SHEEPCRC

mla MEAT & LIVESTOCK AUSTRALIA

final report

Project code:	A.SCT.0005
Prepared by:	Rob Shepard – Estock Systems, Perth WA
	Ian McFarland – DAFWA, Narrogin WA
	Bill O'Halloran – NSW DPI, Armidale NSW
Date submitted:	June 2007

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

Linking live sheep and carcase data via RFID
Traditional (non- inverted) chain

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

1 Abstract

This project was undertaken to develop, test and report a system to monitor and track individual sheep fitted with Electronic IDentification (EID) ear-tags in an abattoir from slaughter to the weigh station using radio frequency identification (RFID) technology.

Existing abattoir carcass gambrel skids were fitted with high frequency (HF) RFID transponders. The sheep's EID ear tag was read and associated automatically to the skid RFID on the slaughter floor.

Weight and grade information was then associated to the individual sheep.

Suitable RFID technologies were investigated and it was found that high frequency (HF) was the most appropriate frequency to use for tracking the skids in the abattoir environment as it did not interfere with the low frequency (LF) EID ear tags used in the sheep.

Trace-back and automatic matching of individual animals and their kill data is now possible on a traditional non-inverted chain.

2 Executive Summary

Radio frequency identification (RFID) technology provides the opportunity to accurately track and monitor individual sheep from farm to abattoir. The ability to monitor individual animal performance provides opportunities to identify groups of animals that have similar traits and then apply better management strategies to deal with those similarities. Historically abattoir feedback has provided information on lines of sheep. The ability to gain carcass feedback on individual animals from the abattoirs would add value to the changing on-farm management regimes. The potential threat from exotic disease outbreaks has also increased the importance of being able to trace individual animals from farm to abattoir. This project was undertaken due to the fact there was no tracking system available for a sheep abattoir.

This project was able to demonstrate that a sheep electronic identification (EID) could be captured within an abattoir environment and associated to a skid and gambrel radio frequency identification (RFID). This in turn links the individual sheep EID with its carcass information. Associated software systems were developed to record the RFID information, track the carcass to the weigh scales and record weight and fat for each carcass.

The system was developed on a non-inverted chain at Hillside Abattoir in Narrogin, Western Australia. It was tested with the assistance of three Q lamb producers supplying lambs fitted with EID ear tags, to Hillside Abattoir. The EIDs of these lambs were successfully assigned to an RFID embedded skid and gambrel and the data was automatically captured at the weight and grade station and recorded in a Microsoft Excel spreadsheet. The key components of the system are described below.

Recommended components:

- Skid RFID: 16mmØ Sokymat 161 13.56MHz Logi-Tag laundry transponders
- Gambrel/skids - transponders injection moulded into existing plastic abattoir skids by SCL
- FEIG MR101A 13.56MHz reader controller
- Electrocom / SCL Harsh environment 120mm wide antenna
- Sheep EID Reader: Allflex 134.2 kHz FDX-B and HDX with 3 amp 12 volt DC power supply
- Sheep EID Antenna: Direct contact modified Allflex flexi-reader encased in food grade white Nitrile rubber
- Sheep EID Pre-read blocker: Controller and 2 carcass detection trippers

The principals of the tracking system can be adapted to most small animal abattoirs and is ready for immediate implementation.

The supply chain from producer to processor stand to benefit from the traceability the system now provides. Improvements in the feedback opportunities should add value to all these sectors also.

Contents

3 Background

3.1 Introduction

3.1.1 Australian Sheep CRC Project 2.3.2

In 2003, Australian Sheep CRC Project 2.3.2 (Opportunities for use of individual animal identification in sheep meat production) began investigations into the use of electronic identification (EID) in prime lamb production systems. In collaboration with six Q Lamb producers, the performance of feedlot lambs were monitored on farm and this data was linked to carcase data at slaughter at Hillside Meats Abattoir, Narrogin W.A. Initially a manual tracking system was used to link the sheep EID with the carcass. This was followed by the development of a portable radio identification (RFID) system using a Symbol Pocket PC and an Allflex blue tooth stick reader.

Whilst this portable system worked well it was recognised that an automatic system could provide further benefits to the producer and processor. Hillside Meats abattoir owner, Peter Trefort was interested in being able to track individual lambs or hoggets through the abattoir and link live animal performance to carcass performance. No commercial system existed to do this. In consultation with Stephen Harvey of Manutech Pty Ltd a draft project description was developed (Harvey 2004).

3.1.2 Project MLA SCT 005 Linking Live Sheep and Carcass Data via RFID

In 2005, the Sheep CRC and MLA commissioned a project to complete the design of a tracking system and install a demonstration system into Hillside Abattoir. Gerry Wind of Sunshine Technologies was contracted to design and develop the hardware components and Rob Shepherd of Estock Systems developed the tracking software and system interface.

Whilst a prototype system was installed there were a number of reliability issues with some of the technology. This report describes the processes and issues encountered in developing the final system to capture the individual EID of live sheep and relate that to a RFID embedded in a skid, capture the weight and grade score of the carcass and provide this via computer software to the processor and producer.

4 Project Objectives

4.1 Project Objectives

The objectives of this project were:

- To install a RFID tracking system within the Hillside Abattoir, in order to transfer ID from a sheep ear tag to the skid/gambrel carrying the carcase and have this information read and available for integration with weight and fat data at the carcass measuring station in the abattoir.
- To document the process of installing the RFID technology at Hillside Abattoir so that a similar installation can be undertaken at other sheep and beef abattoirs.

5 Methodology

5.1 Development Process

The process used to develop the carcass tracking system involved a number of steps. These included:

- System design (hardware and software)
- Prototype installation
- System testing
- Development and implementation of system improvements

5.2 Key Issues

Key hardware and software issues that needed to be addressed included

- Identification of the appropriate RFID frequency for abattoir carcass tracking
- Identification of the appropriate RFID transponders for abattoir carcass tracking
- Identification of the most appropriate option for installation of RFIDs onto gambrel skids
- Identification and testing of gambrel skid RFID reader
- Installation of trippers to detect non-readable RFIDs at initial reader station and weigh scales
- Positioning of readers at critical control points on the chain
- Development and installation of AVR (PLC) micro-controller to interface with the trippers
- Development, sighting and testing of animal EID ear tag reader
- Development of software to allow recording of RFIDs and checking of sequence issues
- Development of a programme to use the tripper event, RFID read and SASTEK data capture to associate the animal EID with the SASTEK generated body number
- Fine-tuning of weigh station data recording with positioning device for accurate read
- Installation of cabling to allow connection between readers and office data logging computer

6 Results and Discussion

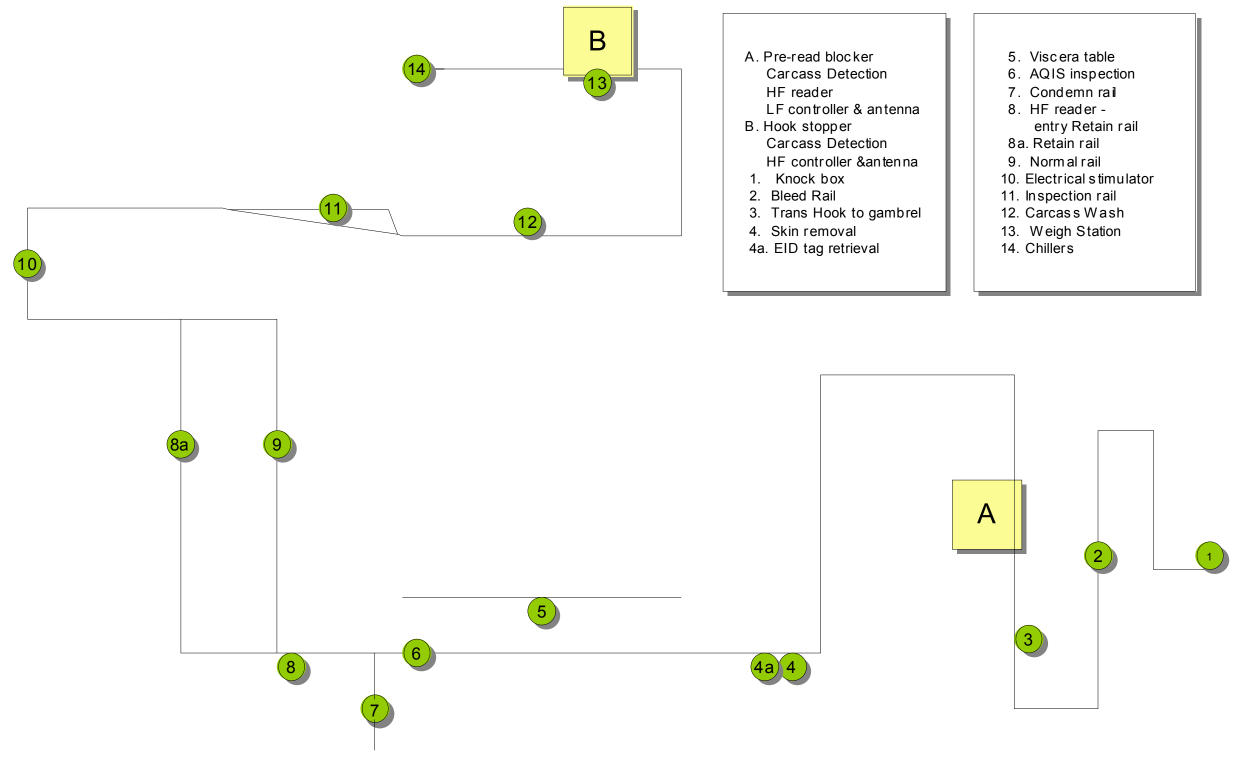
The project was able to demonstrate the concept of reliably capturing a live sheep RFID eartag and correlating this to its carcass body number and associated carcass data recorded at the weigh scales.

The project identified the appropriate equipment to install in an operating abattoir environment. The criteria considered was such that the equipment had to:

- be installed with as little disruption to the operation of the plant as possible,
- be available commercially at the end of the trial, and
- be able to withstand the harsh operating conditions within the abattoir over an acceptable period of time - i.e. withstand the wet and humid environment and washing regimes including the hot caustic wash and possible mechanical damage.

Diagram 1 shows a schematic floor plan of Hillside Abattoir and the location of various key components.

Diagram 1. Hillside Abattoir Floor Plan



The final recommended components are:

- Gambrel skid RFID: 16mmØ Sokymat 161 13.56MHz High Frequency (HF) LogiTag laundry transponders
- Gambrel/skids – transponders injection moulded into existing ITW-Fastek plastic (acetyl) abattoir skids by System Controls Limited (SCL)
- Sheep EID reader: Allflex 134.2 kHz FDX-B and HDX with 3 amp 12volt DC power supply
- Sheep EID Antenna: Direct contact modified Allflex flexi-reader encased in food grade white Nitrile rubber
- Sheep EID pre-read blocker: AVR (PLC) controller and carcass proximity detectors

The demonstration system at Hillside uses software that initially accessed the carcass data from the SASTEK data logging printer. Since the SASTEK system has been updated to a Interm12 it is now linked directly to the existing software framework.

Details on the development of each of the hardware and software components are described in the discussion below:

6.1 Ear tag EID Reader and Antenna

6.1.1 EID Animal Reader - Controller

An Allflex 134.2kHz FDX-B / HDX panel reader controller, coupled with various antenna derivatives was tested to read the animal's EID ear tag before head removal.

The reader controller is a standard Allflex unit and was wall mounted in a harsh environment stainless steel cabinet complete with its own 3 amp 12volt DC power supply. The original power supply was rated at 2amps but this was not sufficient for continuous operation with the antennas under development. The reader was originally connected to the host computer by RS422. This was changed to RS323 when the re-read blocker was installed.

6.1.2 EID ear tag Reader - Antenna

Hillside abattoir has very little background RF interference. The main chain is hydraulically driven so there are no vari-speed motors to create interference. The High Voltage (800 volt) carcass electro-stimulation unit appears not to cause any issues with the RF readers.

An underlying problem with reading eartag EIDs is the distance between the animals versus the read range of the antenna. Earlier antennas had a read range of over 1000mm in all directions, while the animals are only 900mm apart. This would not be a problem if all the animals were fitted with an EID and all were *either* FDX *or* HDX. As neither system is anti-collision*(1) the best oriented EID blocks the read of any other tags in the read-field. The problem arises when the animal in front of the reader does not have an EID or it is a different duplex to the next animal. There is therefore no blocking effect from the tag in front of the reader and the next animal can be read instead or as well. A similar situation arose with poor orientation of the tag in front of the reader coupled with a perfect orientation of the next EID.

