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AUSTRALIAN Pork™

The Development of Practical Measures to Benchmark Pig Welfare in the Australian Pork Industry

Final Report
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2. Executive Summary

The Australian Pork Industry Quality Assurance Program (APIQ), whilst allowing producers to be annually audited (PigCare audit) against a set of standards and performance indicators, does not provide them with the opportunity to monitor the welfare status of their pigs over time and/or benchmark the welfare status of animals between farms. An on-site pig welfare benchmarking protocol, which provides a simple, validated set of pig welfare indicators, would enable the Australian Pork Industry to continue to adopt a pro-active approach to animal welfare by making evident its commitment to the on-going safeguarding and improvement of pig welfare in Australia and demonstrate incremental welfare improvements over time.

The current project was conducted to develop a tool/protocol to form metrics to benchmark pig welfare on farm. It aimed to identify and examined the suitability of a range of reliable, practical and repeatable animal-based welfare indices for inclusion in a practical on-site pig welfare benchmarking tool to be applied by Australian producers for self auditing purposes. This protocol will be applicable to sows and growing/finishing pigs, across all stages of production and within all forms of production system. Thus, the objectives of the current project were to provide:

i. Tools that could be used by the industry to measure and monitor pig welfare within and between farms
ii. Tools that could be incorporated by industry in their day-to-day management routines
iii. Tools that could be used by the industry to identify areas to improve pig welfare. Note: the scientific validation of these measurements are not within the scope of the current project and further work is required to determine the reliability and repeatability of the indices, and to validate the measures (and their methodology) as effective indicators of pig welfare under Australian conditions.

An extensive review of the relevant literature pertaining to animal welfare outcome assessment (Appendix 1) demonstrated the opportunity to develop a practical and effective on-site welfare assessment tool, using validated, repeatable and feasible animal-based welfare indices, capable of benchmarking pig welfare in the Australian Pork Industry. A range of key animal-based welfare assessment indices were identified, during the literature review and focus group meeting, which appeared capable of forming the basis of a practical on-site pig welfare benchmarking tool able to be applied by Australian farmers for self auditing purposes. The practicality of the identified indices for use in the field was examined during a pilot study which was conducted at a range of production systems representative of the Australian Pork Industry. The results of this study determined which indices were recommended for inclusion in the on-site pig welfare benchmarking protocol and identified the methodology modifications which are necessary for on-farm assessment. The animal-based welfare indices recommended for sow welfare assessment are:

- Body Condition Score; modified methodology recommended for on-farm assessment
- Body Lesion Score; modified methodology recommended for on-farm assessment

- Vulva Lesion Score
- Bursitis
- Lameness Score; modified methodology recommended for on-farm assessment
- Coughing
- Sneezing
- Stereotypic Behaviour

The animal-based welfare indices recommended for weaner/grower welfare assessment were:

- Body Condition Score; modified methodology recommended for on-farm assessment
- Body Lesion Score; modified methodology recommended for on-farm assessment
- Tail Lesion Score
- Bursitis
- Lameness Score; modified methodology recommended for on-farm assessment
- Coughing
- Sneezing
- Morbidity

The current project identified key animal-based welfare assessment indices capable of forming the basis of a practical on-site pig welfare benchmarking tool able to be applied by Australian farmers for self auditing purposes. The development of the on-site pig welfare benchmarking protocol meets the projects objectives. It has the potential to be used by the Australian Pork Industry to:

i. Measure and monitor pig welfare within and between farms,
ii. Be incorporated by industry in their day-to-day management routines, and
iii. Be used by the industry to identify areas to improve pig welfare.

The on-site pig welfare benchmarking protocol, applicable to sows and growing/finishing pigs across all stages of production and within all forms of production system, will enable producers and the industry to monitor pig welfare over time, to demonstrate improvement in animal welfare outcomes over time, to identify areas of improvement for pig welfare, and to compare pig welfare across units in multisite enterprises. This benchmarking tool ensures that the Australian Pork Industry continues to remain at the forefront of International developments in animal welfare, maintain a high level of ethical standards and promote sound welfare practices. Furthermore, by contributing to the development of an on-site pig welfare assessment protocol the Australian Pork Industry will demonstrate that the production systems it employs provide levels of animal management and welfare standards greater than required under the COP.

Whilst the key objectives were met; the identification of animal-based welfare assessment indices capable of benchmarking pig welfare in the Australian Pork Industry, the scientific validation of these measurements was not within the scope of the current project. Consequently, the opportunity exists for a future project to evaluate the reliability, repeatability and validity of the piloted animal-based welfare indices and the recommended on-farm methodology modifications, in order to fully develop an on-site pig welfare benchmarking protocol suitable for Australian conditions. Further research is required to validate animal-based welfare indices, such as lameness, body condition scoring and body lesion scoring, as measures of pig welfare on farm, in order to give credence to the proposed on-site pig welfare benchmarking protocol. The proposed validation of animal-based welfare indices for on-site pig welfare assessment is of particular importance if the protocol is to be used effectively to benchmark welfare within the industry and to allow the collected data to be used to demonstrate welfare improvements over time in the Australian Pork Industry.

3. Background to Research

The Australian Pork Industry Quality Assurance Program (APIQ) allows producers to be annually audited (PigCare audit) against a set of standards and performance indicators. This audit does not however provide producers and managers with the opportunity to monitor the welfare status of their pigs over time and/or benchmark the welfare status of animals between farms. Given that the Australian Pork Industry adopts a pro-active approach to animal welfare, a protocol which provided a simple, validated set of pig welfare indicators would both enable the industry to make evident its commitment to pig welfare and demonstrate incremental welfare improvements over time.

The current project was conducted to develop a tool/protocol to form metrics to benchmark welfare on farm. It aimed to identify and examined the suitability of a range of reliable, practical and repeatable animal-based welfare indices for inclusion in a practical on-site pig welfare benchmarking tool to be applied by farmers for self auditing purposes; the identified animal-based indices would be able to be employed either collectively as a benchmarking tool, or individually to assess a specific health or welfare issue. This protocol will be applicable to sows and growing/finishing pigs, across all stages of production and within all forms of production system. Consequently, consideration of both the production system and the animal's stage of production will be required when evaluating the results of the assessment. The protocol will also provide producers with the opportunity to benchmark their welfare status against others within the industry. Furthermore, such a tool may also be used by both producers and the industry to monitor pig welfare over time, to demonstrate improvement in animal welfare outcomes over time, to identify areas of improvement for pig welfare, and to compare pig welfare across units in multisite enterprises.

This project addresses Strategy 1 under Core Objective 4 - Address Changing Expectations & Standards for Food Production and will assist the Australian Pork Industry in further demonstrating to the community its commitment to the continued safeguarding and improvement of pig welfare in Australia. This will aid in assuring consumers, retailers, government and the community that the Australian Pork Industry continues to remain at the forefront of International developments in animal welfare and maintain a high level of ethical standards and promote sound welfare practices. Furthermore, by contributing to the development of an on-site pig welfare assessment protocol the Australian Pork Industry will demonstrate that the production systems it employs provide levels of animal management and welfare standards greater than required under the COP.

4. Objectives of the Research Project

The current project sought to provide;

i. Tools that could be used by the industry to measure and monitor pig welfare within and between farms
ii. Tools that could be incorporated by industry in their day-to-day management routines
iii. Tools that could be used by the industry to identify areas to improve pig welfare. Note: the scientific validation of these measurements are not within the scope of the current project and further work is required to determine the reliability and repeatability of the indices, and to validate the measures (and their methodology) as effective indicators of pig welfare under Australian conditions.

5. Introductory Technical Information

The welfare of an individual is widely defined as 'its state as regards its attempts to cope with its environment' (Broom, 1986). Whilst the 'state as regards its attempts to cope' refers to how much the animal has to do in order to cope with the environment and the extent to which the coping attempts are succeeding (Broom and Johnson, 1993). An animal's attempt to cope can be determined using specific quantifiable criteria, which include behavioural responses, the functioning of body repair systems, immunological defences and physiological stress responses. The biological cost of these responses can adversely affect an animal's fitness, that is, its ability to grow, reproduce and remain healthy (Barnett et al., 2001). Therefore, the risks to an animal's welfare by an environmental challenge can be assessed on two levels, firstly, the magnitude of the behavioural and physiological responses (attempts to cope) and secondly, the biological cost of these responses (the costs of coping and of failing to cope) (Fraser and Broom, 1997). The behavioural and physiological responses include the stress responses, while the biological cost includes adverse affects on the animal's ability to grow, reproduce and remain healthy (Broom, 1998).

Welfare is a complex construct, combining both subjective and objective aspects of an animal's quality of life (Smulders et al., 2006). Despite an obvious need, a system of welfare evaluation which is accepted, comprehensive and fully-validated has yet to be developed. Although a general industry acknowledgement of the complexity of the problem exists, and there is a consensus that multiple measures are required, there remains a lack of agreement on which combination of measures should be used and how discrepancies between them should be resolved (Mason and Mendle, 1993; Broom, 1996; Duncan and Fraser, 1997; Dawkins, 2001, 2003). Animal welfare is a multidimensional concept; therefore any assessment must include resource/environment-based (input), management-based (input) and animal-based (output) measures (Fraser, 1995; Broom, 1998; Barnett and Hemsworth, 2003). Research in the field of animal welfare has become more focused and genuinely applied, making it more applicable to the billions of animals worldwide for which there is growing public concern, that is, those animals kept in zoos, farms and laboratories (Dawkins, 2003). The recent focus for animal welfare research worldwide has been the development of methods for assessing welfare in situ.

The on-site animal welfare assessment/monitoring scheme has become an important tool for the effective management of intensively farmed animals within the different livestock industries. Furthermore, with the welfare of domestic animals high on both the political and societal agendas, an increase in pressure has shifted the scientific focus to the development of a scientifically based on-farm welfare assessment tool, able to be implemented across a wide range of domestic animal species (Winckler et al., 2003). An effective on-site animal welfare assessment and monitoring scheme needs to include both input (environment, resource and management-based) and output (animal-based) parameters which, through past research, have been shown to be valid (how relevant the measure is with regard to representing the welfare of the animal), reliable (consistency of the result with respect to sensitivity of the measure and inter- and intra-observer reliability) and feasible (the ease with which the measurement can be made with regard to time, effort and method). In recent years, the assessment and monitoring of animal welfare has shifted from the conventional approach of evaluating the environment and resources required to ensure good welfare, and instead focused on the application of animal-based measures of welfare (Knierim and Winckler, 2009). An example of this new direction in animal welfare assessment at a farm or on-site level is the European Union Welfare Quality® project. A primary aim of the research was to develop a standardised multi-criterion on-farm animal welfare monitoring system employing predominantly animal-based measures of welfare, which are both scientifically sound and feasible (Blokhuis et al., 2003). The

Welfare Quality® assessment incorporates numerous welfare measures focused essentially on animals, and to a lesser extent, on environment, resource and animal management factors. A substantial amount of data is obtained during the assessment, which then requires interpretation in terms of welfare and integration to produce an overall evaluation at farm/on-site level. Whilst the Welfare Quality® assessment is able to be applied routinely and consistently to measure the welfare of a range of livestock species in an on-farm setting, the time required to perform the assessment and interpret the data currently limits its use in commercial inspection and certification schemes. Thus, while recent research on animal-based welfare assessment has not yet been translated into a system or framework that can be efficiently (time-wise) employed in existing commercial inspection and certification schemes, it demonstrates that a self-assessment tool such as that proposed by the current project, designed to benchmark welfare over time, can be based largely on animal-based indices.

