final report

Project code: P.PSH.1193

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Date published: February 2020

PUBLISHED BY
Meat and Livestock Australia Limited
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NORTH SYDNEY NSW 2059

Supply chain for the 21st Century in Australia

This is an MLA Donor Company funded project.

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

Executive summary

According to statistics published by Beef Central, in 2016-17, Australian exported beef and veal products valued at A$7.1 billion. (BeefCentral, 017).

With trends in meat consumption continuing to rise, and regulatory policy demanding more information, having an efficient system to track, trace, and authenticate meat with confidence is a priority.

The Supply Chain for the 21st Century in Australia project has explored the usage of blockchain technology to underpin a next-gen Supply Chain platform for the red meat industry in Australia.

Ripe.io partnered with Paraway Pastoral, Elders Killara Feedlot, Northern Meat Co-op and Jack's Creek to build out a proof of concept Supply Chain Platform starting with the birth of an animal and following that animal through the supply chain to the processing plant. We have showcased how transparency across the supply chain can be achieved and have set a foundation to explore the export side of the supply chain in a subsequent project.

This project has explored the use of blockchain technology and smart contracts and how they can support the automation of Certifications, compliance of export regulations, and compliance of domestic regulatory obligations such as National Livestock Identification Scheme (NLIS) Animal Movement adherence.

The project tracked of a cohort of 448 cattle supplied by Paraway which were finished at the Elders Killara Feedlot and processed at Northern Meat Co-op. The products produced were ultimately exported by Jack's Creek.

The project participants supplied data relating to each stage of the supply chain, up to and including the processing plant. The types of data provided included:

- Retrospective weight and treatment handling data from Paraway for the 448 animals being tracked in the pilot.
- Retrospective Induction data from feedlot (Elders Killara)
- Live Exit data from feedlot (Elders Killara)
- Carcass Data from processing plant (Northern Meat Co-op)

We also received an export of movement data relating to this cohort directly from NLIS.

The developed platform has revealed several challenges and benefits that could be realised by the beef industry including:

- CHALLENGE: Data quality, consistency and availability across the supply chain. Data capture practices differ across all level of the supply chain, even with the same business, and getting good quality consistent data from all points along the supply chain is important
- CHALLENGE: Adoption is going to be directly tied to alignment of shared economic incentives.
- BENEFIT: Reduce the cost of compliance for adherence to NLIS regulations
- BENEFIT: Richer data from across the supply chain can enable better decision making.

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1 Background

1.1 Why the project was undertaken: Fragmented Food Supply Chain

The global food, beverage and agricultural industry are fragmented with no concentration in any single or group of players. This means there is a vast, decentralized network of growers/farmers, distributors, packers, processors, transporters, third parties, brokers, and retailers (food and dining services, grocers, restaurants, home delivery). This condition has created a very challenging, fragmented food supply chain with many negative impacts, including:

- Increases in food waste, costing Australia and the world significant loss. In 2016-17 (the base year), Australia produced 7.3 million tonnes of food waste across the supply and consumption chain. Of this, 2.5 million (34 per cent) was created in our homes, 2.3 million tonnes (31 per cent) in primary production and 1.8 million tonnes (25 per cent) in the manufacturing sector. (Australian Department of Environment, 2019)
- Lack of visibility of food origin and authenticity
- Rises in third party food certification to create trust
- Lack of monitoring tools for food sustainability, major goal of the industry
- Rising food traceability recall costs

The amalgamation of increased globalisation, new standards for regulatory policy, and information transparency has engendered demands for an efficient, connected, and trusted global food system. With these new demands comes an imminent need to bridge the gaps between both public and private agriculture and food stakeholders and create a more quality food system for all its consumers.

1.2 Impact on Beef Export Market

According to statistics published by Beef Central, in 2016-17, Australian exported beef and veal products valued at A$7.1 billion. (BeefCentral, 017)

With trends in meat consumption continuing to rise, and regulatory policy demanding more information, having an efficient system to track, trace, and authenticate meat with confidence is a priority. Food safety concerns and consumer demand for transparent food has pressured governments to evolve standards and create labelling and reporting requirements. The U.S, one of Australia's largest beef import clients, has mandated food and stakeholders to comply with the Food Safety and Modernisation Act, a monumental overhaul of current standards to prevent foodborne illness. Countries across the world are implementing more stringent import and food traceability protocols to prevent disease, improve quality, and protect their own domestics markets. This places additional strain on the Australian Export sector.

Current processes for documenting and aggregating data and information are outdated and unsustainable for generating on-demand reports for product certification, driving the need for a food quality and verification network.

1.3 Project Purpose and Aim

This project has been established to utilise blockchain technology to improve the transparency, quality and competitiveness of the supply chain from farm to fork by:

- Bringing together a comprehensive set of stakeholders in the red meats business in Australia.
- Establishing the state of digitization in a sector of the red meats supply giving the MLA and government a sense of readiness for a 21st century seamless food supply chain.
- Understanding how to improve full traceability of animal from farm to processor.
- Identifying the scope of a pilot project that solves key problems in the red meats business and delivers new and long-term value for the same using technologies such as blockchain, IOT/sensor, smart contracts, cloud connectivity and other connected capabilities
- Delivering a pilot system to demonstrate the benefits and capabilities of a modern food supply chain platform using blockchain technology.

2 Project objectives

2.1 Problem Statement

In the Australian red meats market, of which this project will focus only on beef, there are several key issues that face participants in the marketplace:

- Fragmented supply chain: The product is perishable and unpredictable. Buyers, like Jack's Creek work with a lot of numbers and assumptions to get product when they need it
- Lack of transparency along the supply chain: Is this a way to encourage better performance by creating more knowns than unknowns? B2B Transparency is as important as B2C.
- Lack of dialogue amongst supply chain.
- Lack of consumer visibility. Currently there few to no ways for consumers to report back to supply chain: Is there a way for consumer at home or in a restaurant to feed back into the blockchain? Is this an opportunity to build a bi-directional dialogue? Possibly in a later phase
- Don't know what behavioural response will be. Are we touching consumers digitally or analog?
- There are a lot of drivers that have nothing to do with the taste or feel of product.
- Regulatory compliance: Food safety traceability compliance and transparency is a requirement for the project.

2.2 Objectives

1. Provide a blockchain platform and interface to showcase the lifecycle of red meats from the baby animal to the point of the buyer receiving the meats and potentially to the end consumer. The priorities to place in the deliverables of the project include:
    - Quality
    - Transparency
    - Regulatory
    - Food Safety

- Authenticity

Success defined as follows:

1. Measuring and benchmarking supply chain alignment in terms of improved data sharing, communications and efficiency and revenue/costs.
2. Improvement in their ability to compete as a supply chain. This will have to be measured by either improvement in market share of brands to increase in profit margins to producers.
3. Increase consistency of overall operations through lower technology cost, improved data validation and sharing.
4. Enrichment of data capture to enhance supply chain intelligence and decision-making.
5. Traceability from a security and food safety perspective. This will be measured by any improvement in time frames for detection and rapid response.
6. Innovate for the government by creating new methodology to ensure compliance with agricultural regulations for beef via smart contract, or automated code on the blockchain.

3 Methodology

3.1 Why Blockchain?

There is an unprecedented, transformational opportunity to globally deploy a new technology, distributed ledgers and blockchain and alter the trajectory of the food system to solve the problems of mistrust, unreliable data, and imbalanced economic power for large entities posed by current decentralised, non-integrated sources. The technology could eliminate third parties who control information and allows for decentralised management of data, transactions, intelligence and value through independent entity owned distributed ledgers, which can be set up for data sharing and consensus of information. Blockchain technology is less than 10 years old but has already demonstrated its disruptive potential in other industry, including finance, banking, insurance, health care, supply chains, distribution and trucking, energy, and of course food.

Blockchain can facilitate collaboration between parties to create single, auditable, immutable, records which are used as a basis for value transfer such as invoicing, more efficient traceability (recalls) reconciliation of food quality and sustainability, etc. It does so by allowing two or more parties to interact as peers, without any party being in control or in charge of the other.

Here are a few examples of situations where blockchain technology can be particularly useful:

- Large number of actors in the system (ex: complex food supply chain);
- Actors are distributed geographically (ex: global supply-chain);
- Actors are not always connected to the network (ex: remote farms);
- Actors do not necessarily know one another (ex: unknown suppliers);
- Actors do not necessarily trust one another (ex: new suppliers);
- Actors desire to collaborate on a common goal (ex: food safety plan);
- Collaboration between actors can be customized by the actors according to their specific circumstances (ex: corrective action);

- Actors require an incentive in order to collaborate (ex: rewards for good behaviour, sharing of data, etc.).
- Regulatory compliance to be incorporated. The complex, distributed, and ever-changing nature of food supply-chains provides an ideal environment and problem-set for blockchain technology.

The ripe.io blockchain of food and suite of tools were designed to answer the simple questions of where did my food come from, how did it get here, is it safe, and does it taste great? It is a food quality communication network allowing private and public collaboration between participants involved in the production of food. The Blockchain of Food provides information protection, licensing, and publishing services that bring transparency for the consumer and monetisation opportunities for providers and certification agencies.