**

**(1) Anti-collision is a system more commonly used with HF where the RFID reader can read all the RFID transponders in the read range of the antenna. As each RFID is read it goes quiet so it does not collide with the next and allows it to be read.*

The Original Allflex abattoir antenna was designed to read rumen bolus as well as ear EIDs. A curved leading edge was added to stop horned animals catching the antenna. This original antenna worked too well, with a read range of up to 1000mm.

However it was still possible to miss the occasional animal due to a perfect orientation of the previous or next animal blocking the read of a poorly orientated animal in front of the reader.

Swinging carcasses also posed a problem, as the oscillating carcasses would come in and out of orientation with the reader. A temporary stainless steel guard was added to stop the carcasses swinging.

It successfully stopped the carcasses swinging however AQIS was concerned about shorter animals dragging their feet along the top of it, leading to possible contamination issues.

The steel guard was then replaced with a curved guard made out of 2 sheets of food grade HDPE sandwiched around a layer of aluminium foil. The foil was designed to block the next carcass EID. Initial trials with foil wrapped around cardboard appeared to reduce the pre-reads of EIDs. The guard was very successful but the foil interlay proved ineffective.

A further development of trying to block pre- reads was to place a swinging shield between the tag reader and the next sheep. Again this was a sheet of aluminium foil sandwiched between two sheets of HDPE. The swing shield appeared to have little effect on the pre reads.

Post reads of the EID posed no problems as once an EID was read, it was added to a lookup stack of recently read EIDs on the host computer. Each new read is compared to the stack and if it has already been read it is ignored.
The end result a combination of directional short range antennas coupled with a reader output blocking device that is controlled by two trippers and give a read opportunity of about 150mm.

The wire coils were removed from a set of Allflex Flexi-antennas. These were then placed between two sheets of 10mm neutral (white) food grade HDPE (High Density Polly Ethylene). A channel was routed in both front sections of the panels and the coils were laid in them. The two sheets of each side were then coated in acid-cure RTV silicon sealer and pressed together and allowed to cure overnight. Both antennas were then seam welded to completely seal them.

The two flexi-antennas were set at 45° to oppose each other at rest. This causes the antennae to go out of tune drawing about 0.75amps while there is no animal to separate them.

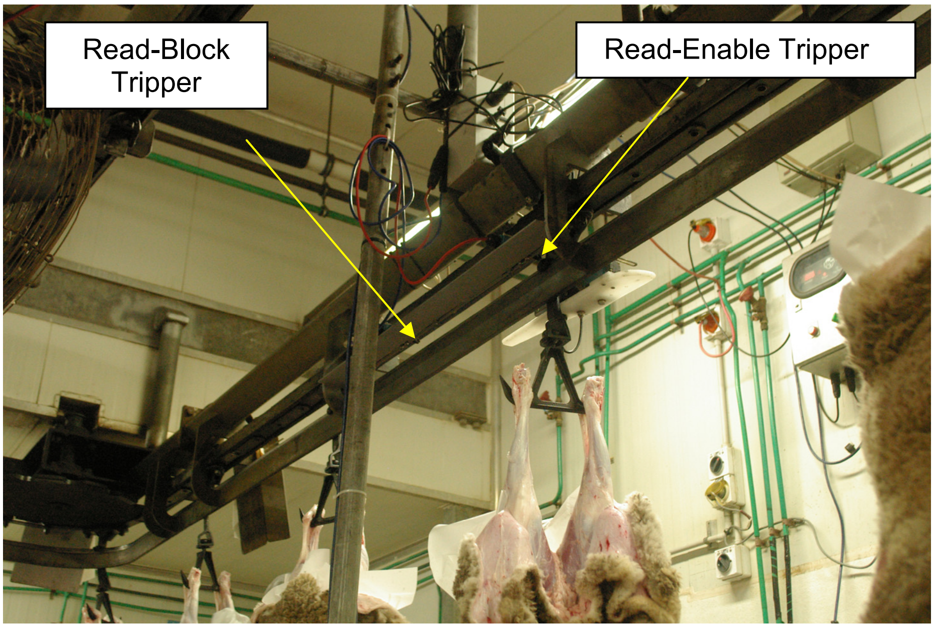
When the animal pushes between them they become parallel and re-tune to about 0.95amps and read the EID while in contact with the animal. The antennas then return to the closed state and once again de-tune.

6.1.3 EID Pre-read Blocker

The de-tuning of the antenna is only part of the solution to solving the pre-read of EID issue. A pre-read blocking unit has been developed that intercepts the serial output data from the Allflex reader before it is sent to the host recording system.

The pre-read blocker has two sensors (trippers) mounted in contact with the chain.

They are triggered by the metal blocks that push the skids along the rail. Both the read-enable and read-block trippers are slide mounted so they can be adjusted to adapt to any read-block combination.



The first or 'read-enabling' tripper is placed after the HF skid reader where the animals head first comes in contact with the closed and therefore detuned Allflex flexi-readers.

The second 'read-blocking' tripper is set to trip before the flexi-antennas reach full power as the animal pushes between the flaps. This has allowed us to achieve a 150mm read window and a 750mm read buffer from the next animal as the skids are spaced 900mm apart on the chain.

The serial output port of the Allflex reader is connected to the input port of the pre-read blocker. An optical isolator circuit and separate power supply had to be used as the Allflex reader would not read when connected directly to the pre-read blocker.

The Allflex reader reads every EID eartag that comes into range. It must be set to send every read mode otherwise it will miss most of the animal EID's during the read-block cycle. Other people have

tried de-powering the Allflex reader or stopping the exciter circuit, but this may result in the animal's EID being missed due to the delay as the reader powers back up.
The pre-read blocker continually monitors the serial output of the Allflex reader and ignores all data until the animal is between the two trippers and directly in contact with the flexi-antennas. The EID is then analysed to make sure it is a valid number and not a re-read of a previous animal. The pre-read blocker then sends the new EID only once to the Host computer.

6.1.4 Abattoir procedural changes at the eartag reader site

Although the tracking system has been installed at Hillside with the objective of being as least intrusive as possible, some procedural changes are inevitable.
Initially with the large Allflex antenna carcass orientation was not an issue. Now the new antenna is subject to a limited read opportunity, orientation has become important. Most observations on the kill floor showed the carcass's entered the reader head first. Adjustments to the pre-read trippers were made to cater for this. There is one operator that appears to have no control over which way the carcass leaves the leg lifter, and therefore the carcass can enter the reader in any orientation. If it enters feet first, the signal is blocked before the ears come in contact with the reader, and the animal EID can be missed.
A procedure needs to be put in place to instruct the leg lifter to place the carcass head first towards the reader. The system can be adjusted to go feet first if all operators wish this to be the case.

6.1.5 Alternative Antenna – Allflex Multi-coil Antenna

Prior to achieving a good EID eartag read result with the current contact antenna Allflex had begun the development of a potential alternate directional antenna. It is designed around a multi-core sequential-read directional cylindrical antenna. This antenna has a short directional read range and may have been an alternative EID eartag reader in a high RF noise plant.

Allflex modified Flexi-reader:
A flexi-reader has been modified and constructed in food grade white Nitrile rubber.
This is a fixed mounted flexible antenna that allows the carcasses to push between the antenna elements to ensure a contact read of the eartag EID. This arrangement still takes advantage of the de-tune effect.

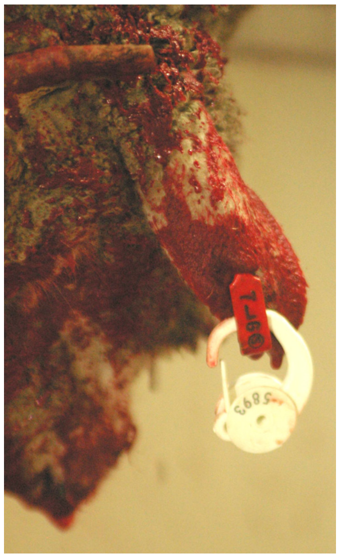
The white Nitrile flexi-reader has been trialled at Hillside and has now replaced the white HDPE reader with excellent read results. The only concern is the durability of the contact adhesives used to laminate the antenna panels.

6.1.6 Testing the EID eartag reader

A system for testing the Allflex EID reader and antennas was developed using a protocol of 3EID - Miss one - 3EID sequence. The EID eartags are a mixture of HDX and FDX from various manufacturers. This sequence immediately shows up any mis-reads or pre-reads.

Yachting clips are used to temporarily attach EID tags to animals. The clips are either clipped to an existing ear tag or slipped over the ear.

Above is an example of the yachting clip along with an Allflex HDX, Allflex FDX-B and a Leader FDX-B. This system allows easy testing of equipment during development. Once the system is working correctly, animals that have been tagged prior to entry to the abattoir can be tested.



6.1.7 Constraints

The issue of the 'pre-read' of EID tags, especially when the animal in front of the reader has no EID or a FDX EID tag and the following tag is a HDX EID tag has finally been resolved. The modified Allflex white Nitrile 'Flexi-antenna' combined with the pre-read blocking circuit now completely eliminates all pre-reads.

6.2 Gambrel Skid Transponders

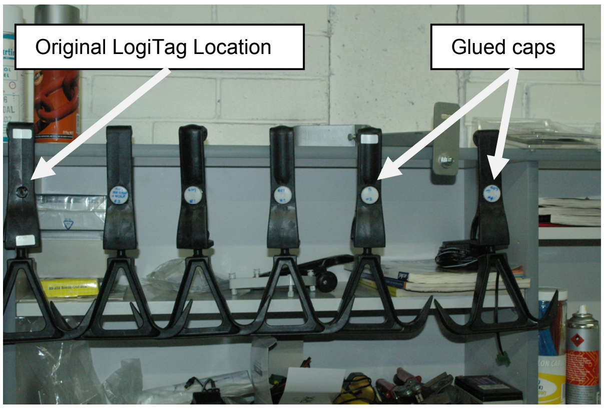
6.2.1 Transponders

a) The original proposal from Sunshine Technologies was to use passive dual frequency transponders attached to the gambrel skids. However testing the Allflex reader in the vicinity of the duel frequency reader completely blocked the LF part of the dual frequency reader.
b) To avoid any further conflict with the LF EID tags and readers used with the sheep high frequency (13.56MHz) was chosen for the skid transponders.
c) A transponder developed for tracking clothing in laundries made by Sokymat was chosen to track carcasses. It is a Sokymat 161 13.56MHz LogiTag that is 16mm in diameter and 3mm thick at its deepest point.
d) LogiTags have a high tolerance to heat and are encased in a plastic that is meant to be impervious to acids and bases and petroleum.

Unprotected, the caustic solution from the wash eventually penetrated the outer casing of the LogiTags causing the transponders to slowly fail over a period of six months.

This problem was overcome by encapsulating the transponders by injection moulding them into the skids. (see 4.2.2)

6.2.2 Attachment of HF transponders to Gambrel Skids



Hillside abattoir use ITW-Fastek black acetyl skids and gambrels throughout the abattoir. The animal still has its head attached when the carcass is placed on the gambrel after the first legger.

4.2.2.1 Initially Sunshine Technologies attached the LogiTags to the centre of the skids by gluing them in a countersunk hole. Approximately 250 skids were initially fitted with transponders. These failed immediately with some of the LogiTags being ejected at each location where a load was put on the skid. A number of skids also snapped through the countersunk hole.

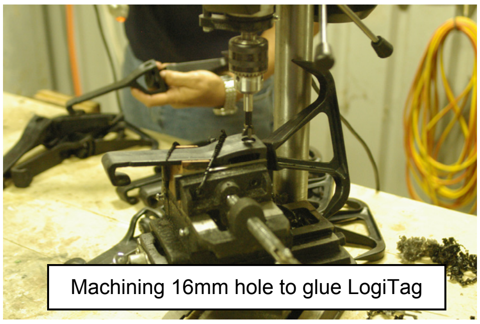
Heat Welded Cap & LogiTag

4.2.2.2 To overcome the weakness caused by the countersunk hole a number of options were trialled. An acetyl cap was machined to hold the chip to attach the LogiTag to the skid. Glue was used to attach the cap to the acetyl skid at the original position, but it failed to hold under the flexing of the skid. The cap was then heat welded to the skid in the original position. This held the caps under flexing but some skids broke upon leaving the chillers.