Animal-based parameters provide a direct measurement of the animal's welfare, and while environmental parameters will offer information regarding potential or current welfare risks, they fail to directly register the state of the animal (Johnsen et al., 2001; Winckler et al., 2003). The benefit gained from directly measuring an animal's state may however be negated by the validity, reliability and feasibility limitations often associated with the measurement of animal-based parameters, which are generally greater than those associated with environmental/resource parameters (Knierim and Winckler, 2009). Although the assessment of animal welfare at a farm or on-site level remains an on-going challenge for animal welfare scientists, the scientific literature demonstrates the opportunity to develop a practical and effective on-site welfare assessment tool, using validated, repeatable and feasible animal-based welfare indices, capable of benchmarking pig welfare in the Australian Pork Industry. Whilst they have been extensively employed within the literature and more recently within on-site assessment schemes, the validity of animal-based welfare indices with regard to pigs has yet to receive meaningful examination.

The comprehensive review of the literature concerning animal welfare outcome assessment, with a focus on pigs, is located in Appendix 1.

6. Research Methodology

i. A review of the relevant literature pertaining to welfare outcome assessment, in both pigs and other livestock species, was performed. The review focussed on animal-based welfare assessment indices (and their methodology) in order to identify those measures most suitable for the assessment of pig welfare under Australian conditions. The literature review is located in Appendix 1.

ii. A Focus Group was convened and met in Melbourne on January 30th 2013. From those identified in the literature review, the most relevant animal-based welfare indices, suitable for inclusion in a practical on-site pig welfare benchmarking tool to be applied by farmers for self auditing purposes, were selected during the focus group meeting. Membership of the Group and outcomes from the January meeting are detailed in Appendix 2.

iii. A pilot protocol, identifying the animal-based welfare indices, the rationale for their inclusion in the pilot phase of the project, and the methodology for their assessment, was developed. The protocol is attached as Appendix 3. The data recording sheets for the pilot phase are attached as Appendix 4.

iv. In early May the investigator piloted the selected animal-based welfare assessment indices at seven representative production systems in Victoria, New South Wales, South

Australia, Western Australia, and Queensland. The production systems ranged from 250 sows farrow to finish, to 5000 sow multisite systems. Each of the welfare indices identified by the current project was piloted on farm to assess the practicality of the measure in the field. The assessment of the indices was performed by the researcher and at least one producer/stock person at each of the production sites. Feedback regarding the training and assessment of the indices was obtained.

v. Feedback from the pilot phase of the project was used to finalise the animal-based welfare assessment indices (and their methodology) to be included in the proposed on-site pig welfare benchmarking protocol. The protocol is located in Appendix 3. The validation of the indices (and their methodology), which form the proposed protocol, is not within the scope of the current project.

7. Discussion of Results

The current project identified key animal-based welfare assessment indices capable of forming the basis of a practical on-site pig welfare benchmarking tool able to be applied by Australian farmers for self auditing purposes. The development of the on-site pig welfare benchmarking protocol meets the projects objectives. It has the potential to be used by the Australian Pork Industry to;

i. Measure and monitor pig welfare within and between farms,
ii. Be incorporated by industry in their day-to-day management routines, and
iii. Be used by the industry to identify areas to improve pig welfare.

The reviewed literature (Appendix 1) demonstrates the opportunity to develop a practical and effective on-site welfare assessment tool, using validated, repeatable and feasible animal-based welfare indices, which is capable of benchmarking pig welfare in the Australian Pork Industry. The identified animal-based indices are able to be employed either collectively as a benchmarking tool, or individually to assess a specific health or welfare issue. Furthermore, the protocol is applicable to sows and weaner/growing pigs, across all stages of production and within all forms of production system.

The animal-based welfare assessment measures and the relevant methodology, identified during the review of the relevant literature and the focus group meeting, suitable for assessing the welfare of pigs in The Australian Pork Industry are listed in Table 1. The selected indices are common to other on-site animal welfare assessment schemes, including welfare audits such as Welfare Quality®, AssureWel, and BPEX's Real Welfare, currently under use or development around the world. Whilst the application, with regard to assessor/observer, objective and species, of these schemes may vary, the common use of the animal-based welfare indices underlines their validity as measures of animal welfare. It should be noted that the recently launched BPEX Real Welfare scheme, a welfare audit tool delivered by veterinarians, only covers weaners and growers rather than all stages of production. The explanation given for excluding breeding stock from the scheme was that weaners and growers receive greater negative press and are therefore deemed to be the area of priority, and the perceived costs to the industry for a tool capable of being employed across all stages of production are considered too high.

The practicality of the identified animal-based welfare indices for use in the field was examined during a pilot study which was conducted at a range of production systems representative of the Australian Pork Industry. The results of the pilot study, to be discussed below, determined the indices and relevant methodology which are recommended for inclusion in the on-site pig welfare benchmarking protocol and identified the further research required.

Table 1: Animal-based welfare assessment indices piloted at representative production systems

Animal-based Indice	Animal	Methodology
Body Condition Score (BCS)	Sow & Grower/Finisher	A visual and tactile assessment of the animal's condition, using Patience & Thacker's (1989) 5-point scoring scale
Body Lesion Score (LS)	Sow & Grower/Finisher	A visual assessment of one side of the animal for injury and wounds, whereby five specified regions of the animal's body are assigned a lesion score using a 4-point scoring scale derived from the well established De Koning scale (De Koning, 1984)
Vulva Lesion Score (VL)	Sow	A visual assessment of the vulva for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or deformed vulva), using a 4-point scoring scale (modified from Welfare Quality®)
Tail Lesion Score (TL)	Grower/Finisher	A visual assessment of the tail for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or missing tail section), using a 3-point scale (modified from Welfare Quality®)
Bursitis	Sow & Grower/Finisher	A visual inspection of one side of the animal for evidence of bursae on both the fore and the hind limbs, paying particular attention to weight bearing points of the limbs
Lameness		A visual assessment of the animal from in front, behind and alongside, whilst at a walk and standing still, using a 3-point scale (modified from Karlen et al., 2007)
Coughing	Sow & Grower/Finisher	Record the total number of pigs in the pen coughing during the five minute observation period
Sneezing	Sow & Grower/Finisher	Record the total number of pigs in the pen sneezing during the five minute observation

		period
Stereotypic Behaviour	Sow	Record the number of animals in the pen which perform a stereotypic behaviour during the five minute observation period.
Morbidity	Sow & Grower/Finisher	Identify the number of 'compromised' animals in the herd which have not been identified for treatment, using the APV Guidelines

On-Site Welfare Assessment of Sows

It is recommended that measurements be taken on pregnant sows at around five weeks gestation with the stipulation that the animals should not have been mixed in the week prior to the assessment. The number of sows requiring assessment (sample size) is still to be determined. Measurements will be taken > 1 hr after feeding, and at least 2 hours prior to next feeding. In the case of EFS, measurements are not reliant on feeding schedule. The indices to be assessed include:

- Body Condition Score
- Body Lesion Score
- Vulval Lesion Score
- Bursitis
- Lameness Score
- Stereotypic Behaviour

The time required to record these measurements was assessed on the pilot farms and was found to be approximately 30 seconds per sow utilising two assessors (one observer and one recorder).

Body Condition Score (BCS)

The assessment of BCS in sows was performed using a visual and tactile method, based on Patience & Thacker's (1989) 5-point scoring scale. Whilst the use of the 1-5 scale in group-housed sows was practical, it was found to be somewhat dependant on group size. In smaller groups of up to 15 sows per pen each sow was able to be given a visual and tactile examination to determine BCS. For group sizes of over 15 sows, it became increasingly difficult to perform a tactile assessment of the sow, however visual assessment was able be made and those sows in the 1 or 5 categories were easily identified. Given these findings it is recommended that the use of a visual BCS method potentially employing a simplified 3-point scoring scale be examined; obese (which will correspond to BCS 5), normal (which will correspond to BCS 3 and 4) and thin (which will correspond to BCS 1 and 2). Validation of the modified BCS scoring scale is therefore required.

Body Lesion Score (LS)

Sows were visually assessed for injury and wounds over five specified regions on one side of the body, and were assigned a lesion score using a 4-point scoring scale derived from the well established De Koning scale (De Koning, 1984). In an on-farm setting this method of lesion scoring was found to be impractical due to the level of detail required and the time taken to observe and record the lesions. It would therefore be recommended that the current scoring system be modified to record a simplified count and classification of lesions over three sections of the sow; head/shoulders (including ears), middle and ham. Potentially, each section of the sow could be assessed for lesions by the assignment of both a classification of the level of lesions (as minor or major) and a lesion count (using a 4-point scale; 0: no scratches/cuts/other lesions, 1: 1-5

scratches/cuts/other lesions, 2: 6-10 scratches/cuts/other lesions or deep open lesion over 1cm diameter, and 3: >10 scratches/cuts/other lesions or deep, open lesion over 5cm diameter). Examination and validation of the modified LS scoring scale is required.

Vulva Lesion Score
A vulva lesion score was assigned to sows following a visual assessment of the vulva for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or deformed vulva), using a 4-point scoring scale. This method of vulva lesion scoring was found to be practical in sows.

Bursitis
Bursitis, assessed during the described visual inspection of one side of the animal for evidence of bursae on both the fore and the hind limbs, was found to be practical in sows.

Lameness Score
Lameness in sows was assessed via a visual assessment of the animal from in front, behind and alongside, whilst at a walk and standing still, using a 3-point scale modified from Karlen et al. (2007). This modified method of examining lameness in sows was found to be practical, and thus now requires validation.

Stereotypic Behaviour
Recording the number of animals performing a stereotypic behaviour during a five minute observation period does not appear to be practical in group housed sows. An alternative method of measuring stereotypic behaviour in sows requires further examination.

On-Site Welfare Assessment of Weaners/Growers
It is recommended that measurements be taken at approximately 8 weeks of age in weaners and 15 weeks of age in growers. The number of animals requiring assessment (sample size) is still to be determined. The indices to be assessed, using the developed recording sheet (Appendix 4), include;

- Body Condition Score
- Body Lesion Score
- Tail Lesion Score
- Bursitis
- Lameness Score
- Coughing
- Sneezing
- Morbidity (using APV Guidelines; pigs which would benefit from being separated into a hospital pen and pigs which require euthanasia)

The time required to record measurements in the target pens was assessed on the pilot farms and was found to be approximately 15 seconds per pig utilising two assessors (one observer and one recorder). The time required to record measurements in the target shed was assessed on the pilot farms and was found to be approximately 15 minutes per 1000 pigs utilising a single assessor.

Body Condition Score (BCS)
The assessment of BCS in weaners/growers was also performed using a visual and tactile method, based on Patience & Thacker's (1989) 5-point scoring scale. This form of BCS assessment was found to be impractical in weaners/growers. Given the difficulty associated with tactile assessment and the low incidence of obesity in weaners/growers, a simplified visual assessment using a 2-point scoring

scale similar to that used by Welfare Quality® would be recommended for BCS in weaners/growers. The Welfare Quality® 2-point scale scores animals as normal (corresponding to BCS 3 and 4) and thin (corresponding to BCS 1 and 2). Validation of the modified BCS scoring scale in an on-farm setting is therefore required.

Body Lesion Score (LS)
Weaners/growers were visually assessed for injury and wounds over five specified regions of the body, and were assigned a lesion score using a 4-point scoring scale derived from the well established De Koning scale (De Koning, 1984). As with sows, this method of lesion scoring was found to be impractical due to the level of detail required and the time taken to observe and record the lesions. The modified scoring system described above for use in sows, would also be recommended for LS in weaners/growers.

Tail Lesion Score
A tail lesion score was assigned to weaners/growers following a visual assessment of the tail for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or missing tail section), using a 3-point scale. This method of tail lesion scoring was found to be practical in weaners/growers.