In addition to the blockchain platform, ripe.io has built a suite of tools to drive the value and capabilities of the Blockchain of Food:

- **Food bundle:** digital picture of food history documentation and a reference library of food, processing and participant data and activities.
- **Food quality certification** using the blockchain record hashes
- **Food browser:** application for visualising the food bundle, data and blockchain participants
- **Data licensing, privacy, and automation** using data privacy via cryptography and smart contracts

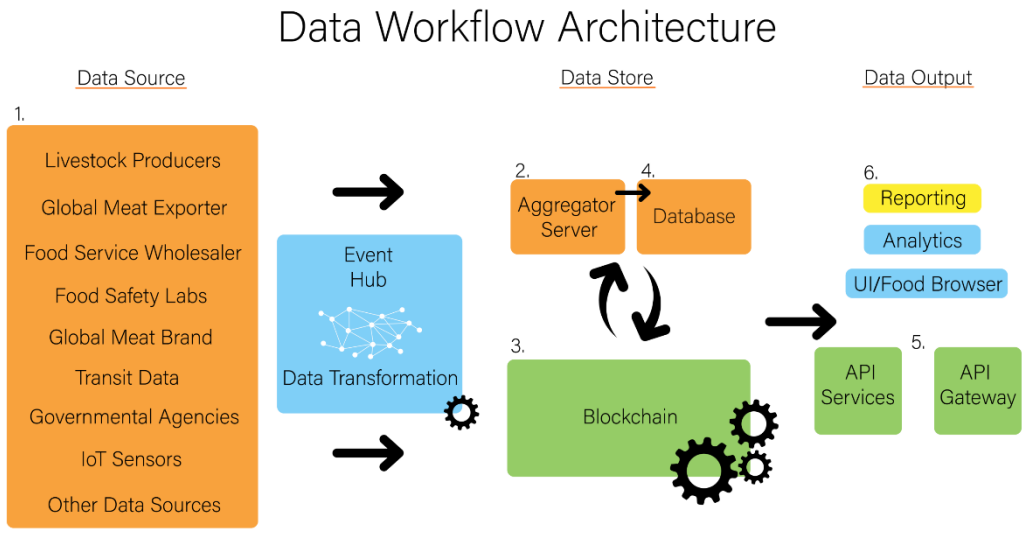

Image - 1 Data Workflow Architecture

The ripe.io platform allows longitudinal tracking of a shipment as it changes conditions and ownership. The food bundle serves as the virtual twin of the physical object, following the item through the chain by appending records to the blockchain. Documentation and records can be appended to the food bundle in order to provide details and evidence of the food product's history. An actor can then query a blockchain and receive all the relevant information from all of the sources involved in the production of a bundle, reducing transaction time and improving efficiency. The system will require users to input data to form records in the system. These records can then be

checked against specified criteria, ultimately producing a certification or an indication of lack of compliance if the criteria are not met. These criteria can then be used for supplier selection or validation.

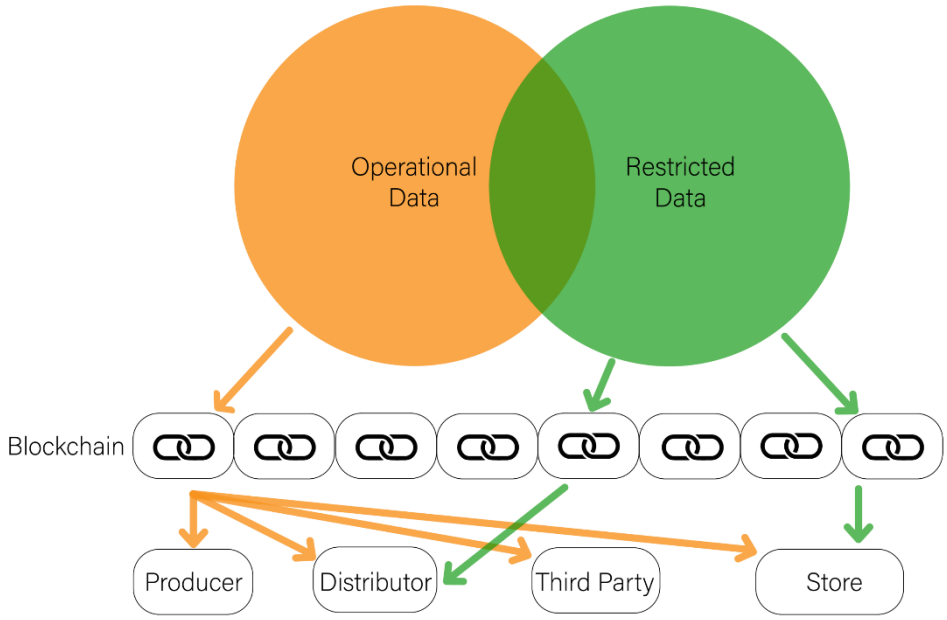

Image - 2 Blockchain Venn

3.2 Project Scope

The first task for the project was to identify several beef supply chain stakeholders who would participate in the project.

Businesses in the beef supply chain who participated in the project were:

- Jack's Creek (Wholesaler/Exporter)
- Paraway Pastoral (Breeding/Backgrounding/Farm)
- Elders Killara Feedlot (Feedlot)
- Northern Meat Co-op (Processor)

All the above participants are members of the Jack's Creek supply chain.

Workshops and requirement gathering session with each participant allowed us to establish a workflow for the supply chain and out of this we set an initial scope for the project.

We would track cattle from their birth on a Paraway property, all the way through to their processing at Northern Meat Co-op.

Out of scope for the project were Joinings, Genomics and Parentage, as these steps relate to the previous generation of cattle, not the animals being calved and processed in this process. Additionally, Paraway is a commercial herd operator and as such, do not generally record Breeding/Joining/Parentage data on animals.

Originally, we planned on ending the tracking with the cartons that were being produced out of the boning room, but to ensure that we could meet the project deadlines, it was necessary to reduce the scope of the project to end with the carcass entering the boning room at the processor. This scope still affords us the ability to track the animals from birth through the supply chain.

The below image details the mapped workflow.

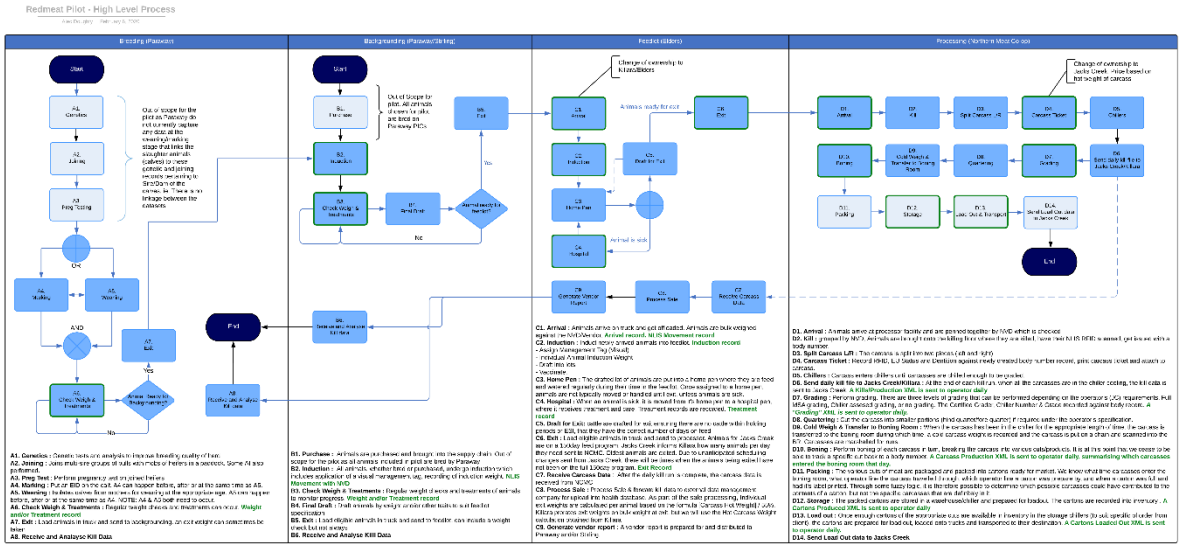

Image - 3 Pilot Supply Chain Workflow

(Ripe.io, 2019)

3.3 Animal Tracking: Live Data vs Retrospective Data

The overall time it takes for an animal to pass through this supply chain is approximately 18 months from the time of birth until the animal's death at the processor. As such, due to the length of time the project had to operate within, it was not possible to live track the animals while they were on Paraway properties. It was necessary to get a retrospective data file from Paraway, once we had identified the cohort of animals we would be tracking.

Another factor which influenced whether we could use live or retrospective data during the pilot was that the animals go onto a 150-day feed program when they enter the feedlot.

Our starting point was therefore identifying a cohort of Paraway animals which had already been inducted into the Killara Feedlot, who were due to be exited from the feedlot to the Northern Meat Co-op processing plant in the months of October and November.

Overall, we identified a cohort of 448 cattle.

The demarcation between live data and retrospective data for the project was therefore the feedlot, after induction.