Cap & LogiTag

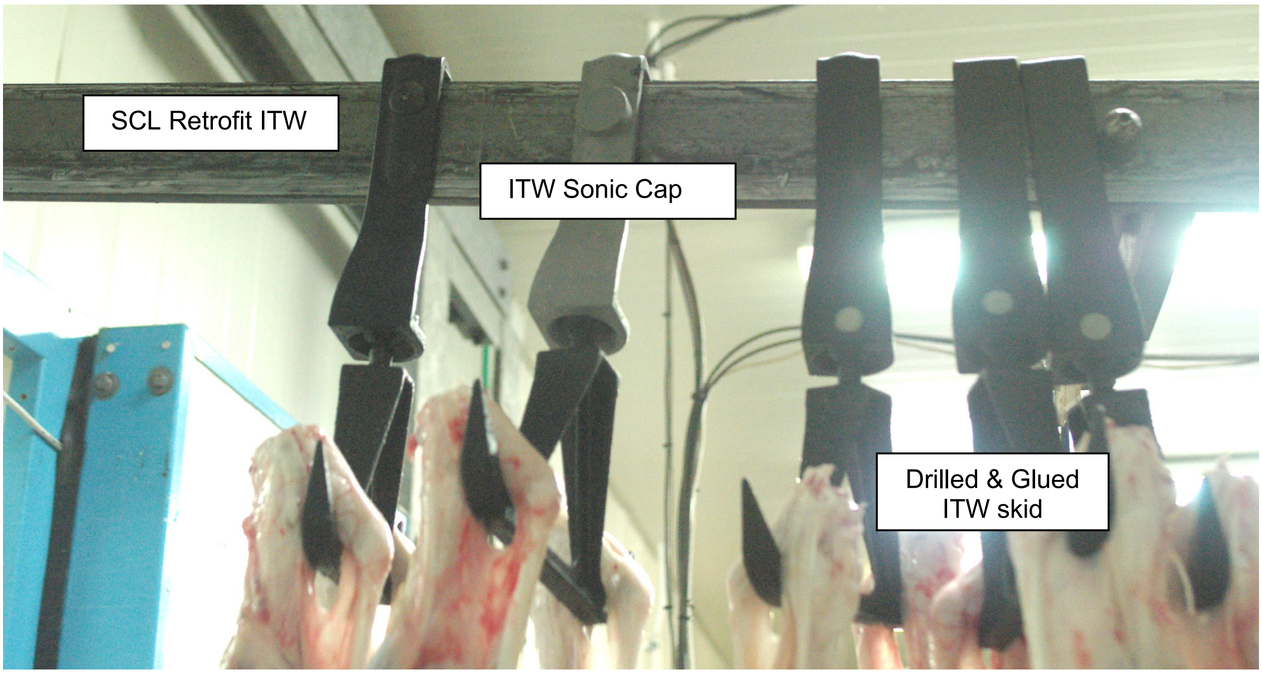
Testing of the skids indicated that some would snap like a carrot whilst others were unbreakable. This was due to the variations in the original moulding process causing the skids to behave slightly differently. Although all the skids were made of black acetyl, there was a great variation in the colour of shavings when you drilled a hole in the skid.

4.2.2.3 The caps were then welded lower on the triangle section of the skid. As the skid does not flex at this point, the LogiTags were glued in a 4mm deep a countersunk hole.


Machining 16mm hole to glue LogiTag

The gluing technique involved priming the skid with Loctite 707 primer. When this dried the hole was flooded with Loctite 406 glue and the chip pressed into place. It was then immediately dusted with baking soda to set it solid.

1700 skids were fitted with LogiTags using this method. The system worked well initially, however it was discovered that the daily hot caustic wash was slowly permeating the LogiTags. An audit of ‘live’ skids after 6 months operation highlighted that a number of transponders had limited reads or had failed completely. A daily audit was added to the monitoring software and the failing chips could be observed on a daily basis.



4.2.2.4.1 Three companies were approached for a solution to the problem. Two companies came up with potential solutions. ITW-Fastek the company that manufactures the skids and gambrels in use at Hillside came up with new idea of welding a cap over the chip. We pointed out the issues we had previously with welding acetyl and they said that as they were using a sonic welding process the skid should not be affected. There were two issues with this solution. Firstly they could not get the caps to seal completely so the LogiTags were potentially exposed to the caustic wash. Secondly as predicted some of them broke after leaving the chillers. ITW-Fastek are developing a new fully moulded skid. This product should be available in the second half of 2007.

Damage in chillers to sonically welded

4.2.2.4.2 The second company SCL (System Controls Limited) supplied a retro-fitted ITW-Fastek skid. SCL had routed a reverse dovetail hole into the top section of the skid where there is no flexing and injection moulded the LogiTag into place. The process fully encapsulated the LogiTag in an impervious plastic and held in place by the dovetail joint. 1420 skids have been injection moulded with transponders. 400 more are being fitted.

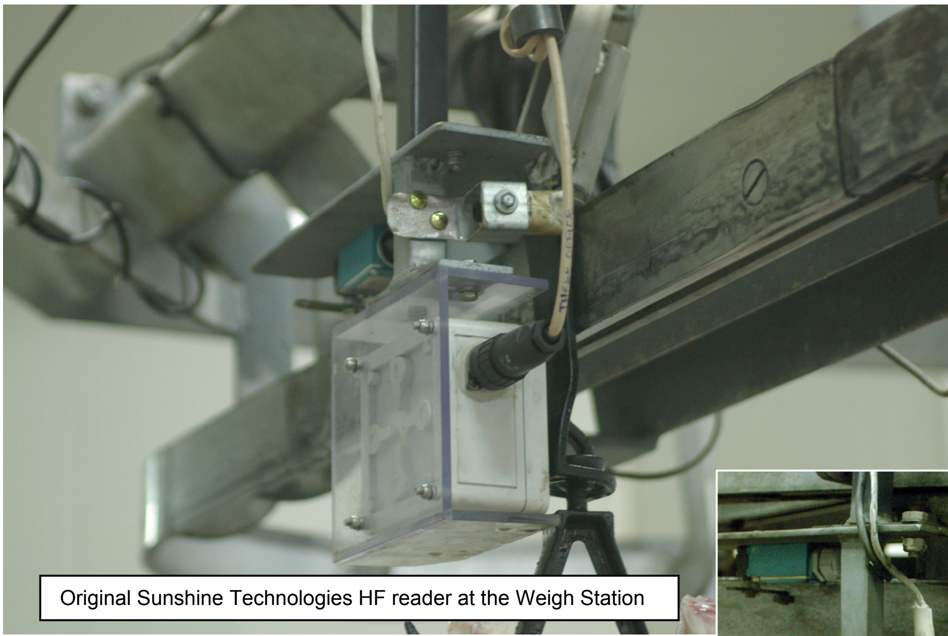
The SCL retro-fitted injection moulded ITW-fastek skids are currently the recommended solution for the tracking system.

Note: ITW-fastek need to pay attention to their moulding process as we have had 7 brand new skids failed due to moulding faults causing air pockets in the extremities of the skid.

6.3 Skid RFID Readers and Antennas

6.3.1 RFID Readers

The original HF 13.56MHz was supplied by Sunshine Technologies. It was single unit that had the antenna, read controller and serial interface all mounted on the one printed circuit board (PCB). This was housed in a standard mounting box. The output of this unit was RS485 (Hex) and connected to the host system via a 4 port RS485/USB hub. The system was a development kit and was supplied with a demonstration programme. Communication to the readers was through an 'Ingot' that has limited programmable flexibility and embedded in the main programme.



Original Sunshine Technologies HF reader at the Weigh Station

The continual contact of the skids on the reader face was wearing away the reader cover.

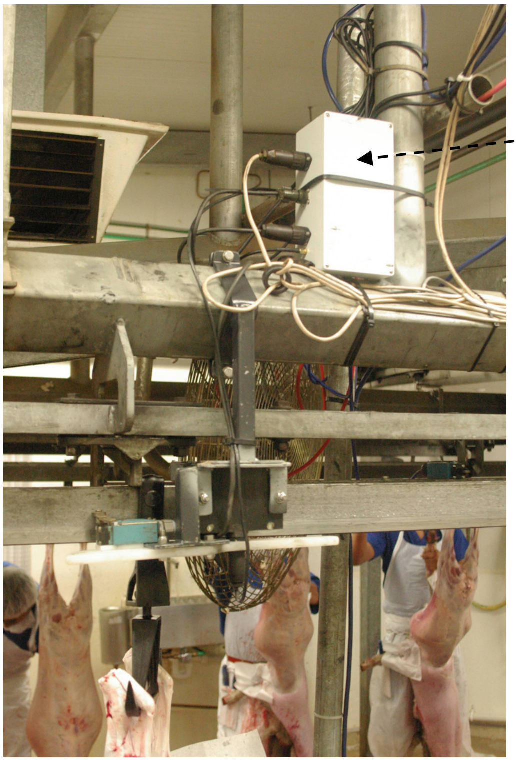
Intermittent reads and limited read range caused problems with reliable data capture.

To protect the HF reader from the harsh environment the reader was encapsulated in plastic (by SCL). The plastic used is very hard wearing and is used in the mining and farming industries in highly abrasive situations. The encapsulation was successful but did not address the limitation of the read range of this HF reader.

SCL Encased Sunshine Technologies HF reader on the Kill Floor

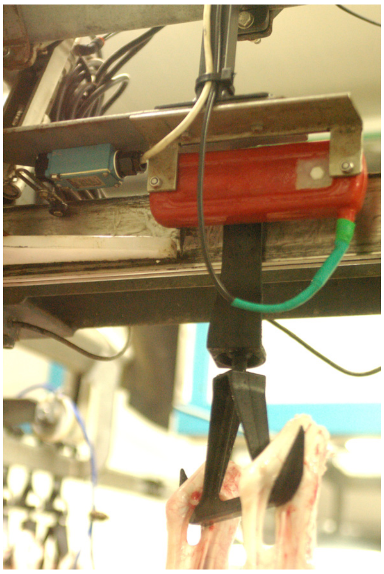
A FEIG MR101 13.56MHz HF reader was sourced from Electrocom to overcome the read range problem on the Kill Floor. The FEIG reader can be supplied with a 300mm x 300mm IP65 antenna, but as we were looking for a more compact reader Electrocom supplied an antenna they had manufactured in house. The antenna was a 76mm x 76mm printed circuit board antenna encased in black HDPE. The read range was significantly improved, and at the test site at the entry to the retain rail 100% reads were achieved. This reader was then moved to the location on the kill floor to try and achieve similar read success. This was not achieved as the operator in front of the reader would occasionally pull the carcass quickly through the reader, missing the RFID.

FEIG HF RFID antenna at the entry to the retain rail: Lower position for original chip location



Electrocom then supplied a larger antenna; 100mm x 76mm. This has been installed on the kill floor to replace the original reader.

The FEIG reader is housed in a box with a controller that intercepts the output from the FEIG reader and checks for duplicate reads, and reads the skids that have passed. The controller communicates with the host computer. The FEIG reader and controller will need to be housed in a stainless steel cabinet mounted on the wall.



SCL have produced a 120mm moulded antenna. This has been installed at the scales and is working well.

6.3.2 Carcass Detection

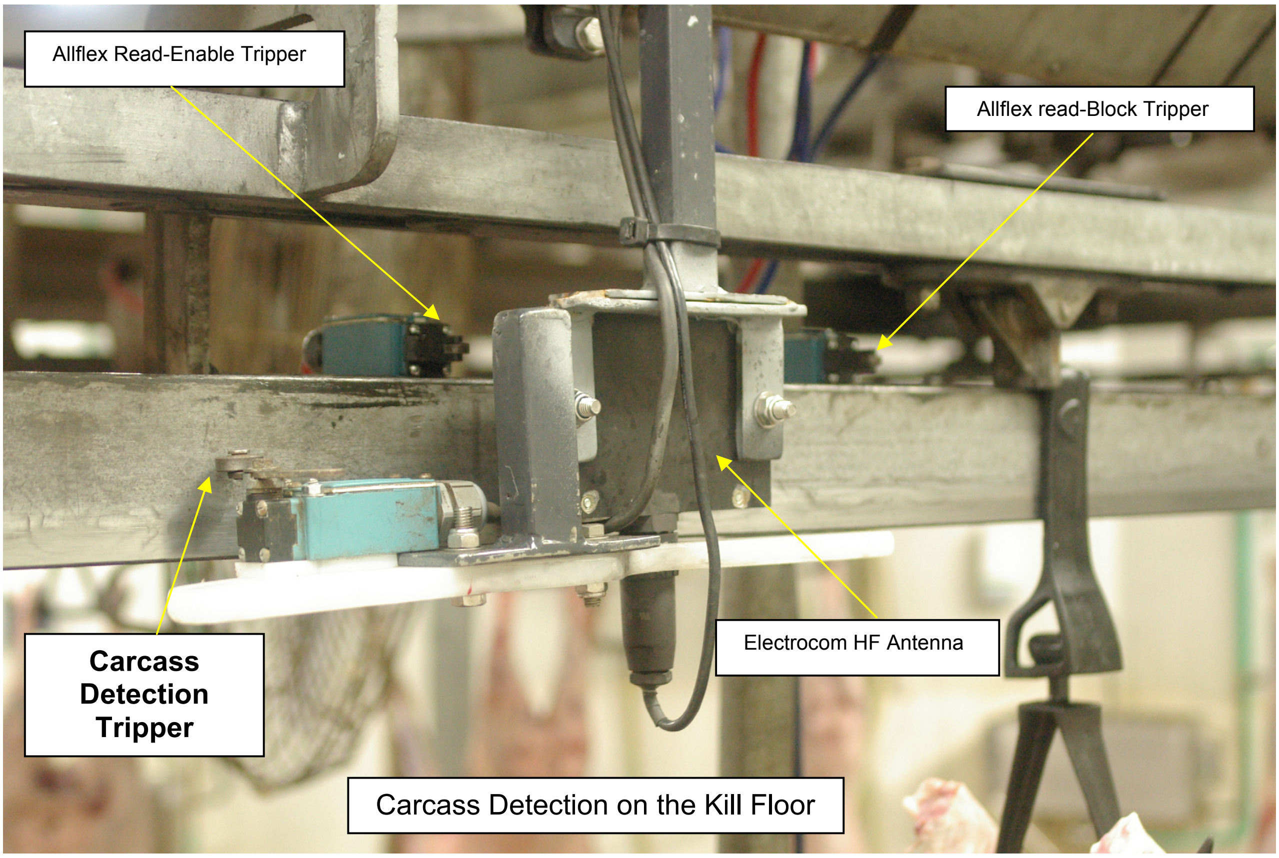
Each HF RFID reader has a carcass detection tripper to indicate the arrival of a new carcass.