Bursitis
Bursitis, assessed during the described visual inspection of one side of the animal for evidence of bursae on both the fore and the hind limbs, was found to be practical in weaners/growers.

Lameness Score
Lameness, assessed via a visual assessment of the animal from in front, behind and alongside, whilst at a walk and standing still, using a 3-point scale, was practical in weaners/growers. Given that this methodology was modified from that described by Karlen et al. (2007), validation on-farm is now required.

Coughing
Recording the number of animals in the pens coughing during the five minute observation period is practical in weaners/growers.

Sneezing
Recording the number of animals in the pens sneezing during the five minute observation period is practical in weaners/growers.

Morbidity
Morbidity, determined by identifying the number of 'compromised' animals in the herd which have not been identified for treatment, using the APV Guidelines, appears practical in weaners/growers. It is proposed that measurements be taken at three levels; Target pens/pigs (determined by statistician; (the number of animals which would benefit from being separated into a hospital pen – % of target population, and the number of animals which require euthanasia – % of target population); Target shed (half the target shed population; the number of animals which would benefit from being separated into a hospital pen – % of target population, and the number of animals which require euthanasia – % of target population); and Hospital pens (The number of animals which have not been treated according to SOP. i.e. Moved into hospital pen and no record of appropriate treatment/monitoring to make decision as to how their recovery is progressing or not progressing -

% of hospital pen population). Given the difficulty associated with standardising the assessment of 'compromised animals' further research and validation of this measurement is clearly warranted.

Whilst the key objectives were met; the identification of animal-based welfare assessment indices capable of benchmarking pig welfare in the Australian Pork Industry, the scientific validation of these measurements is not within the scope of the current project. Consequently, further work is required to determine the reliability and repeatability of the indices, and to validate the measures (and the recommended methodology modifications) as effective indicators of pig welfare under Australian conditions.

8. Implications and Recommendations

The current project identified a range of reliable, practical and repeatable animal-based welfare indices, capable of forming a practical on-site pig welfare benchmarking tool to be applied by farmers for self auditing purposes. This protocol, applicable to sows and growing/finishing pigs, across all stages of production and within all forms of production system, will enable producers and the industry to monitor pig welfare over time, to demonstrate improvement in animal welfare outcomes over time, to identify areas of improvement for pig welfare, and to compare pig welfare across units in multisite enterprises. In line with the Australian Pork Industry's pro-active approach to animal welfare, the developed protocol provides the Industry with the opportunity to make evident its commitment to the continued safeguarding and improvement of pig welfare in Australia and demonstrate incremental welfare improvements over time. The development of an on-site pig welfare benchmarking tool ensures that the Australian Pork Industry continues to remain at the forefront of International developments in animal welfare, maintain a high level of ethical standards and promote sound welfare practices. Furthermore, by contributing to the development of an on-site pig welfare assessment protocol the Australian Pork Industry will demonstrate that the production systems it employs provide levels of animal management and welfare standards greater than required under the COP.

The opportunity now exists for future projects to evaluate the validity of the piloted animal-based welfare indices and the recommended on-farm methodology modifications, in order to fully develop an on-site pig welfare benchmarking protocol suitable for Australian conditions. Further research is required to validate animal-based welfare indices, such as lameness, body condition scoring and body lesion scoring, as measures of pig welfare on farm, in order to give credence to the proposed on-site pig welfare benchmarking protocol. In addition, the literature indicates that fear of humans may be an important indicator of animal welfare; however it remains a challenge to measure in a production setting due to the difficulty associated with standardising its assessment without using a standard human approach test which requires two experimenters, and a purpose-built arena in which to perform the test. Clearly this form of fear assessment is highly impractical for on-site welfare benchmarking, and consequently the development and validation of a fear of humans test able to be employed on-site across all production systems is warranted.

At present, the on-site animal welfare assessment protocol is intended for use as a benchmarking tool and as such the score obtained from each indice score is considered individually rather than as a collective sum. However, given the potential for the protocol to be used in an auditing capacity in the future, it is recommended that the scoring scale across indices be kept consistent. That is, for all animal-based welfare assessment indices the nature of the outcome (positive /normal or negative) is denoted by a similar numeric value or direction; for example, a low numeric value may represent a more normal or positive outcome in all welfare indices. Further examination and modification of

scoring scales is therefore likely to be required for some of the animal-based welfare assessment indices.

The proposed validation of animal-based welfare indices for on-site pig welfare assessment is of particular importance if the protocol is to be used effectively to benchmark welfare within the industry and to allow the collected data to be used to demonstrate welfare improvements over time in the Australian Pork Industry.

9. Intellectual Property

Information generated at this stage of the RD&E process, while creating intellectual property value, does not lead to patentable outcomes.

10. Technical Summary

The information developed by the current project includes;

- An extensive review of the relevant literature pertaining to welfare outcome assessment, in both pigs and other livestock species (Appendix 1).
- The identification of a range of animal-based welfare indices, suitable for inclusion in a practical on-site pig welfare benchmarking protocol (Appendix 3) to be applied by farmers for self auditing purposes in the Australian Pork Industry. The protocol includes the identified animal-based welfare indices, the rationale for their inclusion in the pilot phase of the project, and the methodology for their assessment.
- Data recording sheets for the pilot phase (Appendix 4).

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12. Publications Arising

Not applicable.

Appendix 1 - Summary of the Relevant Literature

The aim of the literature review is to identify validated, practical and repeatable animal, management and resource-based welfare indices relevant to current Australian conditions and concerns, that are suitable to form an effective on-site pig welfare assessment tool able to be applied by farmers for self auditing purposes. This protocol will be applicable to breeding stock, piglets and growing and finishing pigs across all production systems. The scientific literature concerning animal welfare indices and the assessment of animal welfare on-site/at farm level, relevant to both pig and other livestock species, is currently under review. The proposed structure of the final report is detailed below.

1. The Australian Pork Industry: a brief introduction to the Australian Pork Industry detailing
    - the different stages of pig production
    - the current conditions, and
    - the main welfare issues/concerns facing the Industry (these concerns will help determine which of the welfare indices are most relevant for Australian conditions)
2. The concept of animal welfare and it's assessment: a brief overview of 'animal welfare' and the different approaches to on-site animal welfare assessment
3. The on-site assessment of welfare in pigs: a review of the literature pertaining to welfare indices and the on-site assessment of welfare in pigs, with detailed reference to the different stages of production, i.e. breeding stock, piglets and growing and finishing pigs.
4. Recommendations: in conclusion, recommendations will be made detailing the key animal welfare indices which would be suggested for inclusion in a welfare assessment tool intended for use by Australian farmers' to benchmark pig welfare on farm.

This summary will briefly outline the literature relevant to welfare assessment in pigs and the development of a practical and effective on-site welfare assessment tool capable of benchmarking pig welfare in the Australian Pork Industry.

1 The On-Site Assessment of Animal Welfare

As proposed by Broom (1986) the 'welfare of an individual is its state as regards its attempts to cope with its environment'. The 'state as regards its attempts to cope' refers to how much the animal has to do in order to cope with the environment and the extent to which the coping attempts are succeeding (Broom and Johnson, 1993). An animal's attempt to cope can be determined using specific quantifiable criteria, which include behavioural responses, the functioning of body repair systems, immunological defences and physiological stress responses. The biological cost of these responses can adversely affect an animal's fitness, that is, its ability to grow, reproduce and remain healthy (Barnett et al., 2001). Therefore, the risks to an animal's welfare by an environmental challenge can be assessed on two levels, firstly, the magnitude of the behavioural and physiological responses (attempts to cope) and secondly, the biological cost of these responses (the costs of coping and of failing to cope) (Fraser and Broom, 1997). The behavioural and physiological responses include the stress responses, while the biological cost includes adverse affects on the animal's ability to grow, reproduce and remain healthy (Broom, 1998).

Welfare is a complex construct, combining both subjective and objective aspects of an animal's quality of life (Smulders et al., 2006). Despite an obvious need, a system of welfare evaluation which is accepted, comprehensive and fully-validated has yet to be developed. Although a general industry acknowledgement of the complexity of the problem exists, and there is a consensus that multiple measures are required, there remains a lack of agreement on which combination of measures should

be used and how discrepancies between them should be resolved (Mason and Mendle, 1993; Broom, 1996; Duncan and Fraser, 1997; Dawkins, 2001, 2003). Animal welfare is a multidimensional concept; therefore any assessment must include resource/environment-based (input), management-based (input) and animal-based (output) measures (Fraser, 1995; Broom, 1998; Barnett and Hemsworth, 2003). Research in the field of animal welfare has become more focused and genuinely applied, making it more applicable to the billions of animals worldwide for which there is growing public concern, that is, those animals kept in zoos, farms and laboratories (Dawkins, 2003). The recent focus for animal welfare research worldwide has been the development of methods for assessing welfare in situ.

The on-site animal welfare assessment/monitoring scheme has become an important tool for the effective management of intensively farmed animals within the different livestock industries. In recent years public interest in livestock welfare has increased, with consumers expressing particular concern about the effect of intensive farming on animal welfare (Bonde et al., 2001; Fraser, 2001). With the welfare of domestic animals high on both the political and societal agendas, an increase in pressure has shifted the scientific focus to the development of a scientifically based on-farm welfare assessment tool, able to be implemented across a wide range of domestic animal species (Winckler et al., 2003).

Although the assessment of animal welfare at a farm or on-site level remains an on-going challenge for animal welfare scientists, a large body of literature concerning the different assessment approaches already exists (Bartussek 2001; Bracke et al., 2001; Sørensen et al., 2001; Botreau et al., 2007; Knierim and Winckler, 2009). The success of any animal welfare assessment scheme, regardless of the animal species, relies on the validity, reliability and feasibility of the measurement tool. A practical and robust tool needs to be based on relatively simple observations and records relating to the husbandry, management, environment and welfare of the animal to ensure that data can be collected efficiently during a single assessment (Smulders et al., 2006). Although simple, such protocols combining several aspects should provide a detailed and valid picture of the welfare status of any domestic animal. Given the large number of welfare parameters available and the variety of livestock species, the evaluation and monitoring of animal welfare at a farm level is a complex undertaking (Hubbard et al., 2007).

Animal welfare is a multidimensional concept, and consequently, any assessment procedure requires indicators that are able to evaluate all the component dimensions (Mason and Mendl, 1993; Fraser, 2003; Botreau et al., 2007). Approaches for assessing animal welfare at a farm level are generally based on a range of welfare parameters. In principle, these parameters can be divided into two categories or types of measures; the risk factors which involve environmental and management components which are generally either owner/producer/stockperson generated or naturally occurring in the animal's environment (input measures), and the welfare indicators which are animal-based (output measures).

Risk factors are generally regarded as input measures, and describe features of the environment, resources and management which may be considered prerequisites for an animal's welfare (Mollenhorst et al., 2005). These measures assess factors which have the potential to pose a risk to an animal's welfare and may be owner/producer/stockperson generated or naturally occurring in the animal's environment. The environmental/resource measures can include type and size of stall/paddock, feeding and drinking facilities, space allowance, flooring, quality of litter and access to pasture (Johnsen et al., 2001; Winckler et al., 2003; Bonde, 2004). Assessment is generally uncomplicated because environmental parameters are relatively easy and quick to record, require

little expertise, and usually have a high inter and intra-observer repeatability. The management measures may include human-animal interaction, feeding schedules, handling routine, housing situation, condition checks, and husbandry practices such as worming/drenching, hoof care and vaccinations. Once again assessment is generally uncomplicated, repeatable and involves obtaining information regarding a standardized set of management-based questions from the person providing the animal with its primary care.