Overall, the data we received for the project includes the following:

- Retrospective weight and treatment handling data from Paraway for the 448 animals being tracked in the pilot.
- Retrospective Induction data from feedlot (Elders Killara)
- Exit data from feedlot on each day animals exited (Elders Killara)
- Carcass Data from processing plant for each kill run (Northern Meat Co-op)
- Retrospective animal movement data sourced directly from NLIS covering ALL movements for the 448 animals in the pilot cohort

4 Results

4.1 Platform Architecture

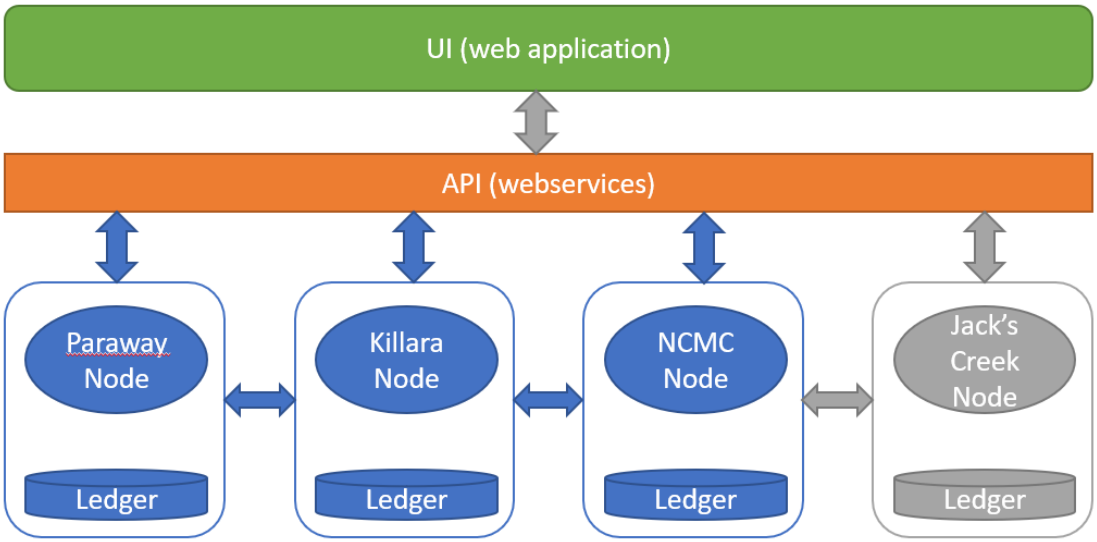

Image - 4 Pilot Platform Architecture

Each participant has been provisioned their own Node, User Account and Ledger within the Ripe.io Platform. Each user account utilises a separate private encryption key for security purposes.

This ensures that each participants data is secure and only available to another participant if it has been explicitly shared with another participant.

For the sake of exploring the benefits of the transparency that blockchain can provide across the supply chain, we have taken the approach that all data provided by each participant has been shared across ledgers with each of the other participants. As this project only covers a specific set of animals within a narrow period of this approach will have no material impact on any of the participants.

A separate measure we employed within our design was to have specific views and dashboards only available to a specific user account. For example, Paraway expressed a desire to be able to view the Average Daily Gain performance aggregated by Property of Birth. This would allow them to determine internally, how each property is performing. This data gives them a competitive

advantage and as such they did not want the other participants in the pilot to be able to this specific breakdown of their property and animal performance, even though their individual animal weight, treatment and movement data has been shared to the other participants.

4.1.1 UI/Dashboards

There are 13 different dashboards and views spread across the 4 user accounts developed for the pilot, providing the participants with visibility over both their own data, and over the data the other participants have shared with each other.

While a detailed breakdown of the functionality and benefits of every screen within the system is beyond the requirements of this report, Appendix A presents images highlighting the screens for each of the participants in the supply chain.

4.2 Sourcing the data for the project

The animal data each participant in the pilot provided for the project received in the form of a data file in either the CSV, XLSX or XML file formats.

The below table summarises the data files we received:

Supply Chain Phase	File Format	File Name	Comment
Breeding/Backgrounding (Paraway)	XLSX	Paraway - Burindi 102hd.xlsx	One-time retrospective data extract from Burindi property
Breeding/Backgrounding (Paraway)	XLSX	Paraway - Newstead 173hd.xlsx	One-time retrospective data extract from Newstead property
Feedlot (Elders Killara)	XLSX	Induction.xlsx	One-time retrospective data extract of the Feedlot Induction data from Elders Killara
Feedlot (Elders Killara)	XLSX	Exit 7JA930 20191204 13hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit 7JA930 20191206 151hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUA928 20191115 63hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUA928 20191125 35hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUB922 20191024 61hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUB922 20191031 20hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUB922 20191125 1hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUC928 20191108 1hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUC928 20191115 70hd.xlsx	Daily extract for the animals Exits from feedlot
Feedlot (Elders Killara)	XLSX	Exit EUC928 20191125 19hd.xlsx	Daily extract for the animals Exits from feedlot
Processor (Northern Meat Co-op)	XML	Carcass and MSA data 24-10-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op
Processor (Northern Meat Co-op)	XML	Carcass and MSA data 31-10-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op
Processor (Northern Meat Co-op)	XML	Carcass and MSA data 25-11-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op
Processor (Northern Meat Co-op)	XML	Carcass and MSA data 03-12-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op

Processor (Northern Meat Co-op)	XML	Carcass and MSA data 05-12-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op
Processor (Northern Meat Co-op)	XML	Carcass and MSA data 14-11-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op
Processor (Northern Meat Co-op)	XML	Carcass and MSA data 7-11-19.xml	Daily extract of carcass data and MSA grading information from Northern Meat Co-op
ALL	XLSX	NLIS Movement Extract.xlsx	Complete one-time extract of all movement records related to the 448 animals in the pilot, provided to the project by NLIS.

It should be noted that the animals sourced from Paraway in this pilot, came from 3 different Paraway backgrounding properties, Burindi, Newstead & Urawilkie. We did not receive any backgrounding data related to the animals from Urawilkie - data capture practices and systems vary across Paraway properties depending on current requirements - there was no data available for the specific animals from Urawilkie in the pilot. We kept these animals in the pilot as there was Feedlot and Processing data available for these animals. This also gave us insight into circumstance where either data is not available, or data has not been shared between participants in the supply chain.

5 Discussion/Findings

5.1 Data quality and availability

To maintain a tight scope for the project, it was decided that we would not build a mechanism by which the individual participants could upload their own data. This decision was made for a few reasons.

1. Laborious & manual process for participants to create the data extracts
2. Variation in tabular format between individual data files
3. Limited number of data files required for the pilot

Northern Meat Co-op utilise a stored procedure in their SQL Server database to generate their carcass data files, as such, they're data extracts were relatively easy to prepare and consistent in schema.

On the other hand, both Paraway and Killara had to manually generate their files. Paraway had a challenge as their data was not accessible from a central location. Instead, Paraway had to interrogate the herd management system at each individual cattle property. Also, the individual cattle properties do not use the same herd management software, so the data schema/format of each file they provided was different.

Given the limited timeframe the pilot ran over, and that therefore there was a limited number of data files the project had to deal with, and for all the above reasons, it was deemed that manually

importing these files onto the blockchain was a more efficient use of project time than building a suite of data import mechanisms to automate the process.

In order to position this system for a commercial release, we would need to build some self-service data import mechanisms to allow each participant in the supply chain to upload their own data.

A requirement for a self-sustaining blockchain system for tracking would be to establish data capture capability via an API, where participants can more easily have electronic data exchange with the system directly from theirs. It will be important to note the identity of the source system, hardware, network to ensure identity integrity of the source. For example, if that server fails and is replaced, we need ensure a proper source registration on the blockchain and that identity is to be shared across other participants ledgers, so a full auditable log is maintained in the case of queries and or even recalls and need for correct data. Another option is to create web and or mobile data entry forms, or file upload forms, so that participant operators can submit data. The prevailing risk of both methodologies are germane to all database technologies including blockchain – you can't fully prevent bad actors for improper data entry, whether intentionally or accidentally. Over time however, since the data and ledgers are shared, multiple parties review and presumably rely on the data and a "natural" scrubbing of the information occurs through collaborative error detection and management of which updates to the block record are seen system wide for validation and consensus. This is an important security measure of blockchain system over centralized databases in that the participants own and are responsibility for veracity and accountability of its collective information.

5.2 Participant concerns over data

One of the primary concerns raised by some of the participants was related to the security of their data and specifically about identifying what value there was for them in sharing their own data to the participants up and down stream in the supply chain.

Elders Killara was also concerned that there could be negative consequences to sharing their data across the supply chain. If looking at the platform in an end-state environment where there are multiple feedlots in the supply chain, their concern was that there was an opportunity to use this data to compare Killara's performance against other feedlots in the supply chain, leading to potential negative impacts to their business.

Paraway had similar thoughts, whereby other participants in the supply chain could use the ADG and weight data, coupled with the Property of Origin information that Paraway has shared with the supply chain to facilitate deeper interrogations of the value Paraway are contributing to the supply chain. Paraway's outlook on this was however different, in that it could lead to them being able to receive a premium for certain animals.

A counter argument to both these perspectives, however, is that Producers, Feedlots and Processors in the supply chain are technically able to perform these sorts of comparisons and evaluations today with the information currently being distributed up and down the supply chain.. For example, as the NLISID of each animal can easily be retrieved via a simple Beast Enquiry query on the NLIS Database, it is possible today to derive each animal's PIC of Origin which is embedded as the first 8 characters

of the NLISID. This PIC could then be used to group and aggregate the MSA Grades, Carcass yields, Hot Weights or ADG.

In terms of security, the blockchain platform ripe.io has implemented for this project, each participant has their own node and private keys to encrypt their data into the ledger.

5.3 Perceived Benefits of Transparency

Various conversations with the individual participants within the supply chain has highlighted the fact that the participants furthermost upstream and downstream in the supply chain derive the most value from the transparency afforded them by this platform.