The tripper forms a series of functions; these are:

- signify the arrival of the new carcass
- finalise the previous record
- check the functionality of the skid RFID

4.3.2.1 Tripper on kill floor
The kill floor tripper detects the arrival of the new carcass and clears the previous record. If the previous skid RFID did not read, the host system records it as a failed skid. The new record is date time stamped.

4.3.2.2 Tripper at the Weigh Station
The weigh station tripper also detects the arrival of the new carcass.
The previous record is updated and cleared. The carcass stopper (see Section 4.4) is activated to prevent the next carcass entering the scales.



Carcass Detection on the Kill Floor

6.4 Weigh Station Carcass Stopper

At the weigh station there is considerable difference between operators and the ability of the tracking system to match up the kill data to the correct carcass. Ironically the better operator caused more errors with data match up than the slower operator. This was caused by the fast operator entering the fat-depth and capturing the weight, and before the printer printed the ticket he would have removed the old carcass with his left hand and slid the new carcass into place with his right hand. This would trip the hook tripper; finalising the record and read the new hook RFID before the data came through from the printer. As far as the tracking system was concerned, the data belonged to the new sheep. This will be less of a problem when the carcass tracking is an integral part of the abattoir software.

To prevent the possible mix up of data a pneumatic hook stopper was developed. The hook stopper is activated by the carcass detection tripper. Initially it was installed to prevent the carcass leaving the scales until the carcass ticket was printed. This was annoying to the weigh-station operator, as the delay on the print is about 3 seconds, and it made no difference to the accuracy of the record if the carcass had left the scales.

The hook stopper was re-located to the entry of the weigh station so it stops the carcasses before entering the tripper and RFID reader. This now allows the carcass on the scales to be removed and prevents the next carcass entering until the ticket is printed and therefore the record is updated. As soon as the ticket has been printed the stopper releases, allowing the next carcass to enter the scales. As soon as the tripper senses the presence of the carcass the stopper resets and prevents the entry of the next carcass.

The hook stopper can also be set to check the functionality of the HF chip in the skid. If the skid fails to read the hook stopper can be set to prevent the next carcass entering the scales until the current skid is dealt with.

The hook stopper control unit is mounted on the frame of the SASTEK computer and there are two lights that indicate the status of the HF read and the print event. When the carcass trips the detector the controller activates the stopper and both lights go on. When the skid RFID is read the EID light goes off. When the printer prints the label, the print light goes out and the stopper releases the carcass. The switch on the left is used to override the RFID checker.

Operator procedural changes need to be implemented to use the hook stoper.

6.5 Computer System and Software

6.5.1 Carcass Tracking Programme

To link the carcass data that SASTEK computer system records with the sheep EID and carcass RFID, a linking programme was developed. The Carcass Tracking Programme was developed by Estock Systems. It is written in open source VBA (Microsoft Visual Basic for Applications) and is embedded in a standard Microsoft Excel spread sheet. Although this is not the recommended setup for a commercial system, this was ideal for the proof a concept trial. All data captured is visible in an excel spread sheet in real time. (See diagram **4.5.3.4** pg 30)

The carcass tracking programme is run on a host computer at Hillside Abattoir. This computer is a 2GHz IBM compatible PC running Windows XP and Microsoft Office 2003. It is located in the QA office that is adjacent to the boning room alongside the SASTEK computer and logging printer. It has two high speed hard drives (HD), one containing the host programme and primary data record and the second HD contains a backup data log of all data.

All the kill floor and weigh station equipment is connected by data cable to host computer system. A combination of serial RS232, RS422 and RS485 data links are used. The RS232 links are via PCI cards and the RS485 links are through a four port RS485 to USB hub.

AVR controllers (similar to a PLC) are used to monitor the equipment at each location and communicate with the host system.

The SASTEK system at Hillside was a pre 2000 Interm10 system and did not allow easy access to the data collected at the weigh station. This is not an issue with later versions of SASTEK. Data is therefore intercepted as is sent to the data logging printer in the QA office. This data is then processed to retrieve the individual carcass number along with hot carcass weight, fat depth, regrade information and cypher and destination. This data is then recorded against the skid number an eartag EID if present.

6.5.2 Data capture process

6.5.2.1 Kill Floor

Each data transaction is recorded on the excel spread sheet and is date time stamped (DTS) to allow trace back and data verification. Each animal is recorded on a new line on the spread sheet.

A new record is started by the carcass detection tripper being activated (Diagram 4.5.3.1a pg 25). This trip event finalises the previous record and inserts a new line with a DTS for the new record. If the skid has an active RFID chip attached, the RFID number is recorded along with a DTS (Diagram 4.5.3.1b pg 26). The pre-read blocker will prevent the eartag EID from being sent until the carcass is in the ideal location to be read (see 4.1.3 pg 12). If there is a eartag EID, this is recorded on the spread sheet against the skid RFID along with a DTS. The next carcass trip event then finalises this record. A skid RFID and or animal EID can also initiate a record if the carcass detection tripper fails.

6.5.2.2 Retain Rail

All carcases are inspected throughout the kill floor and at the AQIS inspection station. Any carcase failing inspection needs to be directed on to the retain rail for the fault to be addressed. The retain reason needs to be recorded to address and rectify areas of inefficiency in the supply chain. There are two main areas for retain. 1) Grower caused.

Clinical: arthritis, pleurisy, ovis, CLA, sarco

Physical: bruising, dog bites, grass seed, dags, mud/dust

2) Abattoir caused.

Contamination: ingesta, urine, milk, faecal, dust/dirt

dropped carcase

As all carcases entering the retain rail are trimmed to rectify the issue, there is a direct loss of saleable product. By accurately identifying the reasons for retain and providing detailed feedback, it's possible to reduce this loss to the supply chain.

Any carcase entering the retain rail is recorded on the system by a HF gambrel skid reader at the entry to the retain rail. The system was designed to have a touch screen at the end of the retain rail to record retained reason, but at this stage it has not been installed. The inspector only has to tap the screen to record a comment against a carcase. Until the screen is installed, the carcase is *automatically* recorded as entering the retain rail but the comments are *manually* entered at the weigh station. Only obvious retain reasons are recorded using this method.

6.5.2.3 Weigh Station

If the hook stopper is in use (see 4.4 pg 21), it will prevent a carcass entering the weigh scales until the previous record has captured all the data required. When the carcass detector is tripped it clears the record on the screen and records the DTS. If the hook stoper is in use the pneumatic cylinder activates and prevents the next carcass entering. If a skid RFID is read, the RFID is looked up on the spread sheet and the DTS is recorded. At this stage a signal is sent to the carcass stopper to signify the skid RFID is OK and the skid light goes out on the control box. (See Flowchart 4.5.3.2 pg 27).

When the body data is captured it is recorded on the spreadsheet against the skid RFID if it exists. If the skid RFID has not been recorded a new line is created at the bottom of the spreadsheet, along with a read fail record.

6.5.2.4 QA Office Tracking system Computer

The carcass tracking host computer housed in the QA office maintains the excel spreadsheet and tracking programme. The host system co-ordinates all of the data received from the AVRs, the LF and HF readers, the carcass stopper and the SASTEK system. A new file is created each day (just after midnight) with the file name being created from the date.

One of this computers tasks is to capture the SASTEK data sent to the logging printer and retrieve the relevant data (See Flowchart 4.5.3.3a pg28). The system monitors the printer line by line and sorts out grower and lot number as well as individual carcass data. This solution was developed for the existing system at Hillside due to age of the SASTEK Interm10 system. This system will be updated in mid July 2007 and data retrieval will be built into the SASTEK system. This will be a similar system that is in use at PVE in Tamworth.

6.5.3 New SASTEK system

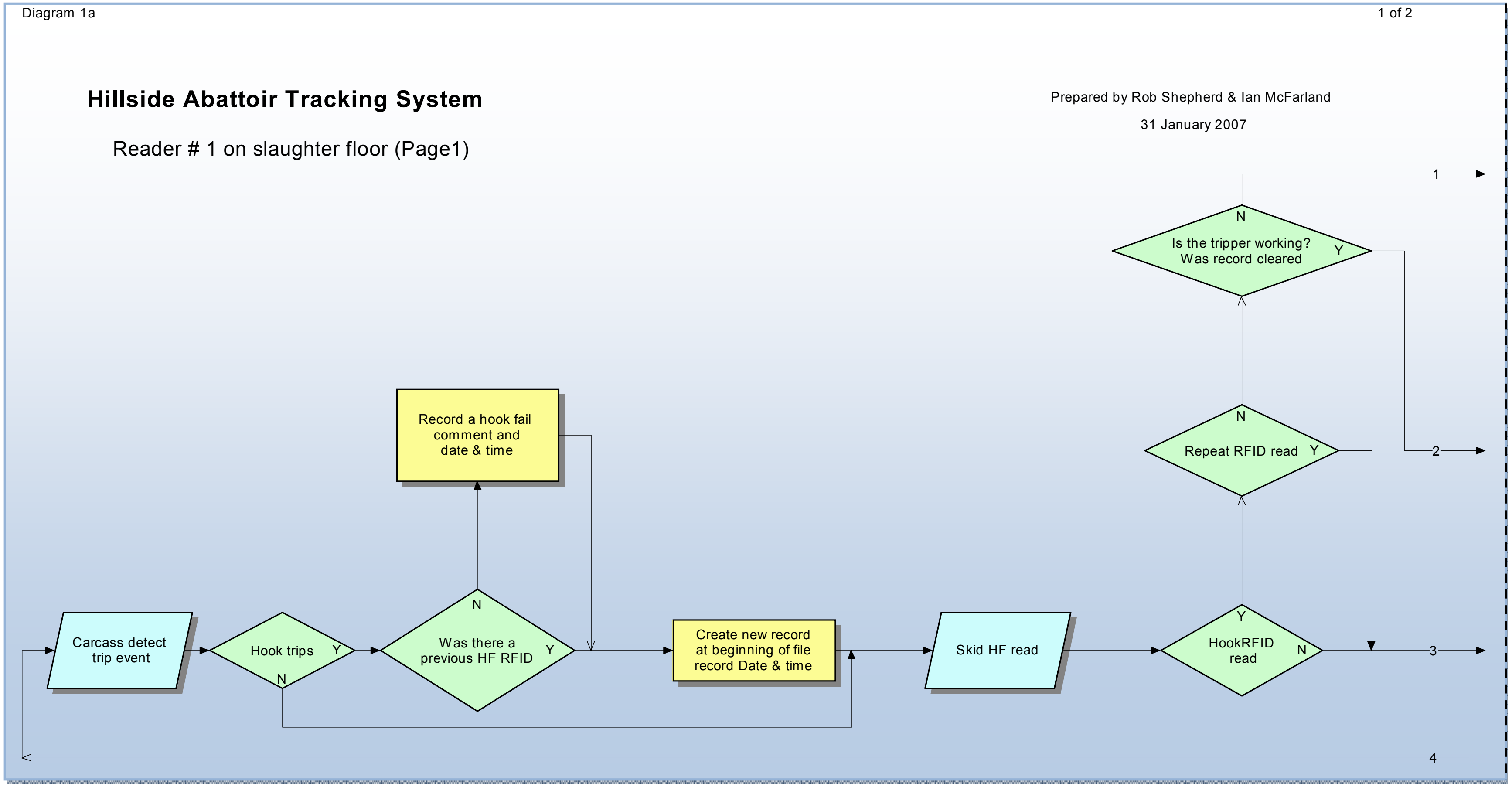
The SASTEK Interm10 system that the carcass tracking system was initially developed for has been upgraded to an Interm12. The new system does not use a logging printer, so the data capture by intercepting the printer data from the Interm10 was no longer valid.