Welfare indicators may be considered as output measures which record animals' reactions to specific environments. Animal-based parameters involve behaviour, health and physiology (Johnsen, et al., 2003; Winckler et al., 2003), and may include levels of stress hormones, aggression, fear and abnormal behaviours, preferences, symptoms of acute disease, injury and mortality. These parameters generally constitute measures of poor welfare, and essentially assess the effect input measures (environment, resource and management) have on the health, physiology and behaviour of the animal. Although there has yet to be any validated animal-based measures of good welfare, positive affective state research has begun examining the use of play behaviour, affiliative behaviour and vocalisations as indicators for on-site assessment schemes (Boissy et al., 2007). Assessment of animal-based parameters occurs during interaction with both the animal and the owner/producer, and generally requires a degree of expertise. Furthermore, measuring animal-based parameters often requires significant time and resources, and the interpretation of results can prove challenging (Johnsen, et al., 2001; Winckler et al., 2003). Consequently, animal-based measures typically have a lower inter- and intra-observer repeatability than the environmental/resource and management measures. These difficulties have, until recent years, limited attempts to create an operational animal welfare assessment protocol which relies primarily on animal-related parameters (Capdeville and Veisser, 2001; Winckler et al, 2003).

Animal-based parameters provide a direct measurement of the animal's welfare, and while environmental parameters will offer information regarding potential or current welfare risks, they fail to directly register the state of the animal (Johnsen et al., 2001; Winckler et al., 2003). The benefit gained from directly measuring an animal's state may however be negated by the validity, reliability and feasibility limitations often associated with the measurement of animal-based parameters, which are generally greater than those associated with environmental/resource parameters (Knierim and Winckler, 2010). Therefore, it is commonly accepted that both environmental/resource and animal-based parameters are important welfare indices, and a valid assessment of animal welfare is obtained when both types of parameters are used in combination (Johnsen et al., 2001).

Many of the early on-farm welfare assessment and monitoring schemes developed for livestock welfare are largely based on environmental/resource and production-based parameters. However, the validity of such assessment and monitoring schemes is disputable due to the poor understanding of the relationship between the parameters and animal welfare (Knierim and Winckler, 2010). These early schemes include the animal welfare index TGL35I in Austria (Bartussek, 2001) and the related TGI200 in Germany (Sundrum, 2001), the ethical account in Denmark (Sorenson et al., 2001), the Freedom Food Scheme (Main et al., 2003), and the Bristol Welfare Assurance Program (Leeb et al., 2004) in the United Kingdom, a decision support system for overall welfare assessment of sows in the Netherlands (Bracke et al., 2002), and preliminary welfare assessment schemes for dairy cattle in France (Capdeville and Veissier, 2001) and Italy (Tosi et al., 2001).

There are currently two major farm auditing schemes for pig production currently operating in Australia; the 'Australian Pork Industry Quality Assurance Program (APIQ√®)' (APIQ√®, 2012), and the 'RSPCA approved farming scheme' for production animals. APIQ√®, owned and managed by the

Australian Pork Limited (APL), is the Australian pork industry's on-farm quality assurance program which provides producers with the framework and standards for the safe and sustainable performance of key farming practices regarding management, animal welfare, food safety, biosecurity and traceability. It is based on managing farm risks by following Good Agricultural Practices (GAP), using the principles of Hazard Analysis and managing Critical Control Points (HACCP). The standards by which produces must abide with regard to animal welfare include proper planning and contingency arrangements, staff training and competency, appropriate facilities and environmental protection (determines whether Model codes are met), adequate food and water, routine health and husbandry checks, and euthanasia (determines whether Model codes are met). It is important to note however that these standards do not consider all aspects of animal welfare nor do they include actual animal observations. The RSPCA approved farming scheme for production animals provides animal-based standards which are derived from the 'Five Freedoms' and concern an animal's right to be free from hunger and thirst, discomfort, pain, injury and disease, fear and distress, and the right to perform normal behaviours. These 'ideal' standards are subjective and are lacking in both detail and scientific basis. Essentially, a list of vague and non-objective criteria is provided by which producers must adhere in order to obtain the RSPCA approved farming stamp. For example, "housing design and stocking density must allow sufficient space for exercise, exploration and social behaviour" (RSPCA, 2011)

In recent years, the assessment and monitoring of animal welfare has shifted from the conventional approach of evaluating the environment and resources required to ensure good welfare, and instead focused on the application of animal-based measures of welfare (Knierim and Winckler, 2009). An example of this new direction in animal welfare assessment at a farm or on-site level is the European Union Welfare Quality® project. A primary aim of the research was to develop a standardised multi-criterion on-farm animal welfare monitoring system employing predominantly animal-based measures of welfare, which are both scientifically sound and feasible (Blokhuis et al., 2003). The Welfare Quality® assessment incorporates numerous welfare measures focused essentially on animals, and to a lesser extent, on environment, resource and animal management factors. A substantial amount of data is obtained during the assessment, which then requires interpretation in terms of welfare and integration to produce an overall evaluation at farm/on-site level. This overall evaluation is based on a formal model (Botreau et al., 2007) allowing the Welfare Quality® assessment to be applied routinely and consistently across livestock species. The evaluation model is described by Botreau et al. (2007), and consists of four main principles necessary for good animal welfare (Good feeding, Good housing, Good health, and Appropriate behaviour) and 12 key animal welfare criteria (see Table 1). These principles and criteria were identified through reviews of the scientific literature, pilot studies and focus groups (Miele, 2009). A definitive set of animal, environment/resource and management-based parameters were developed. Data collected during the assessment are used to check farm compliance with the 12 welfare criteria. The scores obtained are then collated to assess farm compliance with the four main welfare principles. These principle scores are then used to conclude on an overall evaluation (Botreau et al., 2009). The model is intended for several purposes; (i) to provide an evaluation of the welfare status of the animal and identify the aspects requiring attention; (ii) to provide a better understanding of the welfare implications of the housing/farming systems and husbandry and management practices; (iii) to certify farms on welfare grounds, by implementing the assessment system on farms to be certified or by certifying the system and the practices employed on these farms, and (iv) to facilitate informed decision by stakeholders, including consumers (Botreau et al., 2009; Hubbard and Scott, 2011). The Welfare Quality® assessment protocol is currently being examined in a range of livestock species. The Welfare Quality® assessment concerning pig production is described in Table 1.

Table 1: The welfare principles and criteria defined by the Welfare Quality® project and the on-farm measures used to satisfy these criteria with regard to pig production (Hubbard and Scott, 2011)

Principles	Welfare criteria	Sow/piglet	On-farm measures
Good feeding	1. Absence of prolonged hunger	Sows	Body condition score
			Feeding management
		Piglets	Age at weaning
	2. Absence of prolonged thirst	Sows and piglets	Water supply (number of drinkers, hygiene of drinkers)
Good housing	3.Comfort around resting	Sows and piglets	Absence of manure on the body
		Sows	Bursitis, shoulder sores
	4. Thermal comfort	Sows and piglets	Percentage of animals shivering
			Percentage of animals panting
			Degree of social thermoregulation (huddling)
			Environmental temperature
	5. Ease of movement	Sows	Total pen space and stocking density
			Presence and size of stalls
			Presence and size of farrowing crates
Good health	6. Absence of injuries	Sows and piglets	Lameness assessment
		Sows	Wounds on the body
			Vulval lesions
	7. Absence of disease	Sows and piglets	Respiratory problems (coughing, sneezing, pumping)
			Enteric problems (rectal prolapse, scouring, constipation)
			Health management strategy
			Management of sick animals
			Criteria for euthanasia
			Hygiene/cleansing routine
		Sows	Reproductive problems (metritis, mastitis, uterine prolapse)
			Skin conditions
			Ruptures and hernias
			Localised infections
		Piglets	Neurological problems (muscle tremors, paddling of limbs)
			Splay leg
	8. Absence of pain induced by management procedures	Sows	Mutilations (nose-ringing, tail docking)
		Piglets	Mutilations (teeth clipping, castration, tail docking)
Appropriate behaviour	9. Expression of social behaviours	Sows	Positive social behaviours (sniffing, nosing, licking)
			Negative social behaviours (aggression, biting)
	10. Expression of other behaviours	Sows and piglets	Provision of environmental enrichment
		Sows	Stereotyped behaviour
			Exploratory behaviour
			Qualitative behaviour assessment
	11. Good human-animal Relationship	Sows	Fear of/withdrawal from humans

The shift toward the use of animal-based indices can also be seen within the food and livestock production industries, with widespread acknowledgment of the need to include welfare outcome assessment in assurance schemes in order to improve animal welfare. In what may be considered a current limitation of the Welfare Quality® Project, research on animal-based welfare assessment has not yet been translated into a system or framework that can be efficiently (time-wise) employed in existing commercial inspection and certification schemes. The development of a standardised field-tested welfare outcome assessment framework for the major farm animal species, able to be fully embedded into inspection and standards development within current farm assurance schemes such as the RSPCA Freedom Food and Soil Association and Red Tractor farm assurance schemes, is a key objective of recent projects including The University of Bristol's AssureWel and BPEX's REAL Welfare. These projects are working in close conjunction, and are currently piloting a range of 'core' measures, consisting of pre-existing welfare indices, which are intended to form the assessment frameworks in both finishers and sows. The 'core' measures for both the AssureWel and REAL Welfare projects are listed in Table 2. The selected welfare indices have been extensively applied and validated in a range of animal species, and are reportedly feasible, repeatable and reliable. It is important to note however that both projects have essentially removed any behavioural assessment from the pilot frameworks and replaced it with a simple enrichment measure which merely determines whether, at the time of observation, enrichment is supplied and if the animal is using the enrichment. Whilst the results from field-testing in both projects are still pending, the lack of behavioural measures limits the scope of the framework and potentially constitutes a considerable limitation of the proposed assessment protocols.

Table 2: The 'core' measures being piloted by the AssureWel and Real Welfare pig welfare assessments

Finishers	**Sows**
Tail lesions	Shoulder lesions
Body marks	Vulva lesions
Lameness	Body marks
Enrichment use	Lameness
In need of hospital pen	Enrichment use
	Thin sows
	In need of hospital pen

Thus, an effective on-site animal welfare assessment and monitoring scheme needs to include both input (environment, resource and management-based) and output (animal-based) parameters which, through past research, have been shown to be valid (how relevant the measure is with regard to representing the welfare of the animal), reliable (consistency of the result with respect to sensitivity of the measure and inter- and intra-observer reliability) and feasible (the ease with which the measurement can be made with regard to time, effort and method). On-farm welfare monitoring systems also need to provide a standard method of converting welfare-related measures into information that is able to be easily understood by the consumer. Effectively, allowing for the

appropriate modifications based on species specific management practices, an on-farm welfare assessment tool should be applicable to all livestock species.

2 *The On-Site Assessment of Welfare In Pigs: A Review of the Literature Pertaining to Welfare Indices and the On-Site Assessment of Welfare in Pigs*

When evaluating animal welfare in situ, the assessment parameters employed need to be selected for their welfare relevance, information value, and applicability for on-farm studies (Rousing et al., 2001; Sorensen et al., 2001; Spoolder et al., 2003; Bonde, 2004; Knierim and Winckler, 2010). They should be sensitive to changes or fluctuations in management routines over time, and be able to describe welfare problems and their causes (Bonde, 2004). A high inter and intra-observer repeatability is also required, and as a result a number of recent studies have employed observer training programs in an attempt to improve repeatability of the assessment parameters (Courboulay and Foubert, 2007; Goossens et al., 2008; Scott et al., 2009; Temple et al., 2012). A recent study by Goossens et al. (2008) aimed to develop a methodology for comparing pig farms on a range of animal welfare parameters. This study reported that given the selected parameters variability between farms, it is possible to categorise comparison of farms based on relevant animal-based parameters, and formulate advice on how to improve pig welfare based on the integration of animal, resource and management based information. That is, an on-site animal welfare assessment protocol, based on animal, resource and management-based parameters has the potential to benchmark pig welfare. The relevant literature concerning animal welfare methodology and welfare indicators with regard to pigs will now be briefly discussed.