1. **Paraway can more easily see like-for-like data across each of their properties, allowing them to evaluate the perform of their properties without significant data manipulation**. Additionally, they can more easily receive the carcass data for the animals they provided into the supply chain. Currently, processors usually only provide this data directly to their immediate client. In the scenario we encountered for this pilot, this would be Jack's Creek. It would then be up to Jack's Creek to provide this carcass data to Paraway. *This puts a third party in the middle of this dataflow who may or may not forward this data on.*

This platform removes the dependence on the middleman in the supply chain to forward on the data. It also allows for immediate transfer of the data, as soon as the originating party uploads the data.

All of this leads to ready and immediate access to multiple dimensions of data that can be used to evaluate performance and improve decision making at Paraway.

2. **At the other end of the supply chain, Jack's Creek gets visibility of more comprehensive data metrics they can use to monitor product quality and adherence to export regulations including**:

- Chemical and medicinal treatments made On Farm or in Feedlot which may affect a product's ability to meet the regulations of certain export markets. E.g. Hormone Growth Promotants (HGPs) can make cattle ineligible for export in certain markets.
- Carcass Yields
- Carcass Health
- Monitoring an animals EU eligibility
- Visibility of Lifetime Traceability

3. **The Feedlot and the Processor operate in the supply chain more as service providers and do not derive as much benefit from visibility to the upstream and downstream data provided by the other participants within the supply chain**. The value of the data they provide to the supply chain is higher though, so there may be opportunity for these participants to monetise the provision of this data in some way. Other more direct opportunities to benefit from a blockchain distributed ledger system is having a more efficient method of generating digital records for participants who want to improve electronic management of their data through singular transparent networks. Meaning, the long-term elimination of point to point communication which has the tendency to be incomplete, creating inefficiencies in operating such as recalls. A business benefit for the feedlot and processors

are being more digitally ready as farms and brands/retailers continue to push these efforts. To be left behind could have a negative impact on future business.

4. One thought for the government and entities like MLA is to have a regulatory node so that they have an opportunity to witness the data and activity on an aggregated basis for analysis territory or even country wide performance, risk, etc. This is a suggestion that has been offered in structured financial trading markets with regulatory agency's employing a "do no harm" participation for understanding trends and activities versus looking at specific actions for recourse.

5. Another key benefit is the transparency of the many government mandated activities and data. For example tracking movement of animals is not a global practice, but rather a well-worn one in Australia. The many benefits of the obvious – where is my animal at any point in time – it too can help in Agri lending practices at banks as they will have improved visibility into the risk of the animal life activity. In the United States for example, this is voluntarily done and while a regulation for a similar EID tracking system was set to be enacted as law in 2023 but now has been pushed back putting transparency goals as diminished. As their digitization activities under the UN framework for intergovernmental ledgers – the goal being to help government preserve sovereignty over their legislative databases for import export regulations but enable an improved interoperability for businesses to have more streamlined processes for cross border trade. Having a full digital record of food and agriculture activity and attributes, married to required customs forms, FOB and trade documents, certifications and so forth, can streamline the time and cost for ease of cross border trade but insuring the integrity of participant identity and a full traceable record of the underlying cargo.

6. Northern Meat Co-op (NCMC) have identified that with the current level of implementation and the variety and focus of dashboards available in the platform, they do not currently see themselves receiving value from this platform, but can see how the data they are providing to the platform is of great benefit to their customers. They also highlighted a future opportunity for the platform where value and benefit could be provided to NCMC. If NCMC were given the capability to use the data to investigate animal health and carcass quality issues they see in the processing plant, they could reduce occurrences of bone taint and other product quality issues within the supply chain by providing feedback back down the supply chain.

5.4 Smart Contracts: Automating Workflow for Certifications and Export Regulations

Due to the project scope being limited to the tracking of cattle until their entry into the boning room, our options in regard to a subject for the exploration of Smart Contracts as they relate to Certifications and Export Regulations was somewhat limited.

We landed on an implementation which targeted the calculation and evaluation of Lifetime Traceability (LT). We built in logic into the import process that utilised the NLIS Movement data provided to the project by NLIS. It is to be noted that we didn't not receive any LT information from NLIS, only the individual animal movements. We implemented the LT evaluation formulae and business logic directly into the platform.

On top of this, we implemented three different views into the system to highlight and report on LT compliance at an NVD Movement, and an individual animal basis. We also provided a method by which a participant can produce a list of the Lifetime Traceability Exceptions. I.e. Only display the animals who failed LT.

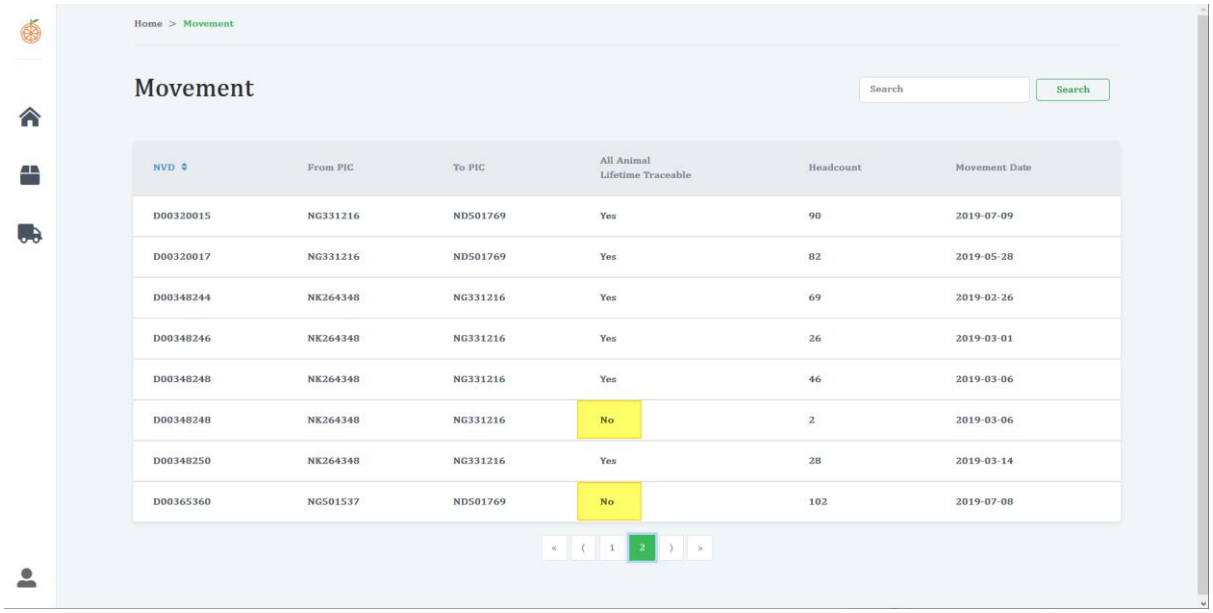

Image - 5 the Movement list highlights those movements & NVDs who had at least 1 animal fail LT

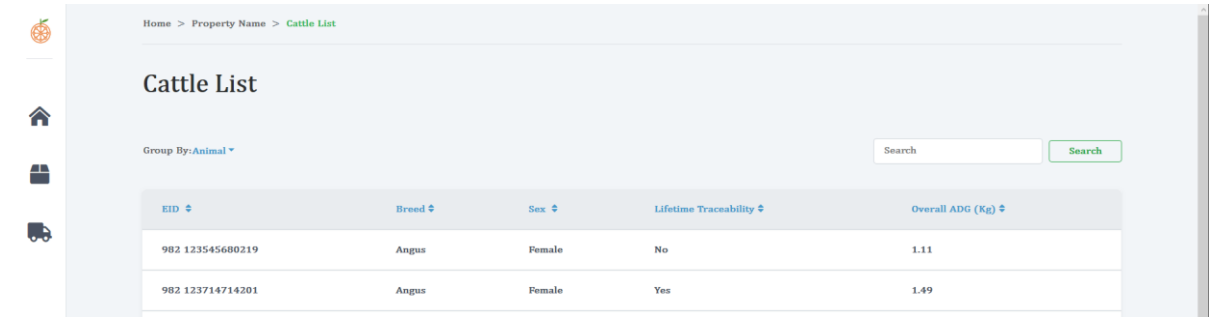

Image - 6 The cattle list shows the LT status of each individual animal

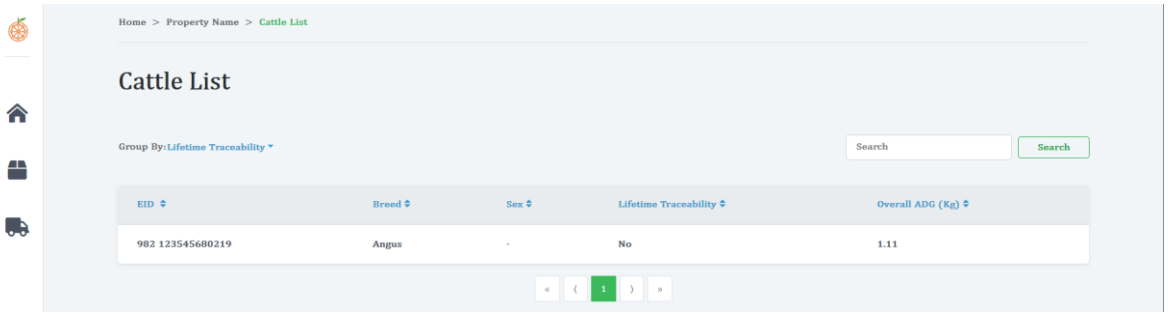

Image - 7 The cattle list can be filtered using the Lifetime Traceability Exceptions option to show only those animals which fail LT