The Intem12 allows for the output a user defined data string enabled by the pressing of the ‘Print’ button on the touch screen of the Interm12. We were able to utilise the original printer cable for the data capture. There have been some issues with the data output from the Interm12 as it handles regraded carcasses differently. Most issues have been resolved.

In the near future a second interface to the Interm12 will be added to enable the tracking system to pass the animal EID to the SASTEK system. This in turn will enable the animal EID to be included in the standard reports.

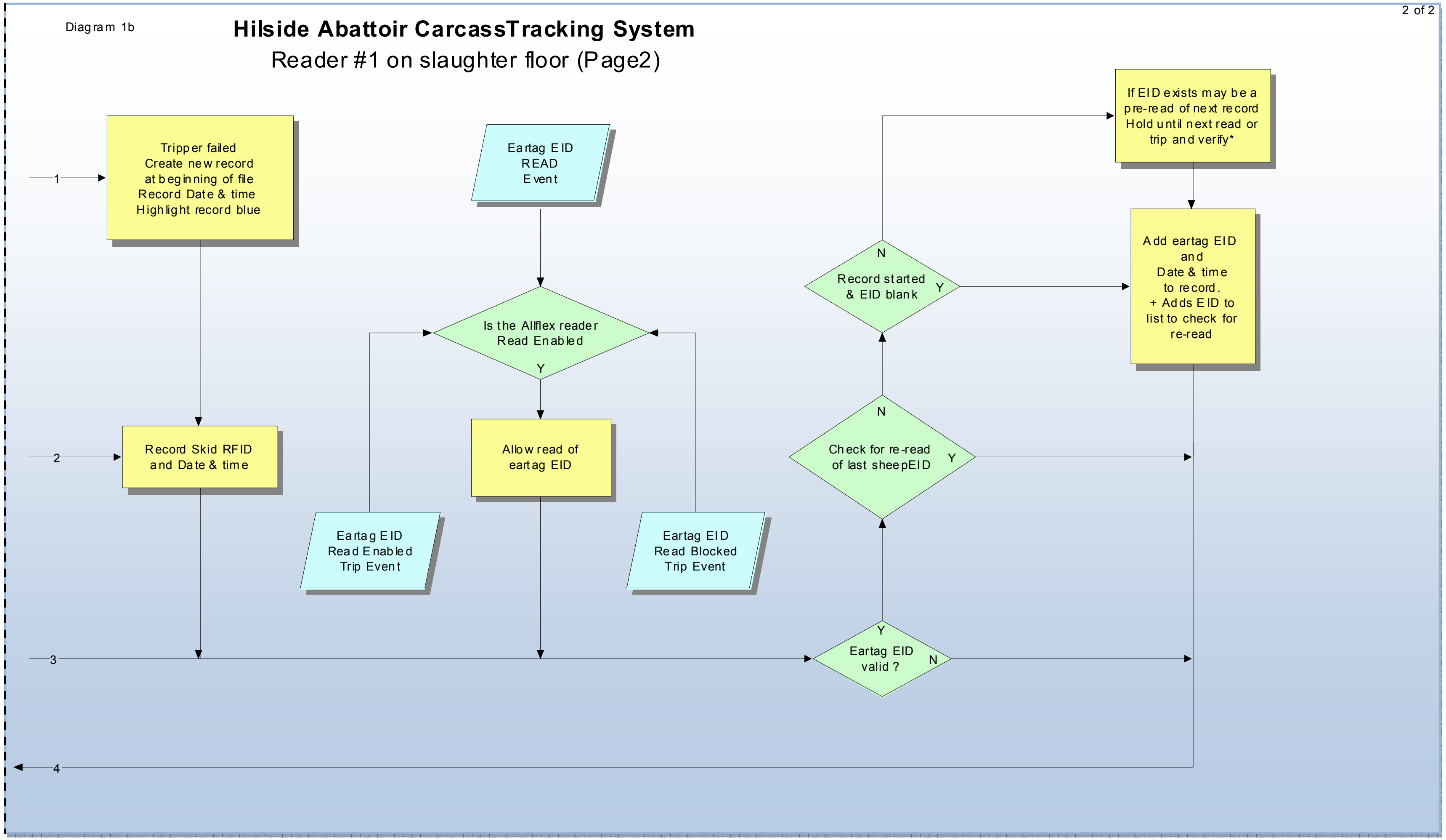
6.5.4 Flowcharts

Flowchart 4.5.3.1a



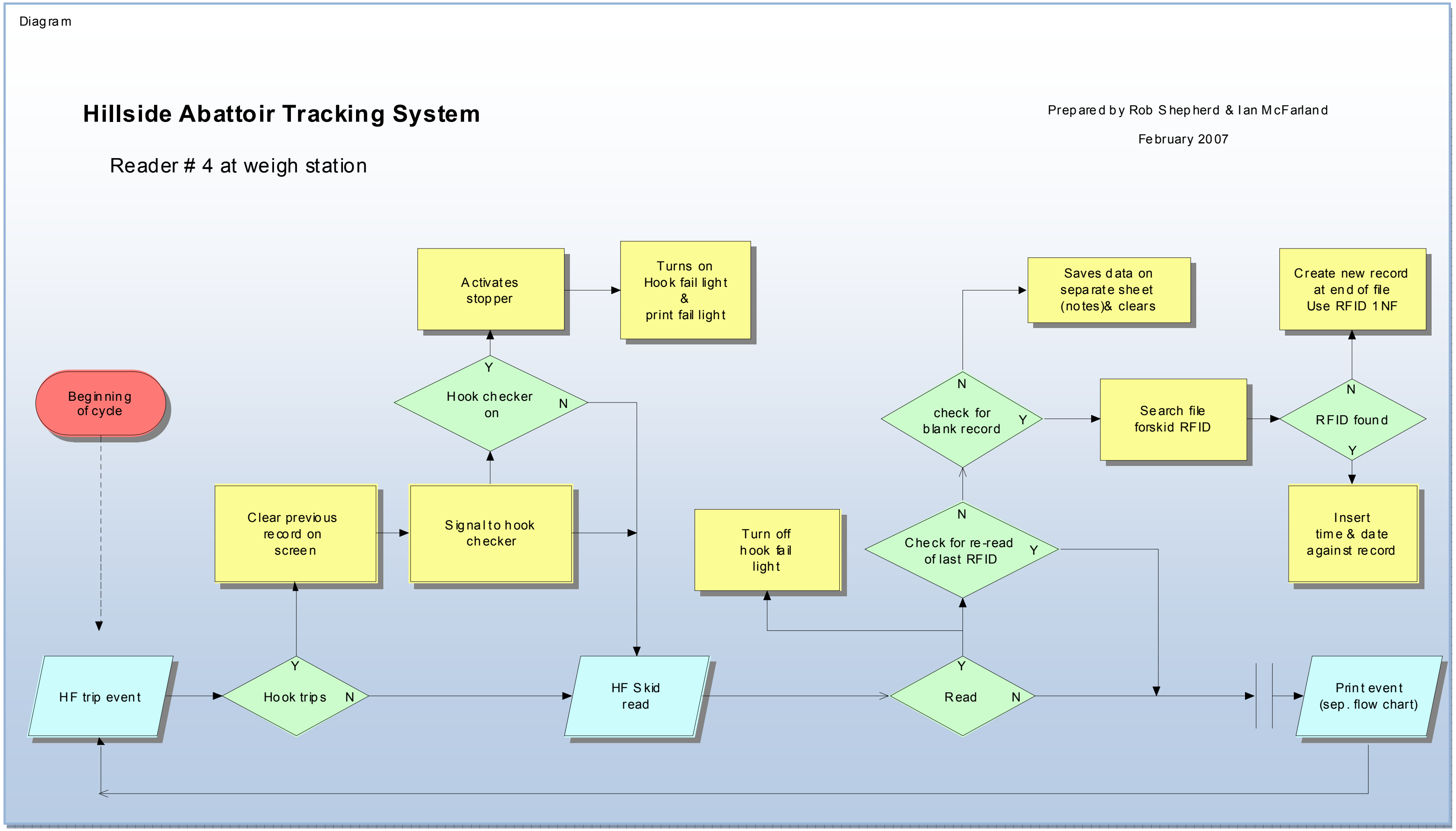
Flowchart 4.5.3.1a Flow chart of the equipment on the Hillside kill floor at the first reader. (adjoins 4.5.3.1b on next page)

Flowchart 4.5.3.1b



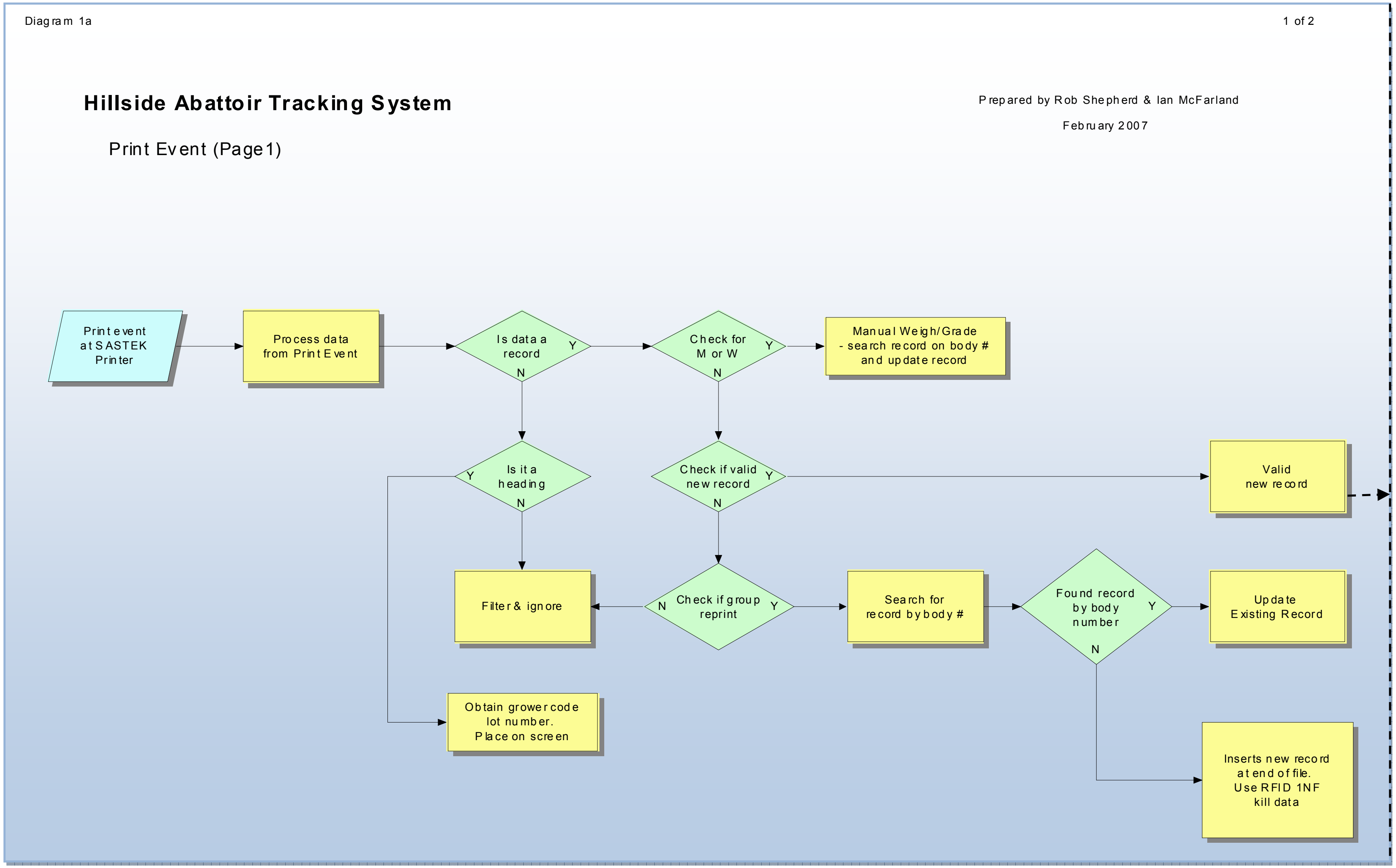
Flowchart 4.5.3.1b. Second half of flow chart of the equipment on the Hillside kill floor at the first reader. (cont. from previous page)