2.1 Animal-Based Welfare Parameters

Welfare refers to a characteristic of the animal rather than something that is given to it (Broom, 1996) and as a result animal-based welfare indicators provide a direct assessment of the state of the animal. This type of indicator may be of a physiological, behavioural or health nature. In general animal-based welfare parameters have been well validated in a range of livestock species, however to date no animal-based indicators of positive affects have been validated (Boissy et al., 2007). Physiological measures, such as hormone levels (e.g.. cortisol and IgA), can be difficult to employ in on-site conditions due to their expense and the need for animal handling, which may result in animals experiencing stress responses that could potentially confound results (Capdeville and Veissier, 2001). In addition, these measures may be unreliable for individual animals as 'normal' often falls within a wide range. As a result, the animal-based parameters included in on-site welfare assessments generally only involve animal health and behavioural measures (Capdeville and Veissier, 2001; Knierim and Winckler, 2010). Whilst they have been extensively employed within the literature and more recently within on-site assessment schemes, the validity of animal-based welfare indices with regard to pigs has yet to receive meaningful examination.

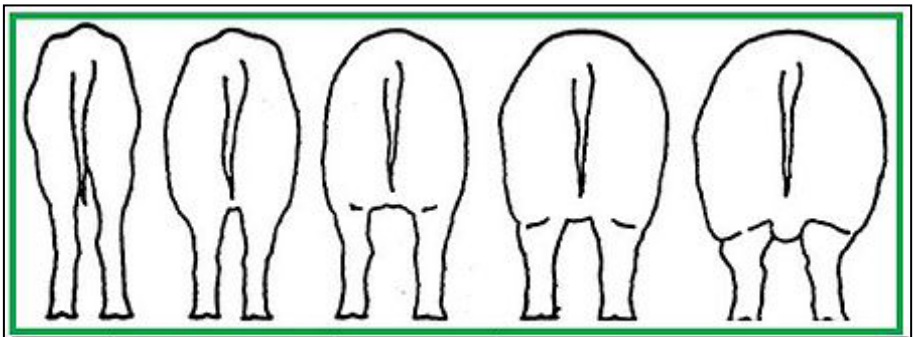
Animal Health

Animal health is one of the most readily applied measures of animal welfare (Mench and Mason, 1997). Injury and disease are regarded as important welfare indicators because they are both commonly associated with negative experiences such as pain, discomfort and distress (Rousing et al., 2001). The prevalence and intensity of certain health and injury problems in animals, determined on the basis of observations and discussions with producers and stockpeople, are relevant health indicators for on-farm welfare assessment methods. Animal health measurements provide specific and practical information, which aids the observer in determining how the animal is managed and its current health and welfare status (Rousing et al., 2001). These measures can be indicative of current and potential welfare concerns, as well as providing information regarding the management and husbandry practices employed by the stockperson, and their response to animal health challenges.

Body condition scoring (BCS) is widely used as an animal health indicator in the welfare assessment of animals such as cattle, buffalo, horses, sheep and pigs (Winckler et al., 2003; Pearson, 2004; Christie et al., 2006; Hemsworth and Coleman, 2010). It provides a means to estimate the energy balance, body composition and body stores in place of live weight change (De Rosa et al., 2004). The inclusion of BCS in on-farm welfare assessment has been strongly supported in systems for both cattle and buffalo (Wagner et al., 1988; Campanile et al, 1998; De Rosa et al., 2004), due particularly to the ease to which a multi-point scoring system can be applied and its ability to detect welfare-relevant malnutrition, under-nutrition and over-nutrition (Winckler et al., 2003). Malnutrition and under-nutrition observed in thin animals has been associated with reduced welfare, while over-condition and obesity is often associated with reduced levels of fertility and poor health and welfare outcomes (Campanile et al., 1998).

Maintaining a sow's optimal body condition is necessary in order to achieve adequate production levels within a herd and to ensure the health and welfare of the animal (Maes et al., 2004). Poor body condition in pigs has been associated with insufficient feed and/or competition around feeding (Scott et al., 2009). Body weight, either absolute weight or weight change, is unsuitable as a single determinant of the nutrient requirements of breeding sows, and as a result has been replaced by BCS which evaluates the adequacy of the nutrient supply according to the animal's body condition (Whittemore, 1998). Three main methods have been developed to determine BCS in pigs; the precise but time consuming measurement of back fat thickness; the quick and easy visual and tactile assessment; and the lesser used BC evaluation of different parts of the animal (Charette et al., 1996; Maes et al., 2004; Courboulay, 2007).

Back fat thickness is measured ultrasonically in the region of the last rib, most commonly in a research setting (Courboulay, 2007). Thus, while validity and reliability are high (Charette et al., 1996), the feasibility of back fat assessment as an on-farm measurement is low. The use of visual and tactile BCS assessment in sows (performed within the animal's home pen) is commonly reported in the literature; however there is a lack of documented scoring systems for assessing BCS in growing pigs. Whilst a range of scoring scales have been employed, for example 3- (Gjein,1994; Scott et al. 2009; Welfare Quality protocol), 6- (Hoffman and Bilkei, 2003), and 9-point (Ebenshade et al., 1986; Yang et al., 1989), Patience and Thacker's (1989) 1-5 scale remains the most widely used scoring system for this parameter (Muirhead and Alexander, 1997; Gatlin et al., 2002; Bracken et al., 2003; Bonde et al., 2004; Maes et al., 2004; Young et al., 2004). A condition score from 1 to 5 is assigned to each sow, based on the ease or difficulty of detecting bones at various pressure points (Figure 1); a score of 1 is assigned to a very thin sow, a score of 5 is given to an obese sow and a score of 3 equates to the optimal body condition (Patience and Thacker, 1989). Whilst the extreme values of this parameter (emaciated and overfat) become the indicators of poor welfare, there are no minimum or maximum thresholds because body condition score is dependent on the physical state of the animal (i.e. weaning, mid-pregnancy, farrowing, etc) and on genetics.



Score	Last rib backfat depth (mm)	Condition	Body Shape
1	<15	Emaciated	Hips, spine prominent to the eye
2	15 – 18	Thin	Hips, spine easily felt without pressure
3	18 – 20	Ideal	Hips, spine felt only with firm pressure
4	20 – 23	Fat	Hips, spine cannot be felt
5	>23	Overfat	Hips, spine heavily covered

Figure 1: Guide for the visual and tactile body condition assessment.

As is the case with most of the animal-based indices, body condition scoring (BCS) has received limited evaluation with regard to its relevance as an indicator of pig welfare. Maes et al. (2004) suggests that body condition is difficult to evaluate in an objective manner under practical conditions, whilst Whittemore and Schofield (2000) report that the subjectivity of the observer is a major shortcoming of the indice (Whittemore and Schofield, 2000). In addition, Charette et al. (1996) found that while the parameter's intra-observer repeatability was high, its inter-observer repeatability was low. Thus, while due to the ease of employment and time efficiency (Scott et al., 2009), the visual and tactile assessment of body condition appears more suitable to on-site welfare assessment in pigs when compared with the measurement of back fat thickness, questions still remain with regard to the reliability and feasibility of the parameter.

Leg injuries and lameness are common in the swine industry, and are considered major welfare concerns that have the potential to induce pain and discomfort for extended periods of time (Main et al., 2000; Barnett et al., 2001), and reduce the ability of the animal to cope with its environment. Restricting an animal's freedom of movement may limit the performance of social and feeding behaviour, and increase the risk of further injury through falling (Bonde, 2004). The USDA have ranked lameness as the third most common reason for culling sows on farm (15% of sows; USDA, 2001, 2007) and Stalder et al. (2004) reported that leg soundness was one of the most commonly identified reasons for the involuntary culling of sows. The high incidence of leg injury and the resultant lameness observed in sows may be indicative of inappropriate resource/environmental factors such as feed (Jorgensen, 1995), housing systems and management practices (Kroneman et al., 1993; Barnett et al., 2001; Jorgensen, 2003; Kilbride et al., 2009) and a lack of physical exercise (Petersen et al., 1997). Thus, it is important to consider lameness when identifying animal health indicators to include in welfare assessment (Bronte, 2004).

Lameness has been widely employed as an animal-based welfare parameter in pigs, as demonstrated by studies such as Main et al., (2000), Whay et al. (2007), Goossens et al. (2008), Elmore et al. (2010), and Temple et al. (2012). These studies appear to have employed a variation of one of two methods for assessing lameness in pigs; either a simple observation from within the pen where the animal is assigned a score (either from a 2 or 3-point scoring scale) regarding weight baring ability (Whay et al., 2007; Goossens et al., 2008; Temple et al., 2012), or an evaluation of standing posture and gait, in a location outside the animals home pen, scored on a 4 or 5 point scale where 0 is normal/not lame and 5 is unable/reluctant to stand and/or move (Main et al., 2000; Elmore et al., 2010). Whilst the 4 or 5-point scoring scales have been based on literature from other livestock species, the 2 or 3-point scales appear to lack scientific validation. Practical lameness scoring systems based on simple descriptive numerical scales have been designed for species including cattle (Manson and Leaver, 1988; Sprecher et al., 1997; Breuer et al., 2000; Winkler and Willen, 2001), broilers (Kestin et al., 1992) and sheep (Welsh et al., 1993). These scoring systems are based on observing gait abnormalities during movement, which include short striding, limping, head bobbing, difficulty putting weight on a limb or difficulty in turning when walking on a hard floor.

Main et al. (2000) attempted to design a simple, repeatable scoring system to quantify lameness in sows. Observing and recording the level of lameness within a herd has the potential to be employed as a clinical tool for monitoring a lameness problem in a unit and providing evidence of active disease management for farm assurance schemes. In addition, a reliable scoring system may be used in epidemiological studies for identification of potential causal factors of lameness (Main et al. 2000). The scoring system, developed by observing the behaviour, standing posture and gait of pigs while they were undisturbed and during exit into an unfamiliar environment, is based on a six-point numerical scale where a score of 0 represents no abnormality in posture, gait, or behaviour, and 5 represents a severely lame pig, incapable of standing unaided (Main et al., 2000). The study reported varied repeatability; intra-observer repeatability was found to be high, and whilst the protocol was repeatable between two trained observers familiar with the system it was not as reliable between unfamiliar observers (low inter-observer repeatability. The lack of consistent scores was attributed to the difficulty associated with observing lameness in pigs (Main et al., 2000); compared with other species, pig possess a stilted locomotion and their natural response to disturbance is often a short rapid gait rather than a steady walk or trot. Furthermore, vertical head movement is often an important indicator of lameness in livestock species, however in pigs this movement is limited by their relatively short necks. Given the scoring system relies on subjective judgements and the inter-observer repeatability was reasonable between trained-observers, the authors suggest that repeatability may be improved by training observers with trainers that are familiar with the scoring system and ongoing retraining in order to prevent drift (Main et al, 2000).

