unique opportunity to provide real-time reporting and alerting functionality for poultry producers.

Development of Idas for poultry continues with further automation of reporting (cumulative mortality, batch days) and alerting functions currently being designed. Batch comparisons are also at an advanced stage of development, an example of which is shown in Figure 4.1 which indicates the combined mortality and cull data from multiple batches of birds acquired during this project. It is envisaged that all data relative to each batch, including weekly and overall FCR will be accessible within a short period of time after this project has been completed. Further refinement of the smart device APP used to enter data from within the shed is also continuing.

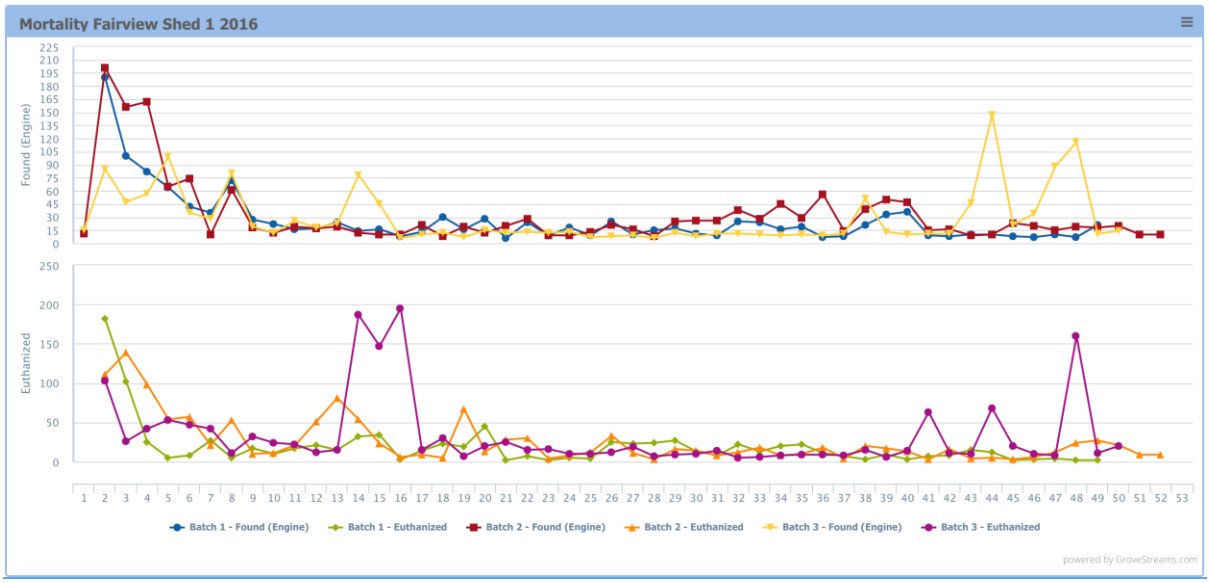

Figure 4.1 Mortality and cull data from multiple batches.

5.0 Concluding comments

During the project, Idas was programmed to send alerts to the farm manager warning of excessive auger run times or when the auger had not run for a period of time. Excessive run time of augers could indicate an equipment malfunction and lead to feed spilling onto the litter which would likely lead to increased feed spoilage and reduced efficiency. Conversely if augers do not run for extended periods of time, birds will be deprived of feed causing reduced performance. The production issues observed in Farm 2 birds were all reported in Idas and this information will be used to establish intelligent alerts for future production cycles.

The project was successful in developing a new technology to accurately measure feed intake and water consumption and to combine these to provide key performance indicators (Objectives 1 and 2). This information was then able to be used for reporting of shed and farm performance in real time, facilitating informed decision making (Objective 3). The real time intelligent alerting functions were also developed and proved useful for management to investigate shed performance issues (Objective 4). Idas was proven in this project to provide key information such as feed intake, intelligent alerts and reporting in real time. The benefits of the aforementioned will drive informed decision making and production efficiency.

6.0 References

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