Flowchart 4.5.3.2



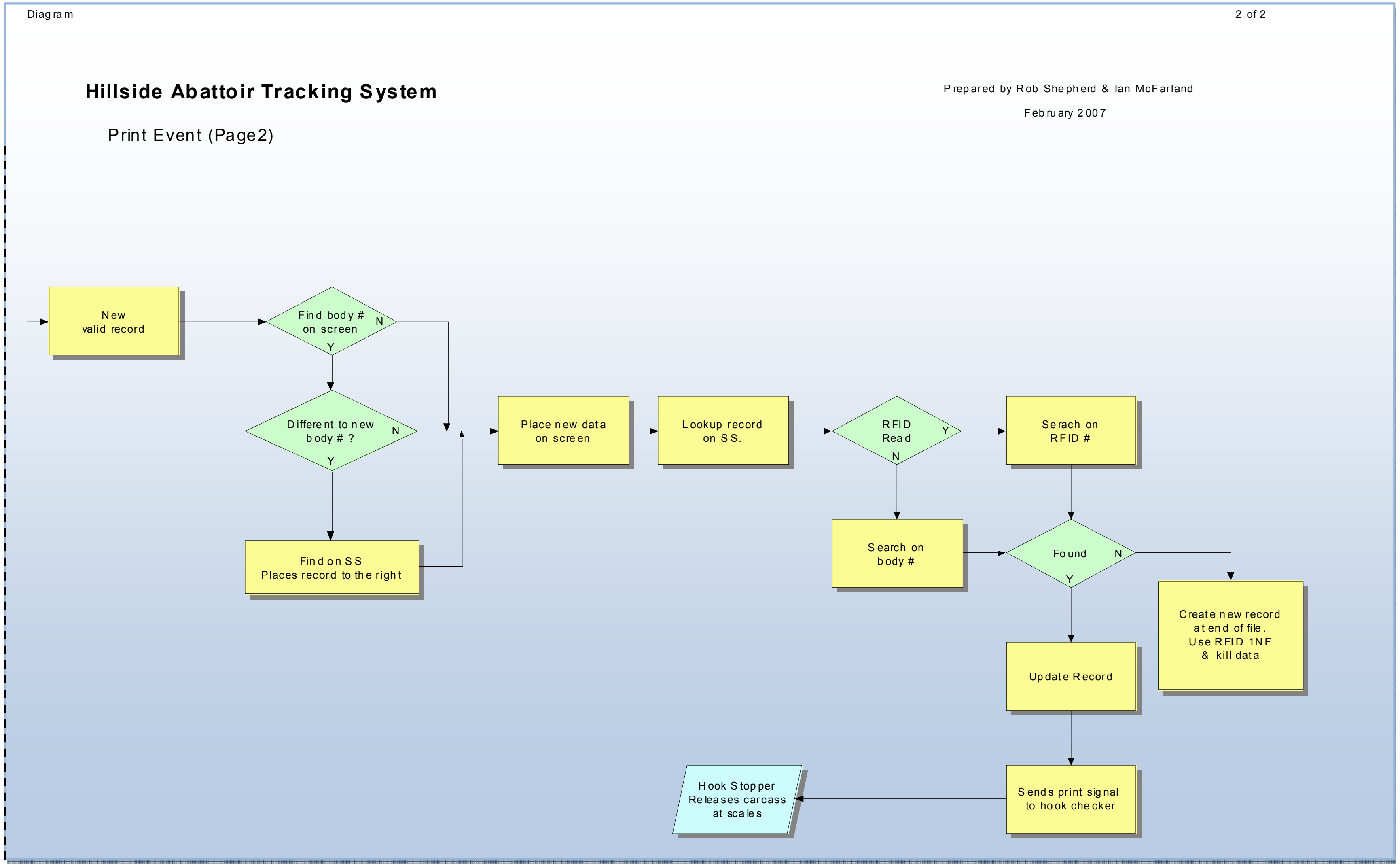
Flowchart 4.5.3.2. The HF Skid reader and Hook checker at the weight & grading station.

Flowchart 4.5.3.3a



Flowchart 4.5.3.3a. The data capture from data intercepted from the SASTEK logging printer. (Adjoins 4.5.3.3b on next page)

Flowchart 4.5.3.3b



Flowchart 4.5.3.3b. Continuation of the data capture from data intercepted from the SASTEK logging printer. (Continued from 4.5.3.3a)

Diagram 4.5.3.4

A2 | 22/06/2007 12:33:42 PM

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	ok Pass Ti	Hook1 #	look1 Tim	Animal EID	EID Time	[illegible]	RTAS	Grower	Lot	Date	Regrade	C _ Time	Body #	Cat	Sex	Dent	Fat Dpth	Fat Cl	Cy
2	########	E002155560533322D	########	982000062807866	########		########	TRE	389	007 12:33:		12:59	483	L	-	0	7	2.0	L
3	########	E002155560533483	########	982000062808486	########		########	TRE	389	007 12:33:		12:59	482	L	-	0	4	1.0	L
4	########	E00215556053320B	########	982000062813083			########	TRE	389	007 12:33:		12:59	481	L	-	0	8	2.0	L
5	########	E00401000894652B	########	982000062808644	########		########	TRE	389	007 12:32:		12:58	479	L	-	0	7	2.0	L
6	########	E002155560532B42	########	982000062813016	########		########	TRE	389	007 12:32:		12:58	478	L	-	0	2	1.0	L
7	########	E002155560531486	########	982000062813386	########		########	TRE	389	007 12:31:		12:58	477	L	-	0	10	2.0	L
8	########	E004010008946167	########	982000062808509	########		########	TRE	389	007 12:31:		12:57	475	L	-	0	7	2.0	L
9	########	E0021555605314DE	########	982009103609499	########		########	TRE	389	007 12:31:		12:57	474	L	-	0	3	1.0	L
10	########	E002155560530573	########	982000062808057	########		########	TRE	389	007 12:30:		12:56	473	L	-	0	7	2.0	L
11	########	E0021555605313E9	########	982000062808607	########		########	TRE	389	007 12:30:		12:56	472	L	-	0	7	2.0	L
12	########	E002155560533002	########	982000062808566	########		########	TRE	389	007 12:30:		12:56	471	L	-	0	6	2.0	L
13	########	E002155560532F40	########	982000062813687	########		########	TRE	389	007 12:29:		12:56	470	L	-	0	6	2.0	L
14	########	E0021555605314D1	########	982000062813684	########		########	TRE	389	007 10:59:		12:55	468	L	-	0	7	2.0	L
15	########	E0021555605308F3	########	982000062808426	########		########	TRE	389	007 10:59:		12:55	466	L	-	0	6	2.0	L
16	########	E002155560532581	########	982000062808053	########		########	TRE	389	007 10:58:		12:54	465	L	-	0	6	2.0	L
17	########	E00215556053148F	########	982000062813506	########		########	TRE	389	007 10:58:		12:54	464	L	-	0	12	3.0	L
18	########	E002155560531029	########	982000062808268	########		########	TRE	389	007 10:58:		12:54	463	L	-	0	3	1.0	L
19	########	E0040100089462C8	########	982000062807960			########	TRE	389	007 10:58:		12:53	462	L	-	0	6	2.0	L
20	########	E0021555605332F3	########	982000062808012	########		########	TRE	389	007 10:57:		12:53	461	L	-	0	6	2.0	L
21	########	E004010008940C3C	########	982000062813737	########		########	TRE	389	007 10:57:		12:53	460	L	-	0	6	2.0	L
22	########	E0021555605312BE	########	982000062813611	########		12:49:58 PM	TRE	389			12:52	459	L	-	0	4	1	L
23	########	E002155560533167	########	982000062813710	########		########	TRE	389	007 10:56:		12:52	458	L	-	0	8	2.0	L
24	########	E002155560530739	########	982000062813287	########		########	TRE	389	007 10:56:		12:52	457	L	-	0	8	2.0	L
25	########	E004010008942553	########	982000062809325	########		########	TRE	389	007 10:56:		12:52	456	L	-	0	6	2.0	L
26	########	E004010008944EC0	########	982000062813565	########		########	TRE	389	007 10:56:		12:51	455	L	-	0	6	2.0	L

Sheet1 | Sheet2 | Sheet3

Ready

Diagram 4.5.3.4 A screen capture from the Excel spread sheet on the Carcass Tracking System computer in the QA Office. Skid (Hook) number is in column B, the animal EID is in column D and the captured SASTEK body number is in column M. Fat depth is in Column Q and carcass hot weight is in column V. This spreadsheet is updated in real time during slaughter.

6.5.5 Future tracking system components

6.5.5.1 AQIS inspection station

The original system was designed to have a terminal at the AQIS inspection station to record retain and condemn information. A HF reader was installed in this position and initially monitored passing skids. Discussion with AQIS staff deemed it inappropriate to install a terminal at this location as it would impede on their operations.

6.5.5.2 Entry to retain rail

The entry to retain rail was planned to be automated in the future. It was envisaged that carcasses identified at the AQIS station for retention would automatically enter the retain rail.

The location was used to test the alternative HF skid readers. Reads at this location could be verified against reads on the kill floor and the weigh station.

6.5.5.3 Exit of retain rail

The exit of the retain rail is the ideal location to install the regrade recording terminal. Plans have been formulated for installation of this terminal in the future. A touch screen computer would record this information against the skid RFID and forward it to the host computer system.

6.5.5.4 Beyond the weigh station and chillers

Recent results from a lean meat yield trial have indicated a reasonable correlation between carcass lean meat yield and specific primal cuts. This provides the opportunity to value add the current tracking system and track carcasses beyond the chillers into the boning room and to specific primal cuts. At Hillside the leg pairs remain on their skid and gambrel up to the point of processing.

6.5.5.5 Grower feedback

Trials to date have provided feedback to participating growers who have sheep with EID's manually by email. In the near future, the individual animal EID will be added to the normal Hillside kill report. This existing report is already obtainable remotely from the Hillside website.
The feedback reports will also be updated to better visually present the kill performance in relation to the payment grids including basic cost of production.

6.5.5.6 Grower feedlot to abattoir information transfer

Trials were conducted in mid 2006 to investigate the feasibility of growers monitoring the individual growth rates of animals in their feedlots and emailing the data to a central data base. From this data base the abattoir would be forwarded with daily reports showing what sheep were on feed, their growth rates and predicted time of finishing. Automatic bookings for the slaughter of these sheep could then be generated from these reports.
The secure data-transaction company Vari-Sign was involved with the concept trial that received data from the trial farms reconcile it and generate live online reports. Vari-Sign then received the kill data from the abattoir and created an online access to all the data on each sheep. Although the reports were very limited in functionality, the demonstrated the concept well.

7 Success in Achieving Objectives

7.1 Success in Achieving Objectives

The project achieved the objectives of designing a tracking system for sheep carcasses within a traditional non-inverted sheep abattoir. This project proved that it is possible to read individual sheep eartag EID and correlate this to another RFID encapsulated in a gambrel skid. The carcass remains on this skid to the weighing scales and beyond into the chiller or boning room enabling the relating of carcass information to the live sheep EID. This allows identity of an individual sheep to be retained throughout the abattoir to load-out or the point of carcass sectioning at the band saw.

The system design and components for reliable use in an abattoir have been documented for use in other locations.

7.1.1 Validation Trials

7.1.1.1 Overview

Although many successful verification trials were conducted with the original tracking system on the SASTEK Interm10 these are the first verification trials conducted since the main abattoir management system has been updated to the Interm12. This has made a significant change to the way kill data is captured by the tracking system. The tracking software has been modified to accommodate the new system, and as new issues are encountered, they are being incorporated into the software.

There are still a number of unchipped (no RFID) gambrel skids in use at Hillside. Over time they will all be replaced by chipped skids. These are displayed on the spread sheet as “1HookFail” record and highlighted in blue. They are listed as ‘*unchipped skids*’ in the result tables. No attempt was made to identify and remove them for the trial.

7.1.1.2 Verification Trial #1 - 13th of August 2007

Animal eartag EID antenna tested: Allflex modified Flexi-antenna; natural HDPE – rigid construction.

Three mobs of lambs at Kojonup (115km SW of Hillside) were weighed and drafted into mobs eligible for delivery to Hillside.
After the initial weighing all the qualifying lambs were tagged with Larder tag Jumbo EID ear tags (remanufactured out of recycled NLIS cattle tags) and re-weighed to create the on farm record. The lambs were then transported to Hillside.

Results Trial 1:

Mob	Eartag EID	Unchipped Skids	Kill Floor reader	Scales Reader
1) 81	1 Missed – 98.8%	1	100%	100%
2) 82	1 Missed – 98.8%	6	100%	100%
3) 53	1 missed – 98.1%	1	100%	100%

Three animal eartag EID's failed to be captured at the kill floor reader. The rigid flexi-antennas in use had broken the return springs in the hinges, so they did not return to the closed direct-contact position they were designed for. Secondly a few carcasses did not enter the reader in the head on orientation. Although the leg lifter operator does align them head first, when he isn't present the carcasses go through in any orientation. As mentioned in the main report this will be addressed by a procedural change.