A study by Geverink et al. (2009) tested the inter-observer variability of two lameness scores, a 4-point scale (0 is normal gait and 3 is severely lame) and a continuous scale from 0 to 100%, as a parameter for monitoring the welfare of sows and fattening pigs on-farm. This study reported that in both sows and fattening pigs, lameness can be reliably scored on a 4-point scale, both live and from video footage (Geverink et al., 2009). Given that within observers, the 4-point score showed a high association with the percentage score, the percentage scoring system did not provide more detailed information than the 4-point scale, and the more detailed scoring systems could potentially decrease repeatability due to the confines of subjective scoring (Winckler and Willen, 2001), Geverink et al. (2009) recommend only scoring lameness on a 4-point scale. Thus, whilst a method of lameness assessment which employs a 4- or 5-point scoring system in a location outside the animals home pen appears to be valid, repeatable and feasible in pigs, further investigation (to determine validity, repeatability and feasibility) is required for the potentially less time-consuming means of assessing

lameness in the animals home pen on a 2- or 3-point scale. Given its relevance to livestock welfare, lameness warrants inclusion within an on-site welfare assessment in pigs, with appropriate observer training to ensure high repeatability.

Body lesions and injuries reflect the impact of the surrounding environment on an animals' body (Ekesbo, 1984). Such lesions will vary in severity, treatment required and the duration of time that the problem persists. The severity and the length of time the animal has the injury are often dependant on the stockperson's response to the problem. A lesion score (clinical scoring) is relevant to on-site welfare assessment because it provides information on current health and welfare concerns of the animal, the animal's physical (housing) and social environment, and the management and husbandry practices employed by the stockperson. If an injury is present, the stockperson's response, in terms of treatment provision may also be measured. A number of protocols have been proposed for the assessment of body lesions (LS) in pigs (Courboulay et al., 2003; de Konig, 1983; Leeb et al., 2004), and a review of the literature reveals the use of a variety of methods for performing clinical scoring in pigs. These methods range from simple skin damage counts, to detailed topographical and qualitative severity scales. However, the majority of these studies have failed to examine the validity, repeatability and inter- and intra- observer reliability of these scoring methods. Following Ekesbo's proposition, de Koning (1985) investigated whether the state of integument was a good indicator of well-being in sows, and if so, how a body lesion parameter should be employed. de Koning (1985) used a methodology which involved the inspection of 52 locations on the sow's body for lesions, which were then classified according to type and extend on a 0-5 severity scale. This study concluded that the relevance of the state of the integument of a sow with regard to well-being depends on both the type and location of the lesion, given that different lesion types were found to occur on different locations of the body in different housing environments, and that the housing environment can impact directly on the integument and indirectly on behaviour (i.e. injurious behaviour) (de Koning, 1985).

The extensive severity scale developed by de Koning (1985) has since been modified by numerous studies using lesion scoring. These scoring systems range from counting and categorising all of the lesions present on specific body areas to simplified arbitrary scoring scales (eg. 0-5). In order to simplify assessment, the body of the pig is commonly divided into different regions, which may be as few as 4 or as many as 52. Each region is either assigned a severity score or a count (depending on the assessment method employed); the scores or counts for all regions are then most commonly averaged to produce an overall lesion (skin damage) score (or count). The division of the animal's body into different regions has also been employed when attempting to identify the source of the lesion or injury; with studies reporting that lesions along the animals backbone are more likely to be a result from a high stocking density, whilst those on the sides of the body may be due to environmental damage or aggression (Velarde, 2007). A number of studies examining sow aggression have linked the location of the body lesion with different forms of aggression, for example lesions located on the animals head, ears and shoulder area are thought to result from fights associated with social ranking (Jensen and Wood-Gush, 1984; Luescher et al., 1990; Barton-Gade et al. 1996), whilst lesions found on the animal's rear are believed to be caused by competition for food (Leeb et al. 2001). As a result location specific lesion scores, such as tail, ear or vulva, have been recorded in addition to the general lesion score. In addition to the lesions which result from aggression, foot and limb lesions, believed to be associated with housing conditions, have been assessed pigs and the number of lesions have been used to determine whether the animal is adequately housed (KilBride et al., 2009a, 2000b).

A range of studies have successfully employed LS systems, of differing scale and complexity, to investigate the impact of different housing and management practices on sows (Badsgard et al. 1996; Boyle et al. 1999, 2000, 2002; Elmore et al. , 2010; Gonyou et al., 1988; Leeb et al., 2001; Weng et al., 1998), growing-finishing pigs (Botermans et al., 2000; Gjein, 1994; Guy et al., 2002; Lyons et al., 1995; Olsen, 2001) and weaners (Baumgartner, 2005). Whilst lesion severity scoring is often quick and simple, body lesion counts may be considered a more objective method of assessing injuries due to their greater precision. The counting of body lesions has been used to examine the effects of different housing and management systems on the health and welfare of pigs in studies including Leeb et al. (2001), Luescher et al. (1990), Scott et al. (2006), Spoolder et al. (1999, 2000a, 2000b) and Turner et al. (2000, 2002).

Although limited, the validation of lesion scoring, both severity scales and counting, has tended to involve measures of aggression. Studies such as Stewart et al. (1993), Burfoot et al. (1995) and Durrell et al. (2002), investigating the use of severity scoring systems (of different scales) to access sow aggression and behaviour in a number of housing systems, all reported positive relationships between total lesion score and agnostic interactions. Burfoot et al. (1995) also investigated intra- and inter-observer reliability in body lesion scoring (count and classification) using one experienced and two inexperienced observers. Results from this study indicate that counts of damage (in region and in total) were consistently similar between observers, however classification of body legion tended to be observer dependant (Burfoot, et al., 1995). Positive relationships have also been found between aggressive interactions and the number of body lesion, by studies including Barnett et al. (1996), Erhard (1997), D'Eath (2002), Turner et al. (2006), and Goossens et al. (2008), whilst studies such as Whittaker et al. (1999) failed to find any correlation between the two variables. With regard to reliability of body lesion counts, Turner et al. (2006) reported favourable inter-observer reliability, whilst systematic differences between the observers' counts identified during analysis caused D'Eath (2005), inadvertently assessing inter-reliability, to discard the data from the second observed. The literature indicates that body lesions do act as indicators of pig welfare, and reflect the quality of the animal's physical and social environment (Leeb et al., 2001). Whilst the inclusion of LS, and/or the location specific lesion assessments, within an on-site welfare assessment scheme would be recommended, the assessment methodology for this parameter still requires standardisation.

Clinical diseases typically involve pain and discomfort however the welfare implications will vary according to the intensity and duration of the disease condition (Bonde, 2004). A disturbance in the general health and condition of the animal generally indicates a potential welfare risk. The incidence of clinical disease and the treatment are important in the assessment of animal welfare, and are obtained through information from herd health data, veterinary records and clinical observations (Bonde, 2004). A number of other animal-based indices that are associated with a range of health conditions have also been employed in welfare assess in pigs; these include bursitis, coughing and sneezing, rectal prolapsed, faecal consistency, neurological problems, reproductive problems, and the condition of the animal's coat and skin. Much of the scientific literature on the health conditions relates to prevalence and/or severity and whilst these indicators have been used to monitor incidences of the conditions, methodology, validation and repeatability of these potential parameters have received little investigation (Scott et al, 2009). Bursitis, which develops as a result of a pressure injury on the weight-bearing points of the leg and is characterised by fluid filled sacks (bursa), is a health concern which has been employed as an animal-based indicator of pig welfare (KilBride et al., 2009a; Scott et al., 2009). With further validation, this indice could potentially be used to indicate housing/flooring suitability. Coughing and sneezing are common indicators of a variety of respiratory problems. Studies such as Geers et al. (1986, 1989), Maes et al. (1999), Mores et al. (2001), Escobar

et al. (2002), Halloy et al. (2004), Done et al. (2005), and Thacker et al. (2006) have successfully measured the incidence and/or severity of coughing as an indicator of respiratory problems in pigs, using a prevalence or classification scale. Whilst coughing and sneezing appears to have the potential to be used as an indicator of respiratory concerns in pig welfare assessment, the lack of validation and reliability examination need to be rectified. Rectal prolapsed is common in pig units and is associated with a number of factors which result in an increase in intra-abdominal pressure (Straw et al., 2006). The available literature again focuses on the prevalence and cause of the health concern, rather than the qualitative assessment of its severity. Variation in faecal consistency may result from diet and/or disease (Straw et al., 2006). The use of faecal consistency scales is well documented (Owusu-Asiedu et al., 2003; Vente-Spreeuwenberg et al., 2003; Taras et al., 2006; ; however the nature of the scale has varied considerably between studies (Scott et al., 2009). The limited reporting of scoring methodologies results in a high reliance on practical experience when assessing parameters concerning health conditions in pigs. Furthermore, a lack of information results in the need to investigate the validity, reliability and feasibility of health problems, in order to use their presence as an indicator of welfare in pigs. Whilst each parameter would require assessment according to its own individual scale, a Welfare Quality report by Scott et al (2009) recommended the use of a simple 3-point severity scale (0-2) for most health conditions. The qualifying description for each point on the scale would need to be specific for each condition, however generally a score of 0 would be indicative of acceptable welfare, a score of 1 would equate to some form of welfare compromise and 2 would be indicative of a serious and unacceptable welfare problem. Farms could then be classified by the proportion of animals or pens which fall under each category (Scott et al., 2009).

Animal Behaviour

Behaviour in animal species is the other most commonly applied measure of welfare (Mench and Mason, 1997). An important question with regard to the relationship between behaviour and animal welfare is whether or not animals have independent behavioural needs or requirements (Rousing et al., 2001). Behavioural restriction or deprivation is believed to cause animals to suffer (Petherick and Rushen, 1997). Accordingly, the performance of certain behaviours appears to be beneficial to the animal and provides some form of reward (Simonsen, 1996). Behavioural measurements and tests are included in on-site welfare assessments and interpreted according to our knowledge of normal behaviour patterns, i.e. behaviour normally displayed to achieve functional goals (Rousing et al., 2001). Through this method, behavioural measurements and tests can reveal whether animals are adapted to their environment and management system, or whether they are showing signs of stress (Rousing et al., 2001).

While behaviour in animals is readily assessed as a measure of welfare, there appears to be a limited range of validated and reliable on-site behavioural parameters capable of measuring poor welfare. Abnormal behaviours, such as stereotypic behaviour, injurious behaviour or negative social behaviour, are generally agreed to have a high validity as indicators of poor welfare because they essentially may be considered as the animal's first level of response to an aversive environment. A 'natural' behaviour can be considered abnormal if it is performed by the animal in an invariant sequence (stereotypies in sows), too frequently (as found in aggressive behaviour and belly-nosing) or not at all (social behaviour or investigation). For example, negative social behaviours are common after mixing of pigs and should, after a few days, occur less frequently. After this initial period, if the occurrence of negative behaviours remains high, it may indicate that the relationship between pigs has failed to stabilise. There are several different measures that could potentially be used to monitor abnormal behaviour, such as the number of animals performing the behaviour, or the amount of time an animal spends performing the behaviour. However on-site it may be difficult to apply these

measures reliably and without disturbing the animals' performance of the behaviour in question. In order to include abnormal behaviours in a welfare assessment for pigs, repeatability and feasibility require evaluation.

Stereotypies are repetitive, unvarying and apparently functionless behaviour patterns commonly believed to indicate animal welfare concerns (Lawrence and Rushen, 1993; Appleby, 1999; Mason and Latham, 2004). They are generally thought to result from the frustration caused when environmental constraints prevent an animal from exhibiting highly motivated behaviours (Broom and Kennedy, 1993). Stereotypic behaviour is generally measured by obtaining stereotypic scores through observation. The stereotypic scores can relate to the number of animals in the housing system performing stereotypic behaviour, or the amount of time an animal spends performing the behaviour. Once a stereotypic score has been obtained, interpreting the results can be challenging due to the complicated relationship between stereotypic behaviour and poor welfare. The persistent nature of stereotypies makes it difficult to equate their performance with challenges in the current environment rather than a previous one. Furthermore the individual expression of stereotypy does not alone indicate poor welfare because it may represent a form of coping mechanism and therefore be associated with improvements in welfare (Rushen, 2003). Thus the difficulties encountered measuring stereotypic behaviour and defining the relationship between stereotypes and poor welfare ensure that simple stereotypy scores should never be used as the sole index of welfare (Mason and Latham, 2004).