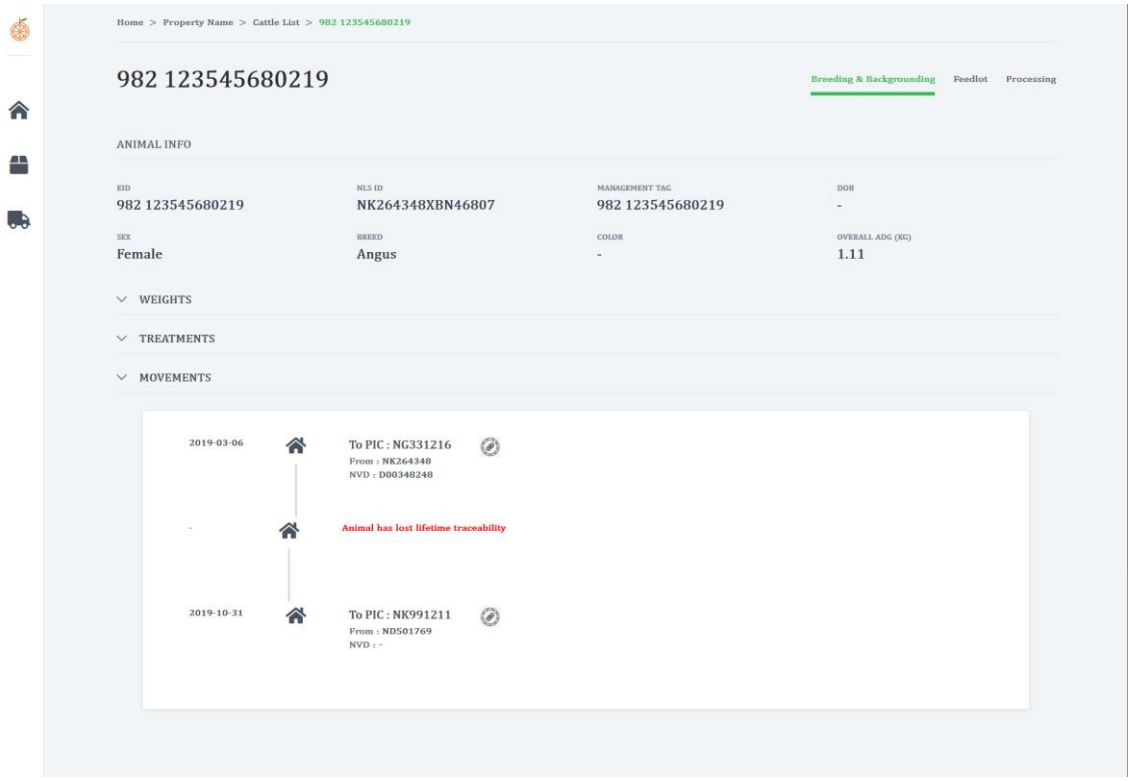

Image - 8 The Breeding/Backgrounding version of the Cattle Details shows exactly where lifetime traceability was lost

Additional functionality that can be provided by the implementation of a Smart Contract could be to trigger follow up actions or put a halt to the progression of an item through a workflow.

Specific to the Lifetime Traceability scenario used in this project, an example of an additional follow up action triggered by an LT failure could be an email being forwarded to the PIC where the LT was discovered.

Another implementation of a Smart Contract which could be considered for a subsequent research project might be to put a stop on an Export shipment if a carton of product has a likelihood of having a HGP treated animal in it, is assigned to an export shipment.

5.5 Interaction with Regulatory Systems like NLIS

This pilot project has implemented an approach whereby the ripe.io Beef Supply Chain platform is a downstream consumer of movement data from the NLIS platform in an environment where the producers, feedlots and processors submit their NLIS movements by other means. No direct programmatical interface with NLIS was implemented as part of this project, though there is opportunity in a future project to explore this further.

It would not be far-fetched to envision a scenario where the data flows between the NLIS Database and the Beef Supply Chain Platform in both directions. Producers, Feedlots and Processors could initiate a movement of cattle from the ripe.io platform, which would then push the movement down into the NLIS system. The ripe.io platform could also be capable of pulling down transactions from the NLIS database (an extension of the current design) to act as a validation and to catch movements

that may not have occurred via the platform. I.e. animals purchased into backgrounding rather than bred may not get their initial NLIS movement relating to the purchase processed, which would in turn trigger a LT failure.

There are a few considerations that would need to be evaluated before a bi-directional data flow between the NLIS database and the Beef Supply Chain Platform be considered.

Data segregation in the NLIS system: Currently the NLIS database limits Producer, Feedlot and Processor NLIS user accounts to submit and report on movements related to PICs associated with their own account. In a commercial implementation of this Beef Supply Chain Platform, we would need to consider scenarios where cattle are purchased and moved into backgrounding in a scenario where the movement was related to a Destination PIC not associated with the NLIS user account of the Producer directly supplying cattle to the feedlot.

Paraway have suggested that this type of NLIS integration could be used to help alleviate some of the compliance burdens that operators with the sector must bear. It would be possible to utilise the animal locations as recorded in the ledger on the Ripe.io platform against PIC holdings as queried from the NLIS database. A reconciliation could then take place with the Ripe.io platform being capable of pushing corrective movement transactions through to the NLIS System. It's an interesting idea that is worth exploring as it could prove beneficial to the whole livestock sector. Operators of Cattle, Sheep and Goat businesses would all benefit, particularly when considering sheep and goat operators who are using EIDs to individually identify animals, like those businesses operating in Victoria where individual sheep and goat traceability is legislated, but also early adopters in NSW and the other states and territories of Australia who have started using EIDs on sheep and goats.

NLIS and Integrity Systems have been working on the eNVD (electronic national vendor declarations) platform and rollout for several years. We see the opportunity the blockchain offers eNVDs, particularly when looking into the future and considering blockchain as the underlying technology of a future version of the NLIS system. The Ripe.io Supply Chain platform, NLIS, and the ENVD platform all operating in harmony via blockchain interoperability.

5.6 Meeting the Project Objectives

1. *Provide a blockchain platform and interface to showcase the lifecycle of red meats from the baby animal to the point of the buyer receiving the meats and potentially to the end consumer. The priorities to place in the deliverables of the project include:*
    - *Quality*
    - *Transparency*
    - *Regulatory*
    - *Food Safety*
    - *Authenticity*

The project implemented a platform using blockchain technology which tracks cattle from the calved animal through to the carcass's entry into the boning room. The tracking of individual animals into specific cartons becomes impossible after the carcass enters the boning room, but it would be possible to provide time-based windows to determine which potential carcasses contributed to a specific carton. In terms of quality, the system tracks certain attributes which contribute to or report on product quality including Treatments animals may have received, whether an animal is lifetime

traceable, and MSA grading evaluations of specific carcasses. In addition, DNA trackers could be deployed from the time a calf is readied to be ID'd and then follow up with a DNA sampling test before product is being placed in cartons. The positive is getting exact origin to the product. However, this is expensive with costs of DNA tracking up to $50 per head of cattle. Ultimately this need will be a function of consumer demand for such precision and their willingness to pay for that premium information and have that premium paid go back to the farmer. Smart contracts can do such things but implied is a high level of coordination and participant procedure adherence.
In terms of transparency, the platform is currently operating with 100% of data being shared between all participants. Any commercial implementation of this platform that Ripe.io may pursue in the future would include self-service screens where a participant can explicitly share their data with specific other participants.

Success defined as follows:

1. Measuring and benchmarking supply chain alignment in terms of improved data sharing, communications and efficiency and revenue/costs.
2. Improvement in their ability to compete as a supply chain. This will have to be measured by either improvement in market share of brands to increase in profit margins to producers.
3. Increase consistency of overall operations through lower technology cost, improved data validation and sharing.
4. Enrichment of data capture to enhance supply chain intelligence and decision-making.
5. Traceability from a security and food safety perspective. This will be measured by any improvement in time frames for detection and rapid response.
6. Innovate for the government by creating new methodology to ensure compliance with agricultural regulations for beef via smart contract, or automated code on the blockchain.

Given the short timeframe within which the tracking of animals, along with the small cohort of animals being tracked within that time period, it is difficult to quantify what impact on market share and/or profit margins this platform has made.

It is however undeniable that this platform has led to improved data quality via attribute mapping during import where data from different sources has different formatting, spelling, nomenclature and terminology for the same attribute.

Seeing the data from the different sources all sitting in the same view, allows the participants to identify where inconsistencies are occurring and gives them an opportunity to implement procedural changes to rectify these inconsistencies.

The improved data sharing provided by this platform provides participants visibility over parts of the supply chain they did not previously have. The transparency gives the participants the information they need to improve their business. For example, Paraway could use the Feedlot and Carcass data they receive via this platform to enhance their decision making in relation to herd performance and property performance. It could also be used to influence their breeding programs.

The implementation of Lifetime Traceability in a form of Smart Contract demonstrates how blockchain could be used in conjunction with the NLIS system to strengthen the overall compliance of participants with government regulations relating to biosecurity in Australia.

6 Conclusions/recommendations

6.1 Conclusion

Although the scope of the project was narrowed to exclude carton production, the implementation of full individual animal tracking from birth to carcass entry into boning room has demonstrated blockchain's utility and promise as the underlying technology of a food supply chain platform.

The improvements in data validation and quality that are facilitated by this platform provides industry with definite benefits.