Manually reading eartag EID with grey Allflex stick reader connected to an XR300 to obtain tracking number

The carcasses were also manually tracked using an Allflex grey stick reader linked directly to a TruTest XR3000. A VID number (assigned at body weighing) was written on a carcass ticket and attached to the gambrel. A number of animal eartag EIDs were very difficult to read with the stick reader so this may also account for some of the EIDs missed at the Allflex rigid flexi-reader.
When the carcass reached the scales, the body number created by the SASTEK system was written on the manual tracking ticket. The manual tracking system verified that all carcass records were associated to the correct eartag EID.

The manual tracking number is written on a carcass label which is attached to the carcass gambrel

In the first trial three records did not have kill data assigned to skid RFID (which was successfully read) at the scales due to operator actions. If the operator decides to regrade another carcass (that is not the one on the weigh scale), the carcass in front of the reader may be missed. This situation was addressed on the old Interm10 SASTEK system, but works slightly different on the Interm12 SASTEK system. The software has now been modified to accommodate the new system.

7.1.1.3 Trial 1 Extract of output

Hook Pass Time	Hook1 #	Animal EID	Grower	Lot	Regrade	C _ Time	Body #	Cat	Sex	Dent	Fat Dpth	Fat Cl	Cyp	Dest	Hot Wt	Cold Wt	Wt Class
14/08/2007 11:06:55 AM	E00215556053120C	951000002530517	KMF	977	no	11:37:23 AM	534	L	N	0	7	2.0	L	Q	20.6	20.6	22
14/08/2007 11:06:37 AM	E002155560531418	951000007811917	KMF	977	no	12:04:27 PM	634	L	N	0	4	1.0	L	H1	18	18	20
14/08/2007 11:06:18 AM	E002155560530CAE	951000005048896	KMF	977	no	11:37:13 AM	533	L	N	0	8	2.0	L	Q	18.8	18.8	20
14/08/2007 11:05:59 AM	E0021555605331CD	951000006761177	KMF	977	no	11:37:00 AM	532	L	N	0	7	2.0	L	Q	18.2	18.2	20
14/08/2007 11:05:41 AM	E002155560532CDB		KMF	977	no	11:36:50 AM	531	L	N	0	6	2.0	L	Q	18.8	18.8	20
14/08/2007 11:05:22 AM	E0021555605332B0	951000003517996	KMF	977	no	12:03:02 PM	633	L	N	0	6	2.0	L	Q	18.4	18.4	20
14/08/2007 11:05:04 AM	E0021555605330BB	951000003820664	KMF	977	no	11:36:38 AM	530	L	N	0	6	2.0	L	Q	19.2	19.2	20
14/08/2007 11:04:45 AM	E002155560530531	951000000131821	KMF	977	no	12:02:31 PM	632	L	N	0	6	2.0	L	Q	19.2	19.2	20
14/08/2007 11:04:26 AM	E0021555605308F8	951000001582602	KMF	977	no	11:36:24 AM	529	L	N	0	6	2.0	L	Q	20.4	20.4	22
14/08/2007 11:04:08 AM	1Hook Fail	951000005148009															
14/08/2007 11:03:49 AM	E0021555605314FD	951000004875662	KMF	977	no	11:36:03 AM	527	L	N	0	2	1.0	L	H1	18	18	20
14/08/2007 11:03:29 AM	E002155560531333	951000006144177	KMF	977	no	11:35:50 AM	526	L	N	0	6	2.0	L	Q	19.4	19.4	20
14/08/2007 11:03:09 AM	E002155560530A6D	951000002201377	KMF	977	no	11:35:18 AM	524	L	N	0	2	1.0	L	H1	18.2	18.2	20
14/08/2007 11:02:49 AM	E00401000893ED03	951000007301962	KMF	977	no	11:35:09 AM	523	L	N	0	3	1.0	L	H1	18.6	18.6	20
14/08/2007 11:02:29 AM	E0021555605303E5	951000007098392	KMF	977	no	11:35:00 AM	522	L	N	0	8	2.0	L	Q	19.2	19.2	20
14/08/2007 11:02:09 AM	E002155560530C17	951000005376976	KMF	977	no	11:34:50 AM	521	L	N	0	7	2.0	L	Q	20	20	20
14/08/2007 11:01:49 AM	E00215556053148F	951000001394723	KMF	977	no	11:50:56 AM	583	L	N	0	3	1.0	L	H1	21	21	22
14/08/2007 11:01:30 AM	E0021555605314D7	951000005946240	KMF	977	no	11:34:42 AM	520	L	N	0	7	2.0	L	Q	22.2	22.2	24
14/08/2007 11:01:10 AM	E0040100089464D5	951000003217974	KMF	977	no	11:34:31 AM	519	L	N	0	6	2.0	L	Q	19.4	19.4	20
14/08/2007 11:00:50 AM	E002155560532EB8	951000008042599	KMF	977	no	11:33:52 AM	518	L	N	0	5	1.0	L	AL	17.6	17	18.5
14/08/2007 11:00:30 AM	E0040100089425E2	951000003721827	KMF	977	no	11:33:36 AM	517	L	N	0	7	2.0	L	Q	19.4	19.4	20
14/08/2007 11:00:10 AM	E002155560533462	951000006556293	KMF	977	no	11:33:15 AM	516	L	N	0	6	2.0	L	Q	18	18	20
14/08/2007 10:59:51 AM	E002155560532BD3	951000007516837	KMF	977	no	11:33:01 AM	515	L	N	0	3	1.0	L	AL	17.2	16.6	18.5
14/08/2007 10:59:31 AM	E004010008946286	951000000635363	KMF	977	no	11:50:27 AM	582	L	N	0	2	1.0	L	L1	14	14	14
14/08/2007 10:59:11 AM	E002155560531238	951000007659166	KMF	977	no	11:32:50 AM	514	L	N	0	4	1.0	L	H1	18.6	18.6	20
14/08/2007 10:58:51 AM	E002155560531290	951000007142457	KMF	977	no	11:32:39 AM	513	L	N	0	2	1.0	L	H1	18	18	20
14/08/2007 10:58:32 AM	E00215556053158F	951000009266184	KMF	977	no	11:32:30 AM	512	L	N	0	6	2.0	L	Q	21.4	21.4	22
14/08/2007 10:58:12 AM	E002155560532DB3	951000008655439	KMF	977	no	11:32:21 AM	511	L	N	0	6	2.0	L	Q	20.4	20.4	22
14/08/2007 10:57:53 AM	E0021555605314EC	951000007669406	KMF	977	no	11:32:12 AM	510	L	N	0	6	2.0	L	Q	18.8	18.8	20

7.1.1.4 Verification Trial #2 - 5th of September 2007

Modifications to the Carcass Tracking software have been made since the first verification trial. The first modification as a result of trial one, deals with carcasses re-entering the scales from the chiller direction. The second major modification deals with the way carcasses are re-graded. Not all categories of re-grade use the re-grade flags 'no' and 'yes'. This modification now captures all re-grades (so far!).

100 lambs in two mobs, randomly selected from lambs being processed at Hillside, kill-floor staff were not notified of trial.

Test animal eartag EID's were used; these consist of clip attached test tags in both FDX-B and HDX from the manufactures Allflex, Leader and Zeetag. (These are our standard test tags; ref 4.1.6 page 14)

Animal eartag EID antenna tested: Allflex modified Flexi – White food grade Nitrile Flexi-Antenna (ref 4.1.5 page 13). The Allflex reader has also been upgraded to the latest model. There was an intermittent fault with the original reader, caused by damage when the original multi-coil reader was trialled.

Mob	Eartag EID	Unchipped Skids	Kill Floor Reader	Scales reader
1) 100	100% *1	3	1 missed 99%*2	100%

Note *1) One EID is missing; this was caused by the clip-on eartag EID being knocked off the lamb before the Allflex Flexi-reader.

Note *2) The read failure was caused by a slaughterman pulling the carcass quickly through the reader station. Fortunately the animal EID was read. This is to be addressed by change of practice by procedural changes in the future.

Results
The tracking system is operating as well it can without the procedural changes being adopted by the abattoir.

7.1.1.5 Trial 2 Extract of output

Hook Pass Time	Hook1 #	Animal EID	Grower	Lot	Regrade	C _ Time	Body #	Cat	Sex	Dent	Fat Dpth	Fat Cl	Cyp	Dest	Hot Wt	Cold Wt	Wt Class	Condem	Retained
05/09/2007 12:04:02 PM	E0021555605328C8	951000000151420	RDY	838	no	12:47:01 PM	845	L	N	0	10	2.0	L	Q	18	18	20		Retain
05/09/2007 12:03:46 PM	E0021555605315C6	951000000186659	RDY	838	no	12:28:42 PM	788	L	N	0	8	2.0	L	Q	19	19	20		
05/09/2007 12:03:29 PM	E002155560531B0E	982000062813696	RDY	838	no	12:28:34 PM	787	L	N	0	5	1.0	L	AL	16.4	15.9	18		
05/09/2007 12:03:13 PM	E002155560531256	982000062807908	RDY	838	no	12:28:22 PM	786	L	N	0	10	2.0	L	Q	19.4	19.4	20		
05/09/2007 12:02:56 PM	E0040100089456AB	982000062809190	RDY	838	no	12:26:14 PM	780	L	N	0	8	2.0	L	Q	18.4	18.4	20		
05/09/2007 12:02:40 PM	E004010008945328	982000062813260	RDY	838	no	12:25:01 PM	778	L	N	0	5	1.0	L	H1	18	18	20		
05/09/2007 12:02:24 PM	E0021555605332FE	951000000105305	RDY	838	no	12:24:36 PM	777	L	N	0	5	1.0	L	H1	19.2	19.2	20		
05/09/2007 12:02:08 PM	1Hook Fail	951000000106126																	
05/09/2007 12:01:51 PM	E00215556053310F	982000062813557	RDY	838	no	12:23:54 PM	775	L	N	0	9	2.0	L	Q	19.2	19.2	20		
05/09/2007 12:01:35 PM	E004010008946180	951000000156087	RDY	838	no	12:23:43 PM	774	L	N	0	4	1.0	L	AL	17.6	17	18.5		
05/09/2007 12:01:19 PM	E0021555605303D2	951000000106208	RDY	838	no	12:23:14 PM	773	L	N	0	9	2.0	L	Q	18.4	18.4	20		
05/09/2007 12:01:03 PM	E0021555605330E4	982000062813350	RDY	838	no	12:23:04 PM	772	L	N	0	9	2.0	L	Q	17.2	17.2	18.5		
05/09/2007 12:00:46 PM	E00401000893FD23	951000000106100	RDY	838	no	12:22:36 PM	771	L	N	0	10	2.0	L	Q	17.4	17.4	18.5		
05/09/2007 12:00:30 PM	E002155560532AF8	951000000156380	RDY	838	no	12:22:24 PM	770	L	N	0	9	2.0	L	AL	16.8	16.3	18		
05/09/2007 12:00:13 PM	E0021555605308FC	951000000152006	RDY	838	no	12:22:02 PM	769	L	N	0	8	2.0	L	Q	18.8	18.8	20		
05/09/2007 11:59:57 AM	E002155560530E22	951000000105802	RDY	838	no	12:46:34 PM	844	L	N	0	8	2.0	L	Q	17	17	18.5		
05/09/2007 11:59:41 AM	E002155560532A52	951000000105930	RDY	838	no	12:21:53 PM	768	L	N	0	8	2.0	L	Q	19	19	20		
05/09/2007 11:59:25 AM	E002155560532D9D	951000000105202	RDY	838	no	12:21:31 PM	767	L	N	0	11	3.0	L	Q	19.2	19.2	20		
05/09/2007 11:59:08 AM	E00401000CE0D883	951000000105528	RDY	838	no	12:21:21 PM	766	L	N	0	7	2.0	L	Q	17	17	18.5		
05/09/2007 11:58:52 AM	E004010008946288	951000000105899	RDY	838	no	12:21:02 PM	765	L	N	0	12	3.0	L	Q	19	19	20		
05/09/2007 11:58:36 AM	E002155560533327	982000062813320	RDY	838	no	12:20:52 PM	764	L	N	0	10	2.0	L	Q	18	18	20		
05/09/2007 11:58:19 AM	E00401000893FE21	982009102612253	RDY	838	no	12:20:27 PM	763	L	N	0	8	2.0	L	AL	15.2	14.7	16.5		
05/09/2007 11:58:03 AM	E00215556053165B	982000062808854	RDY	838	no	12:20:16 PM	762	L	N	0	10	2.0	L	Q	17.6	17.6	18.5		
05/09/2007 11:57:46 AM	E004010006BCE3E1	982000062812874	RDY	838	no	12:19:53 PM	761	L	N	0	8	2.0	L	Q	18.6	18.6	20		
05/09/2007 11:57:30 AM	E002155560530CB7	951000000106113	RDY	838	no	12:19:42 PM	760	L	N	0	8	2.0	L	Q	17.2	17.2	18.5		
05/09/2007 11:57:14 AM	E002155560531588	942000000133285	RDY	838	no	12:45:38 PM	841	L	N	0	8	2.0	L	Q	17.2	17.2	18.5	P	Retain
05/09/2007 11:56:57 AM	E002155560533131	951000000104665	RDY	838	no	12:44:21 PM	836	L	N	0	10	2.0	L	Q	17.2	17.2	18.5		
05/09/2007 11:56:40 AM	E002155560533031	982000062808003	RDY	838	no	12:19:22 PM	759	L	N	0	9	2.0	L	Q	20	20	20		
05/09/2007 11:56:24 AM	E00215556053118C	951000000150769	RDY	838	no	12:40:09 PM	826	L	N	0	8	2.0	L	Q	18	18	20		Retain

8 Impact on Meat and Livestock Industry – now & in five years time

Previously the sheep industry has been able to record and provide feedback to producers on the carcass attributes of lots of sheep with no relationship of information to individual sheep. This project allows for the immediate application of the proven system and its components into other sheep abattoirs. Commercial suppliers of components have been identified and these have shown interest in supply of both hardware and software components for installation in other abattoirs.