Stereotypic behaviour is believed to be associated with feeding frustration in gestating sows, however their expression may also be enhanced by a barren environment (Rushen, 1985; Oderberg et al., 1991; Robert et al., 1997; Terlouw et al., 1991); stereotypies are rarely reported in lactating sows. A range of studies have measured expression or non-expression stereotypic behaviour in sows, including those by Courboulay and Foubert (2007), Whay et al. (2007), Goossens et al. (2008), Courboulay et al. (2009 – Welfare Quality report), and Scott et al. (2009), predominantly via observations conducted over a set period of time (ranging from 15 seconds to 5 minutes). A study by Courboulay et al. (2009) aimed to develop an on-site method to assess stereotypic behaviour (sham chewing, tongue rolling, teeth grinding, bar/trough/drinker biting, and floor licking) in group and/or stall housed gestating sows, and evaluate the measures repeatability (inter- and intra-observer repeatability). The observations were conducted over three days by three observers; and all sows were recorded during 15 seconds and then one minute, and scored as stereotyped, non stereotyped or doubt of stereotypy. Courboulay et al. (2009) report that the method used to measure stereotyped behaviour in sows to be robust in terms of both inter- and intra-observer repeatability, and that observations need to occur at least 10 minutes after the animal has been made to stand up, and 30 minutes after the sow has been fed (due to their relationship with feeding, stereotypes need to be assessed outside of feeding times). Whilst investigations regarding validity are still required, the assessment of stereotypic behaviour in gestating sows appears to be a parameter relevant for on-site welfare assessment.

Courboulay et al. (2009) also examined social behaviours in group housed weaned piglets and growing pigs, via observations (beginning 10 minutes after the animal was standing) over a two hour period using two minute interval scan sampling. The study reported that a time period (two minutes) starting at least 20 minutes after the beginning of observation provides a good representation of the animal's behaviour for the two hour period. Given that validation over a longer period of time has not occurred, observations should occur outside of atypical times, i.e. feeding, mixing, or recent intervention of the stockperson. Courboulay et al. (2009) found the observation method allowed for

the accurate recording of belly nosing, positive social behaviour and negative social behaviours (not in piglets), with a reasonable inter- and intra-observer repeatability.

Whilst the literature is extremely limited, play behaviour in piglets is considered a positive indicator of welfare. Silerova et al. (2010) reported that the expression of play behaviour in piglets indicates the animal is coping well with their environment. Improvements in health and wellbeing are believed to result in increase play behaviour in piglets; theoretically, play behaviours will only occur when animals are physically and environmentally safe and their primary needs are satisfied (Kittawornrat and Zimmerman 2010; Silerova et al. 2010). An increase in animal age corresponds with a decrease in play behaviour, and as a result the expression of play behaviour tends to be measured in piglets and young pigs rather than sows (Bolhuis et al. 2005). Whilst the definition of play may vary between studies, it generally involves the piglet engaging in behaviours such as hopping, scampering, running, chasing, pivoting, pawing, flopping, and tossing their head; either alone, with other piglets or with the sow. Hohenshell et al. (2000) grouped fighting behaviour with play behaviour, whilst other studies suggest that play behaviour becomes fighting behaviour when biting (Arey and Sancha, 1996; Chaloupkova et al., 2007; Devillers and Farmer, 2009), head knocks (Chaloupkova et al., 2007; Yuan et al., 2004), or pushing occurs (Hessel et al., 2006; Mason et al., 2003). Evaluation of validity, repeatability and feasibility are clearly required, however play behaviour appears to have the potential to be included in an on-site welfare assessment as an indicator of positive behaviour in piglets.

Under wild conditions, the ancestors of the domestic pig cohabit in small, genetically related matriarchal groups (Turner et al., 2006). Outside of the mating season, aggression is infrequent and rarely injurious; a trait now observed in domestic pigs housed in an extensive enclosure (Stolba and Wood-Gush, 1984, 1989; Mendl, 1995). The social stability of the group is facilitated and maintained by the infrequent and gradual integration of new members to the group (Mauget, 1981), close kinship, the preservation of individual space and the use of threats and nonaggressive behaviour to maintain dominance relationships (Mendl, 1995; Turner et al., 2006; Melotti et al., 2011). In a commercial production setting, pigs are often repeatedly exposed to sudden mixing episodes with unrelated animals in an environment which restricts the expression of appropriate submissive behaviour and the opportunity for effective dispersal. Under these conditions, post-mixing aggression is often intense during the first 24 hours after mixing (Meese and Ewbank, 1973), but has been found to vary considerably between members of the group (Mount and Seabrook, 1993; Erhard et al., 1997). Agnostic or aggressive behaviour (intra-specific aggression), particularly in group housed sows, represents a significant challenge to the welfare and productivity of pigs (Arey and Edwards, 1998; O'Connell and Beattie, 1999; Turner et al., 2006). As with other behaviours, the observation of agnostic or aggressive behaviour is considerably time consuming, and as a result lesion or injury scoring (the number of lesions/injuries on different sections of the animal's body) is most commonly employed as a alternative indicator of aggressive behaviour in pigs (Turner et al., 2006). This validated approach enables the rapid assessment of aggression in a large number of pigs, and has been used extensively in the investigation of aggression in group housed animals (Francis et al., 1996; Erhard et al., 1997; Spoolder et al., 1999, 2012; Turner et al., 1999, 2000, 2002).

A significant body of research within the livestock industries has demonstrated the effect human-animal interactions have on the behaviour, productivity and subsequent welfare of animals (Breuer et al., 2000; Rushen et al., 1999; Hemsworth et al., 2000; Lensink et al, 2001; Hemsworth et al., 2002; Waiblinger et al., 2002; Hemsworth et al., 2009; Hemsworth and Coleman, 2010). An animal's reactions to human interaction can be measured experimentally by using behavioural tests (Hemsworth et al., 2000; Waiblinger at al., 2003). Tests measuring an animal's reactions to humans

are generally grouped into three main categories; (i) reactions to a stationary human, (ii) reactions to a moving human, and (iii) responses to actual handling. The reliability and repeatability of behavioural tests are high (Bonde, 2004; Waiblinger et al., 2006). The physical and social environment can strongly influence the outcome of the test. That is, animals reactions to the test human may be confounded by a number of factors, including; (i) either fear induced flight or behavioural inhibition elicited by enforced novel stimuli, (ii) distraction of attention by the novel stimuli, (iii) memory of handling associated with the test location, and (iv) human contact incurred in moving the animal from its housing to the test arena (de Passille et al., 1996; Rushen et al., 1998; Jago et al., 1999). All these factors need to be taken into consideration when measuring an animal's behaviour in response to human interaction.

Behavioural tests such as avoidance, approach and startle tests measure an animal's level of fear towards humans which provides a reflection of the nature of the human-animal relationship (Bonde, 2004; Waiblinger et al., 2006). Fear is a negative emotion associated with physiological stress, which has been found to negatively affect an animal's performance (Hemsworth et al., 1989), health status, and reproductive performance (Von Borell, 1995; Hemsworth and Coleman, 2010). Consequently, fear of humans is often included in assessments and recommendations of animal welfare. Fear is arguably the most frequently investigated emotion in domestic animals (Forkman et al., 2007), and a fear of humans represents a welfare problem because the animal may be negatively affected by reoccurring contact with humans (Bonde, 2004). Tests measuring an animal's response to human interaction have been validated in a range of species including pigs (Gonyou et al., 1986; Hemsworth and Barnett, 1992; Hemsworth et al., 1981, 1986, 1987, 1989, 1990, 1996, 1999; Janczak et al., 2003; Marchant et al., 2001, 2003; Wemelsfelder et al., 2000, 2001).

The underlying assumption of tests involving distance measures (withdrawal and approach behaviour) is that animals that are highly fearful of humans will keep the greatest distance; a review by Waiblinger et al. (2006) concluded that the sensitivity of animals' responses to different handling treatments and the reported correlations with stockperson behaviour support the validity of this type of human–animal relationship test. Three main approaches have been employed to characterise level of fear in livestock using withdrawal and avoidance behaviour; response of animals to approaching hand contact (sows: Hemsworth et al., 1981; calves: Rousing et al., 2005), response of free moving animals to a stationary observer in an open field test (sows: Andersen et al., 2006; growing pigs: Hemsworth et al., 1986), and response of group-housed animals to approach by an observer (fattening pigs: Courboulay and Foubert, 2007; calves: Rousing et al., 2005).

Scott et al. (2009) compared the three different methods of assessing fear of humans in sows in order to identify the most valid option for inclusion in an on-site assessment scheme. The study reported that the response of sows in stalls to approaching hand contact and the response of free moving sows in groups to approach by an observer both provided good repeatability and appeared to measure the same level of underlying fear in sows. It was therefore concluded that both tests were well suited to an on-farm assessment of the human–animal relationship, and that together, the two tests provided a standardised method of assessing the human–animal relationship in a variety of different sow housing systems. Although previously validated, the response of free moving sows to a stationary observer in an open field test was found to have low repeatability and feasibility under practical farm conditions; this test was not recommended for use in on-farm welfare assessment (Scott et al., 2009).

The recent study by Clouard et al. (2011) developed an approach test (one for stall-housed sows and one for group-housed sows) and a handling test (one for stall-housed sows and one for group-

housed sows) for on-farm assessment of sow reactivity to human in different housing systems. The study reported a high inter- and intra-observer reliability for all four tests and sow responses which were not influenced by external factor such as time of the day or testing order; therefore indicating the potential for one assessor to conduct the tests and consistently observe the animals' responses, regardless of the type of housing system and the time of the working day without any effect on the sows' response to the tests. Clouard et al. (2011) concluded that the quick and easy-to-use tests, applicable to various housing systems, were promising tools for assessing sow reactivity to humans during on-farm welfare assessment procedures.

Courboulay et al. (2009) developed an on-farm behavioural test to evaluate the human-animal relationship in growing pigs. To generate a population of pigs exposed to a range of different levels of human-animal interactions, groups of growing pigs were exposed to three types of handling; minimum, mild and aversive (electric prod). The test was based on the response (panic, avoidance or contact) of the whole group of pigs to three successive situations; a human walking around the pen, a human staying motionless during 30 seconds, and then continuing to walk around the pen. Courboulay et al (2009) found the test to be an effective and practical way of detecting poor human-animal relationships, and concluded that following an evaluation of repeatability, the test could be used as a measure of fear of humans in a welfare assessment scheme employing animal-based parameters. Thus, the literature, including recent studies by Courboulay et al. (2009), Scott et al. (2009) , and Clouard et al. (2011), demonstrate the potential for fear of humans, assessed using withdrawal-approach tests, to be employed as a valid, repeatable and feasible parameter in on-site welfare assessment, in sows (both stall and group-housed) and fattening pigs.