6.2 Recommendations

Opportunities for to expand on the existing project include:

- Extending the platform to include carton production, carton shipments, export logistics and shipment tracking, and streamlining customs requirements with a digital record
- DNA tracking for enhanced animal identify tracking. If this was used in conjunction with DNA samples taken during packing in the bone room, it would be possible to
- Using disease testing such as Neogen's NeoSeek STEC test in the production line and implementing a smart contract to halt/flag an export shipment if a test comes in positive
- Exploring the usage of the Ripe.io blockchain platform to facilitate NLIS compliance activities such as reconciling physical animals on a property (physically EID scanned while on farm) with the holdings of that same property on the NLIS database.

7 Key messages

The key messages that can be taken away from the findings of this project can be summarised as below:

- The acceptance and adoption of a supply chain platform such as the Ripe.io Beef Supply Chain will largely be dependent on clear communication of the value and benefits such a platform can provide. It would be beneficial to focus on how the system could be applied to the legislative and regulatory compliance burdens businesses face in the sector, and how those compliance costs could be reduced.
- Although this pilot was narrow in scope, there was enough there for most of the individual participants to see the potential such a platform can provide. When we consider the platform being extended beyond the pilot, the future looks bright.
- Focussing on reducing the compliance costs to the industry by integrating this platform with the NLIS system and providing NLIS holdings reconciliation capabilities could be a key focus of a future project.
- Expanding the platform to extend deeper into the supply chain to include international export traceability is also an opportunity worth exploring

8 Bibliography

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Ripe.io. (2019). *High Level Supply Chain Workflow.* Retrieved from https://www.lucidchart.com/publicSegments/view/6e1b0a26-ab51-4920-8b9a-61bebc00160d/image.png

8.1.1 Table of Figures

9 Appendix A – UI/Dashboard Screenshots

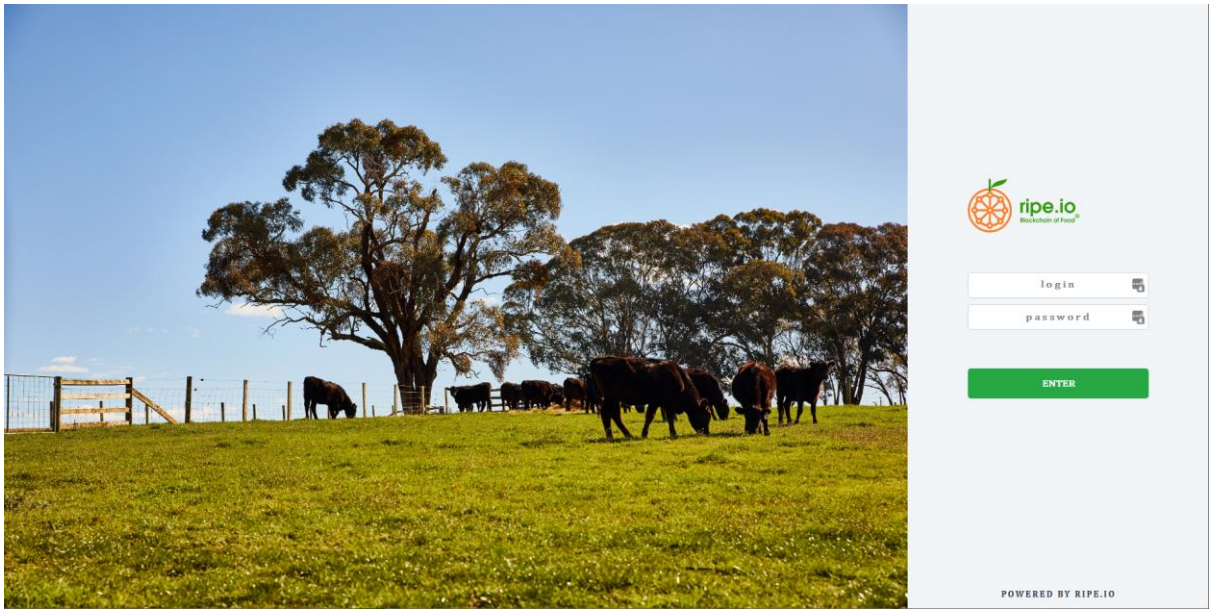

Image - 9 Login Screen

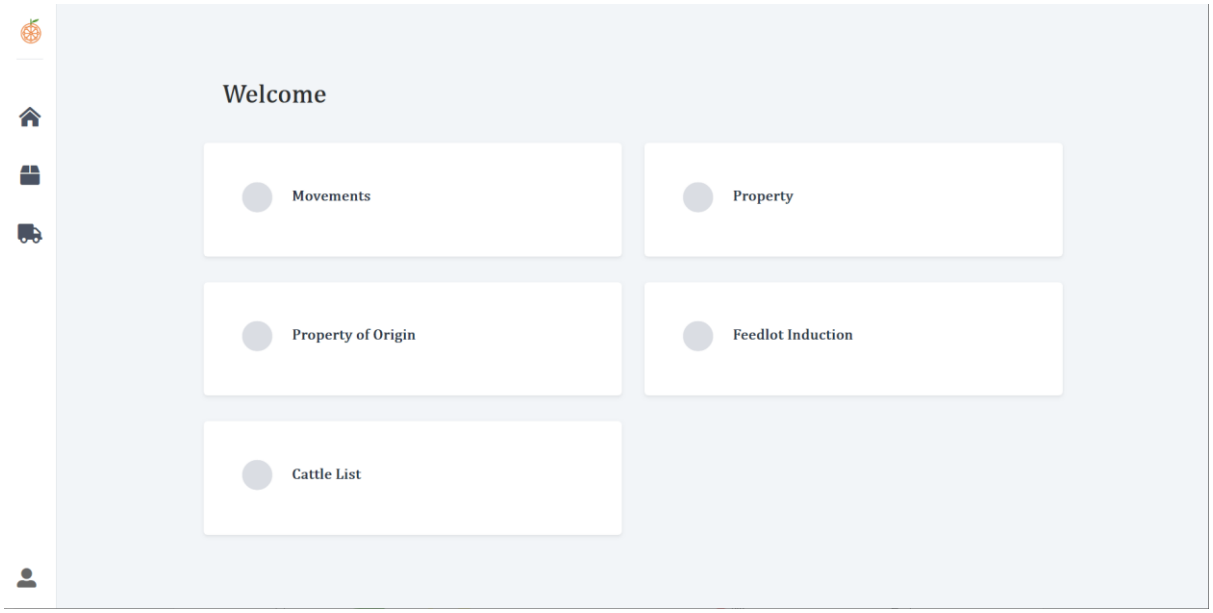

Image - 10 Home screen for the Breeding/Backgrounding account provided for Paraway