The Australian sheep industry is currently implementing a National Livestock Identification System (NLIS) for Sheep and Goats. The current system is based on visually readable plastic tags and movement documents. If this system proves inadequate in meeting national traceability criteria set down by Safemeat, the industry may consider implementing an electronic identification system for sheep and goats. The system proven in this project would be appropriate if benefit:cost and associated industry technology for tracking sheep on property and in saleyards proves similar efficacy.

The system will allow abattoirs/processors to be able to track the performance of supplier's sheep or lambs through their abattoir. This would allow improved feedback, for example progeny testing of sires or groups of sires of known genetic merit. This may also encourage the use of individually numbered RFID eartags in sheep or lambs supplied

Research to be conducted in the CRC for Sheep Innovation , to commence July 2007, will investigate the potential for RFID to be retained on carcasses to the boning room band saw and then potentially transferred via bar codes to indicator cuts to allow their measurement and prediction of carcase yield and relative profitability between carcasses and between sites on carcasses.

9 Conclusions and Recommendations

9.1 Conclusions

An electronic tracking system for sheep carcasses within a traditional non-inverted sheep abattoir has been achieved with the ability to read individual sheep eartag EID correlate this to another RFID encapsulated in a gambrel and to relate carcass information to the live sheep EID.

For the system to be attractive for other abattoirs to implement further research is needed into ways in which the electronic tracing can be used to improve abattoir profitability. One such way may be to develop or incorporate systems for estimating boning room yield, such as VIAscan ® or the measurement of indicator cuts. Improved feedback systems may benefit both the processor and producer.

9.2 Recommendations

9.2.1 High Speed Abattoir

The Australian sheep industry, through MLA and the CRC for Sheep Innovation now need to test and prove the same technology within a high speed inverted chain sheep abattoir.

9.2.2 Boning Room Yield

The Australian sheep industry, through MLA and the CRC for Sheep Innovation develop or incorporate systems in conjunction with electronic carcass tracking, for estimating boning room yield, such as VIAscan ® or the measurement of indicator cuts.

9.2.3 Feedback Systems

The ability to monitor individual animal performance on-farm and then link this with individual carcase data in the abattoir could prove an important tool for improving profitability of both the processor and producer. Feedback systems need to be designed to make the best use of the data collected through the use of RFID technology.

9.2.4 Promotion

MLA and the Australian Sheep CRC promote the results of this project to the Australian sheep industry.

10 Bibliography

10.1 References and Reports (on accompanying DVD)

The following documents and reports are available on the accompanying DVD.

Harvey, S (2004) Hillside Project Description 3.11. 25th July 2004. ManuTech (Vic) Pty Ltd

Rowe, J (2005) MLA – SCT 005. Linking live sheep and carcass data via RFID. Sheep CRC August 2005

Shepherd, McFarland, O'Halloran (2007) Linking Live Sheep and Carcass Data via RFID – Traditional (Non-Inverted) Chain Final Report June 2007 (This Report)

Shepherd, R (2007) Milestone: MLA SCT 005 Hillside WA –Progress Report **February** 2007

Shepherd, R (2007) Milestone: MLA SCT 005 Hillside WA – Progress Report **April** 2007

Shepherd, R (2007) NILS (Sheep & Goats) Technical and Operational Barriers Project – PVE Tamworth NSW – Interim Proposal 22nd June 2007

Shepherd, Rowe, O'Halloran, McFarland (2006) Sheep CRC project SCT 005 Progress Report. June 2006

Wind, G (2005) Detailed Costing and Installation for RFID automated Data Capture System at Hillside Abattoir Narrogin WA (2). 6th October 2005. Sunshine Technologies

11 Appendices

11.1 Appendix 1

11.1.1 DVD - Movie

Accompanying this report is a DVD to demonstrate the carcass tracking system at Hillside Abattoir in Narrogin Wester Australia. © Estock Systems 2007 this DVD may be reproduced and distributed with acknowledgement of author.

11.1.2 DVD - Verification Spreadsheet

The DVD also contains the Microsoft® Excel® spreadsheet files captured during the Verification trials. Sheep that were not relative to the trial have been deleted from the files.

11.1.3 DVD – Bibliography

The Bibliography files are also contained on this DVD

11.2 Glossary of Terms

AVR - Programmable micro-controller made by Atmel (see PLC)

EID - Electronic IDentification eartags and rumen bolus are used for the identification of livestock. In Australia a low frequency of 134.2kHz is used in two similar systems: FDX-B and HDX

FDX-B - Full Duplex. Full duplex transponders continuously communicate with the scanner, simultaneously receiving and transmitting data. A FDX tag will not transmit until there is sufficient energy received from the transmitter. Uses Amplitude Shift Key (ASK) – similar to AM radio.

Gambrel - The device by which a carcass is suspended by the back legs for slaughter and dressing in an abattoir. It is attached to the abattoir rail by a skid. (From Medieval Latin – 'gamba' – hoof or leg of animal)

HDPE - High Density Polly Ethylene. A petroleum derived polyethylene thermoplastic. The Neutral (white) grade is approved for use in the food industry. It is machinable and easily welded.

HDX - Half Duplex. A HDX transponder receives a signal form the scanner and alternates between transmitting and receiving at very high speed. The HDX transponder is equipped with a capacitor that accumulates energy from the transmitter. As soon as there is enough energy the HDX tag transmits. Uses Frequency Shift Key (FSK) – similar to FM radio.

HF - High Frequency. Radio Spectrum Frequency between 3 MHz and 30 MHz

Inverted chain – carcass held initially by rear legs, then all legs horizontally and then by the fore hocks until evisceration. They are then returned to the rear leg suspension position.

kHz - kilo (10^3) Hertz measurement of frequency of signal in cycles per second.

LF - Low Frequency. Radio spectrum Frequencies between 30 kHz and 300 kHz

MHz - Mega kilo (10^6) Hertz measurement of frequency of signal in cycles per second.

NLIS - National Livestock Identification System (NILS) is a system that has been developed to enable lifetime traceability of Australian livestock in the event of a disease outbreak of food safety or residue contamination issue. NLIS Sheep & Goats is based on a system of visually read eartags imprinted with the owner's brand registered to the property where the tag was applied.

NVD and **Waybill** - National Vendor Declaration is a document that producers use to declare valuable information about the food safety status of the livestock being sold and transported. Buyers rely on the NVD/Waybill for accurate information on the livestock purchased and processors rely on the information to ensure only the safest food enters our food chain.

Optical isolator circuit – a device that is interposed between two systems to prevent one of them from having undesired effects on the other, while transmitting desired signals between the systems by optical means.

PLC - Programmable Logic Controller. A multi input/output digital industrial programmable micro-controller, usually with non-volatile memory.

RFID - Radio Frequency IDentification refers to any device that responds to a radio frequency

RTV - silicon sealer – Room Temperature Vulcanising sealer

Skids -The section which attaches the gambrel to the overhead rail and 'skids' along it. The skids in this case have been manufactured by ITW-Fastek. They are injection moulded black acetyl.

Traditional chain – animals dressed while hanging from the hind legs and remain in this posture throughout the slaughter process.

Transponder – an automatic device that receives amplifies and retransmits a signal on a different frequency.

11.3 Acknowledgements

This project could not have happened without the encouragement and enthusiasm of the Hillside plant owner Peter J. Trefort and his family. It was Peters unwavering faith that we could provide individual carcass feedback to his Q Lamb members that kept the project alive. His objective is to provide feedback to Q Lamb members on breed and bloodline differences in relation to carcass and meat yield.

Hillside provided the electrician, maintenance staff and access to workshop for the initial install and subsequent upgrades of equipment. The original project had no provision for software so Hillside covered the cost of the development of the original Carcass Tracking programme.

The staff at Hillside have been amazing despite some inconveniences. Rex (Hillside's McGyver) is always there to construct another component or adapt an item to fit without once saying "you want what?" Stevo who drilled, glued, pulled apart and re-assembled the skids and gambrels *many* times.
The sparky, how he got the cables where he got them will go to his grave. Wayne at receivals, who somehow managed to slot in our trial sheep in whenever we wanted to track them. Jacko and Ticko, the floor bosses, went out of their way to make the project possible. If something wasn't right they would diplomatically point it out and usually come up with a solution.
Davo in the weight and grade area made things happen. He had a good understanding of what we were trying to achieve and he knew who to ask. His help in some of the trial work was invaluable.
The administrative staff in the office deserve special thanks. There were numerous times we needed to book a truckload of lambs for the trial or chase down information, they were always there. Finally Scotty, our little ray of sunshine on the scales. He was our 'Buster' (Myth Busters test dummy), if there was a way of making the system fail Scotty could find it. And for those who came in late, he does actually speak.

Special thanks must go to Rod and Jenny Shaddick who EID tagged all their lambs from the 2006 drop and sent lambs through Hillside for us to monitor.

Sincere thanks to Reg Crabb from Q Lamb who contributed a considerable amount of his valuable time and expertise to the project. He was always available and his support and advice was invaluable. Reg is an integral part of the feed back to Q Lamb growers and the implementation of the recommendations from the enhanced information that will be provided.

Finally thanks to the *Sheep CRC* and the *Department of Agriculture and Food of Western Australia* (DAFWA) and MLA for the support, guidance and funding of the project.

11.4 Project Participants and Contacts

Estock Systems
Rob Shepherd
Estock Systems
71A Anzac Road,
Mount Hawthorn, WA 6016

Mobile: 0427 471 097
Email: robshepherd@wn.com.au

Hillside Abattoir
Peter Trefort (snr)
Hillside Meats
Boxsel Road,
Narrogin WA 6312
Company Principal

Phone: (08) 9881-1016
Mobile: 0417 961 643
Email: hillmeat@wn.com.au

Bill O'Halloran
Industry Leader, Sheepmeats
Division of Agriculture and Fisheries
NSW Department of Primary Industries
Armidale

Phone: 02 67 388505
Mobile: 0412 816811
Fax: 02 67 728664

Ian McFarland
Development Officer
Department of Agriculture & Food WA
10 Doney St
Narrogin, WA 6312

Phone: (08) 98810222
Mobile: 0428 942 757

Allflex
Patrick Gunston
Market Development Manager
Allflex Australia Pty Ltd
33 Neumann Road, Capalaba, QLD, 4157

Phone: 07 3245 9100
Mobile: 0418 724 445
Fax: 07 3245 9110
Email: pat.gunston@allflex.com.au

SCL
Contact: David Wright
SCL systems, 505 Rosebank Road, Te Atatu, Auckland, New Zealand

Mobile: 0011 64 21 721 013
Email: davew@systemcontrols.co.nz
Website: http://www.systemcontrols.co.nz

Electro-com
Haydon Lennard
RFID Systems Manager
Electro-Com Pty Ltd
12 Bastow Place Mulgrave Vic 3170

Phone: 03 9535 0705
Fax: 03 9545 3315
Website: *www.electrocom.com.au*
Website: *www.rfid.com.au*
Email: hlennard@electrocom.com.au

ITW Deltar (ITW-Fastek)
Kent Ballan
8-12 Jacks Road
South Oakleigh
VIC 3167

Phone: (03) 9564 3229
Fax: (03) 9579 2862