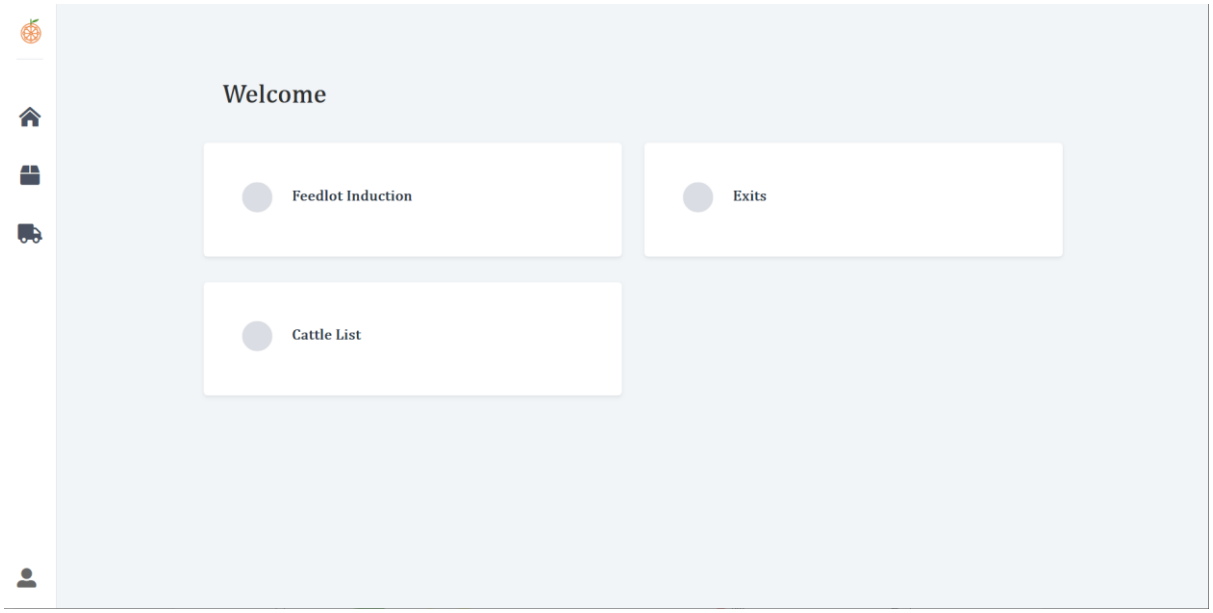

Image - 11 Home screen for the Elders Killara Feedlot account

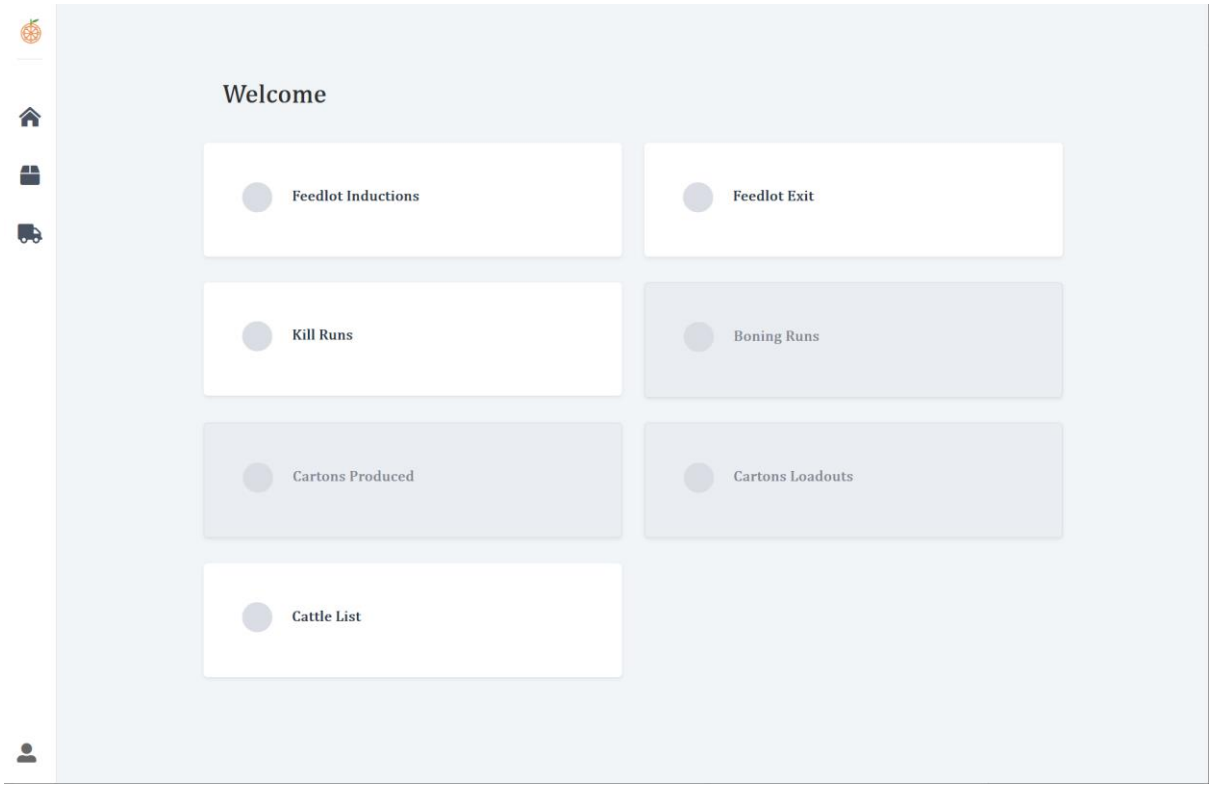

Image - 12 Home screen for Jack's Creek. The greyed-out options show the direction that could be taken in Phase 2.

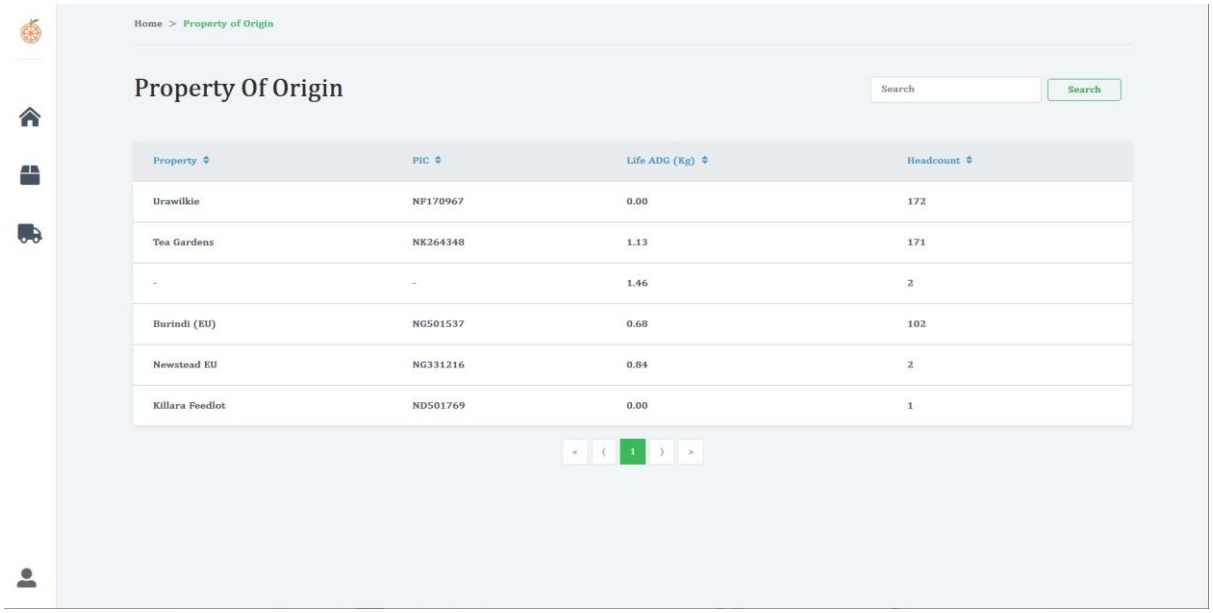

Image - 13 Property of Origin screen is only available to Paraway as a Breeder/Backgrounder. No other participant has access to this view.

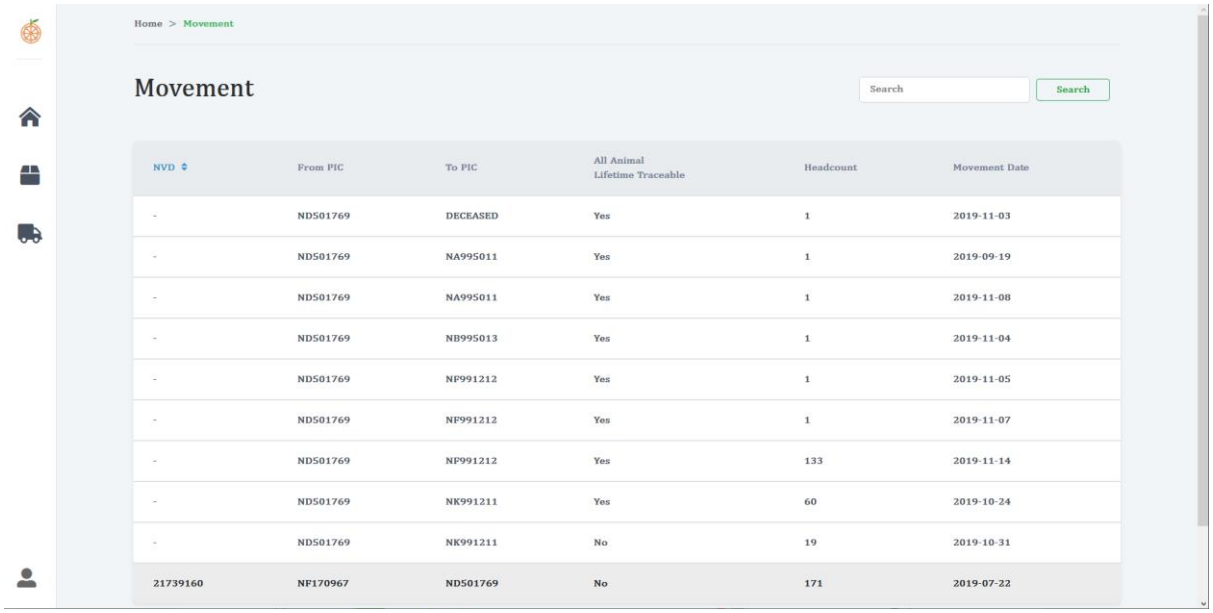

Image - 14 The Movement screen is another screen currently only available to the Paraway (Breeding/Backgrounding) account, to illustrate that data and specific perspectives of data can be controlled using the security model employed by the project. It shows the specific NLIS Movements grouped by NVD and includes information on whether any of the associated animals broke their Lifetime Traceability. You can drill down into a specific NVD to see the associated animals, allowing the customer to locate and inspect any animals which failed their LT as demonstrated in the next image.

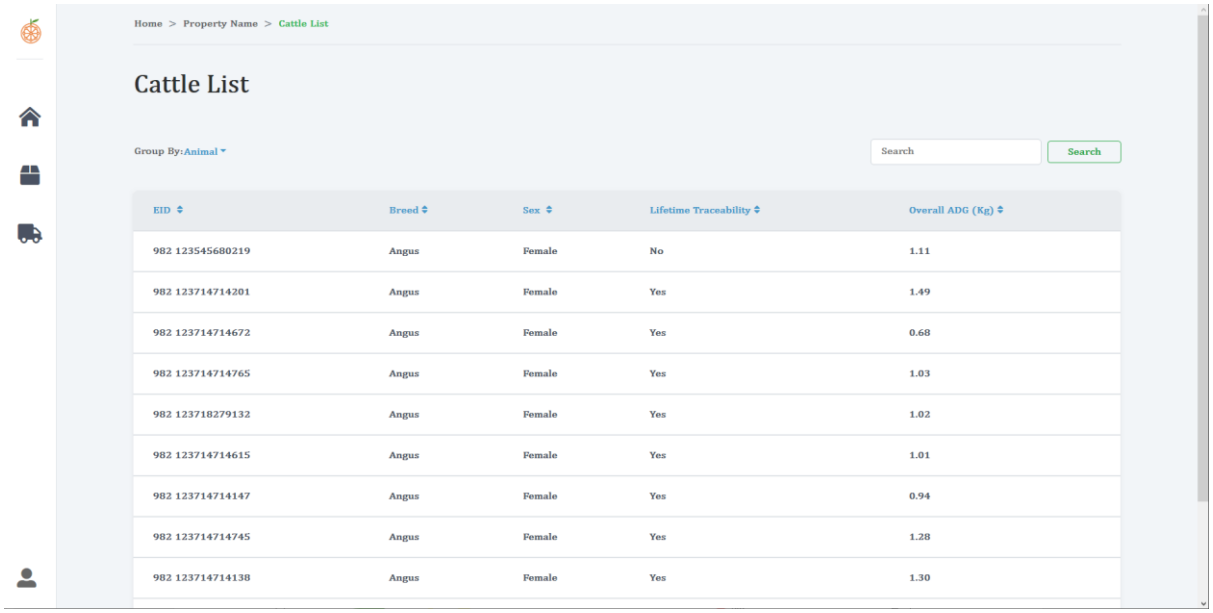

Image - 15 The Breeding/Backgrounding (Paraway) version of the Cattle list.

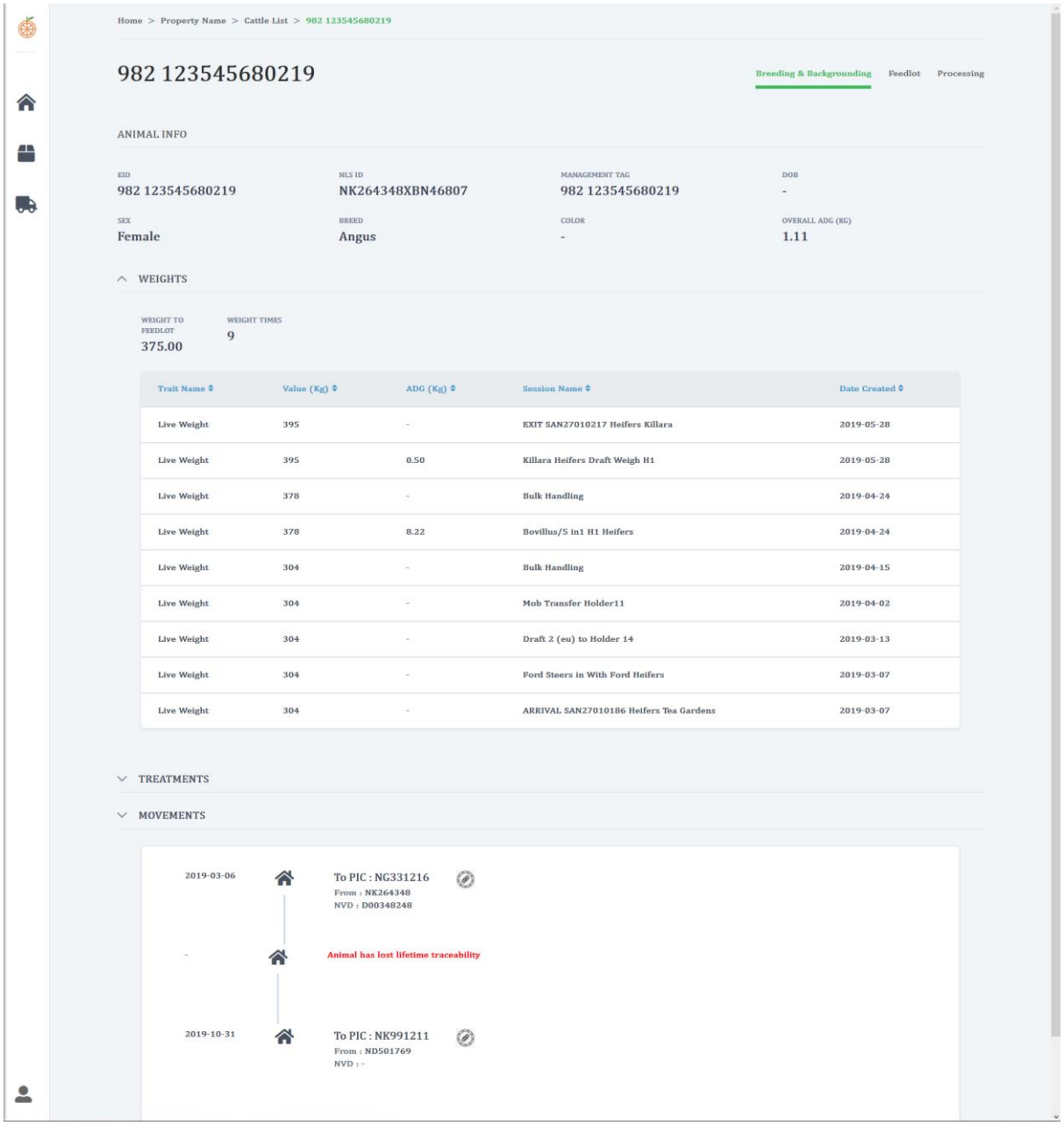

Image - 16 the animal details screen shows all attributes and events that are available for a specific animal, split across the three sections of the supply chain we are tracking in this pilot (Breeding/Backgrounding, Feedlot & Processor). This specific image depicts the Breeding/Backgrounding data that Paraway contributed.

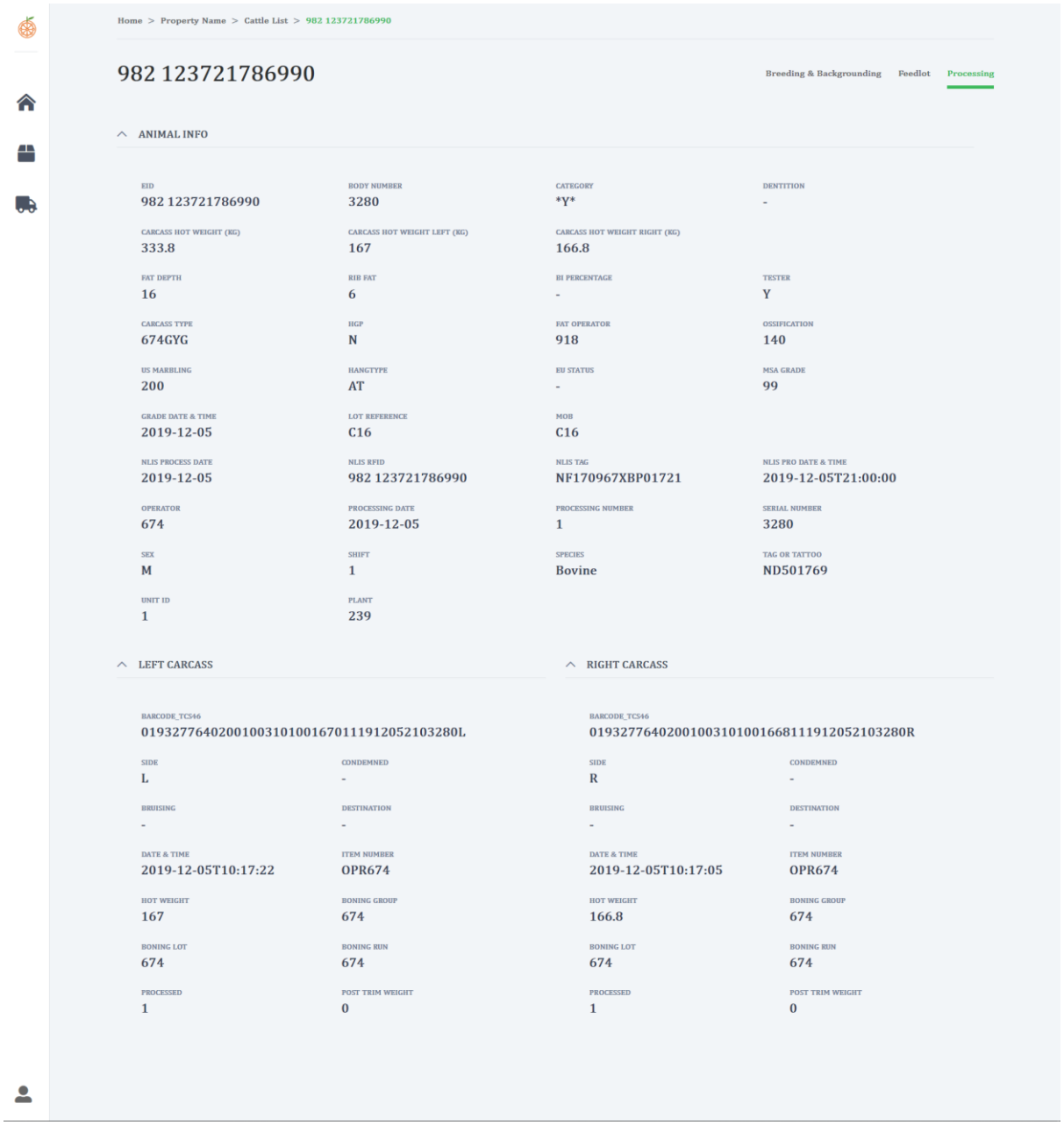

Image - 17 Another image depicting the details related to a specific animal. This time it is showing the carcass data about the animal contributed by the processing plant, Northern Meat Co-op.