Behaviours displayed when animals are ill, injured, or restricted, such as, change in gait, lying behaviour and in-activity, are often considered measures of an animal's comfort and useful indicators of poor welfare. Qualitative behaviour assessment is often employed when measuring injurious behaviour in animals. Jongman et al. (2005) used behavioural measures such as change in gait, inactivity, and lying behaviour when examining the welfare risks associated with the use of an alternative collection procedure for urine (PMU) in pregnant mares. Sitting and lying behaviour have also been employed in animal welfare assessments in cattle and sheep. Poor body condition, leg disorders and injuries, unsuitable flooring, and restriction in freedom of movement may all lead to a deviation in an animal's normal sitting and lying-down behaviour sequence (Bonde, 2004). The duration and frequency of lying bouts are behavioural indicators of cow comfort (Haley et al., 2000) and have direct relevance to clinical health, in particular the incidence of lameness (Garbarino et al., 2004; Juarez et al., 2003) and milk production (Munksgaard and Lovendahl, 1993). Lying behaviour is most commonly collected by human observation, or is recorded on video for subsequent analysis. However, these methods however, are time consuming, labour intensive, and have the potential to influence the behaviour of the animals (Muller and Schrader, 2003).

Lying behaviour can include the patterns of standing up and lying down a sow performs, together with the location, posture and duration of the behaviour (Velarde and Geers, 2007). Pigs have been found to spend up to 80% of their daily time budget resting, and during this time more than 60% of lying pigs adopt a fully recumbent position (Ekkel et al., 2003). It could therefore be suggested that lateral recumbancy may indicate the highest degree of comfort (Scott et al., 2009). In addition, Boyle et al. (2002) suggested that less lateral and more ventral lying can be considered an indicator of stress in pigs. The study by Scott et al. (2009 – welfare quality pg 36) attempted to assess the validity of behaviours around resting as indicators of comfort and therefore welfare in pigs. The study reported that measures of resting behaviour failed to show good validity, were influenced by age of

pig within finishing period, displayed a diurnal pattern not consistent across different environments and assessment in a one hour period was not always representative of behaviour over a greater period of time. As a result, Scott et al. (2009) concluded that resting behaviour in pigs would not be recommended for inclusion in an on-site assessment tool. The literature concerning lying behaviour in cattle and the apparent lack of literature regarding the behaviour in pigs suggests that further investigation of lying behaviour and its potential as a parameter for on-site welfare assessment is warranted.

2.2 Environment/Resource- and Management-Based Welfare Parameters

The welfare of animals may be affected by both the environment they live in, as well as the practices under which they are managed. The environment/resource and management conditions imposed on the animal may fail to meet the physiological and behavioural needs of the animal, and in turn impact upon their health and welfare (Bonde, 2004; Wickens and Heleski, 2010). Environment/resource and management factors, imposed on the animal by the stockperson or producer, can be considered risk factors or indicators of potential animal welfare concerns. Including those risk factor measures pertaining to descriptions of the animal's environment and the management practices involved in a welfare assessment provides information regarding the potential for welfare problems and any potential causal factors. Surveying the environment, management and handling of the animal, as well as conducting interviews with the people responsible for the animals appear to be applicable and repeatable methods of measurement of risk factors.

Environmental Factors

Environmental factors which have been found to affect the health and welfare of livestock include space allowance, flooring, pen and paddock fittings, ventilation and hygiene (Johnsen et al., 2001; Winckler et al., 2003; Bonde, 2004).

The space allowance afforded to an animal is a relevant welfare risk indicator. If an animal experiences spatial restriction and is prevented from performing desired or necessary behaviours its welfare may be affected. The area per animal must adequately meet the needs of the animal or risk frustration or discomfort being experienced (Bonde, 2004). Victorian legislation states the minimum space allowance for group housed sows is 1.4m2 (Victoria DPI 2012). A number of studies have investigated optimal space allowance in pigs. Spoolder et al. (2012) reported that increasing a pig's spatial allowance can reduce the prevalence of aggression, decrease lesions and injuries, provide a greater opportunity to stand and therefore reduce the incidence of pressure sores, and lessen overall stress. The study by Barnett et al. (2001) found the ideal space allowance for pigs was 1.4 – 1.8m^2, however when a special allowance of 3m^2 was compared to one of 2m^2 an increase in reproduction was observed; Weng et al. (1998) recommended a space allowance of 2.4 – 3.6m^2. Measurements of pen dimensions are easily repeatable, and can be supported by behavioural observations of an animal's posture and housing area usage.

Poor flooring has the potential to cause injury and discomfort, and is therefore an important component of welfare assessment. Bedding and flooring type are important factors with regard to the thermal and lying comfort of an animal, and Scott et al. (2007) has reported on the potential injuries to sow and piglets that can result from particular flooring types. Straw is the most commonly used bedding material in pigs, and it has been shown by a range of studies to promote positive health and behaviour outcomes for the animal. For example, when compared to concrete or slatted flooring, the use of straw bedding reportedly resulted in fewer leg and foot lesions and injuries (Heinonen et al., 2006), improved gait (Andersen et al., 1999), and decreased expression of stereotypic behaviour (Barnett et al. 2001). Furthermore, preference tests have demonstrated pigs'

preference straw bedding (Matthews and Ladewig 1994). A description of flooring materials and construction is both reliable and feasible, and can be further supported by observations of sitting, lying and posture change behaviour and clinical observations of skin and leg condition (Bonde, 2004).

The equipment and fittings in an animal's pen or paddock have the potential to cause the animal pain and discomfort if incorrectly sited, constructed, maintained or functioning. Pen and paddock equipment and fittings can be reliably measured and described, and supported by clinical observations of body condition (Bonde, 2004). Appropriate ventilation aids an animal's welfare by maintaining the optimal temperature and reducing the amount of dust particles, infectious microbes, and noxious gases in the environment. Ventilation systems are able to be described, and room temperature and air quality can be measured. Additional measurements of cleanliness, lying behaviour and pen usage are able to be recorded for support (Bonde, 2004).

Management Practices

The welfare of any animal is significantly influenced by the manner in which its resources requirements are managed (Hemsworth and Coleman, 2010), both in terms of the husbandry and management practices employed and the stockperson's response to the animal. The management parameters which may affect an animal's health and welfare include feed and feeding procedure, water availability and water quality, health and husbandry practices, surveillance/monitoring, housing and grouping strategies, injury and illness treatment, disease control protocols, and mortality and morbidity rates.

An animal's welfare may be influenced by the amount and quality of feed it receives, as well as the feeding procedures themselves, therefore feed type and feeding procedures are relevant risk factors. Generally, reliable information regarding feed and feeding procedures can be obtained from stockpeople, and feed quality is easily observed (Bonde, 2004). Supportive information can be collected through behavioural, health and environmental observations. Water quantity and quality appear to be appropriate risk factors because a sufficient quantity and quality of water are important to an animal's welfare; however requirements vary depending on the animal's age and physiological state (Bonde, 2004). Assessment of water quality may be reliable, but somewhat difficult in on-farm locations. The surveillance of animals and their environment is an important component of animal welfare. However as a risk factor in on-site welfare assessment it is difficult to directly measure and assess, and is therefore reliant on information obtained from stockpeople. As previously discussed, group size and grouping strategies play an important role in the welfare of animals, in terms of space and access to feed, and aggression and competition, and may therefore be appropriate welfare indicators. Group size can be obtained through observation and information regarding grouping strategies can be collected from the stockperson.

Finally, whilst not applicable to the current development of an on-site pig welfare benchmarking protocol, it is important to note the important role of human attitudes in the management of livestock. An important determinant of livestock management and their ensuing welfare outcomes is the human-animal relationship (Hemsworth and Coleman, 2010; Breuer et. al., 2000; Hemsworth et. al., 2000; Lensink et. al., 2000; Waiblinger et. al., 2002). There is a considerable body of research demonstrating that human-animal interactions (management practices) can have substantial effects on the behaviour, physiology, welfare and productivity of commercial farm animals (Hemsworth et al., 1981, 1986, 1987, 1989, 2009; Gonyou et al., 1986; Hemsworth and Barnett, 1991; Lensink et al., 2000, 2001; Waiblinger et al., 2002, 2006; Edwards, 2009). The sequential relationships reported between stockperson attitudes, stockperson behaviour, and animal welfare in the pig and dairy industries indicates the opportunity to improve the welfare of production animals by modifying the

attitudes and behaviour of stockpeople (Hemsworth, 2003). Furthermore, intervention studies aimed at improving stockperson attitudes and behaviour have demonstrated the opportunity to improve the welfare of farm animals by changing the attitudes and behaviour of stockpeople (Hemsworth et al., 1994, 2002; Coleman et al., 2000). Cognitive-behavioural intervention programs (stockperson training and education programs), such as ProHand, have been successfully employed in the pig industry to improve key attributes of stockpeople and reduce animal welfare concerns (Hemsworth et al., 2002; Hemsworth and Coleman, 2010). Thus whilst stockperson attitudes are important determinants of animal welfare and productivity, they are not a relevant indicator for an on-site welfare benchmarking tool to be employed by the stockperson.

3 Recommendations

The reviewed literature demonstrates the opportunity to develop a practical and effective on-site welfare assessment tool, using validated, repeatable and feasible animal, management and environment/resource-based welfare indices, which is capable of benchmarking pig welfare in the Australian Pork Industry. Table 3 provides a list of animal, management and environment/resource-based welfare indices which could potentially form the on-site pig welfare assessment tool to be applied by farmers for self auditing purposes. Your feedback, suggestions and recommendations would be appreciated.

Table 3: Suggested animal, management and environment/resource-based welfare indices

ANIMAL WELFARE INDICE	ANIMAL
Animal-based indices	
Body condition score (BCS)	Sow and Grower/Finisher
Lameness	Sow and Grower/Finisher
Body lesion scoring (LS)	Sow and Grower/Finisher
Tail lesion scoring	Sow and Grower/Finisher
Vulva lesion scoring	Sow
Bursitisis	Sow and Grower/Finisher
Health problems	Sow, Piglet and Grower/Finisher
Coughing and sneezing	Sow and Grower/Finisher
Fear of humans	Sow and Grower/Finisher
Stereotypic behaviour	Sow
Lying/resting behaviour	Sow and Grower/Finisher
Play behaviour	Piglet
Environment/resource-based and Management-based indices	
Water	Sow, Piglet and Grower/Finisher
Feeding practices	Sow, Piglet and Grower/Finisher
Space allowance	Sow, Piglet and Grower/Finisher
Group size	Sow, Piglet and Grower/Finisher
Floor type	Sow, Piglet and Grower/Finisher

Bedding	Sow, Piglet and Grower/Finisher
Cleanliness	Sow, Piglet and Grower/Finisher
Environmental temperature	Sow, Piglet and Grower/Finisher
Air quality	Sow, Piglet and Grower/Finisher
Mortality	Sow, Piglet and Grower/Finisher
Morbidity	Sow, Piglet and Grower/Finisher
Use of 'hospital' pen	Sow, Piglet and Grower/Finisher

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Appendix 2 - Membership of Focus Group and Outcomes of Meeting Held on January 30th at the University of Melbourne

Focus Group Members

Trish Holyoake	DPIV	
Ellen Jongman	AWSC Uni Melb	
Jean-Loup Rault	AWSC Uni Melb	
Maxine Rice	AWSC Uni Melb	*Apology*
Lauren Hemsworth	AWSC Uni Melb	
Paul Hemsworth	AWSC Uni Melb	
Jeremy Skuse	AWSC Uni Melb	
Herman Vermeer*	Uni Wageningen	
Hans Spoolder*	Uni Wageningen	
Graeme Pope	Graeme Pope Consulting	
Pat Mitchell	APL	
Geordie Charles	Berrybank Farm	*Apology*
Rod Hamann	Australian Pork Farms	
Kenton Shaw	Rivalea	
Jeff Braun	Myora Farms	
Neil Ferguson	Westpork	

* Not at meeting - provided input via email

The purpose of the meeting was to:

1. Review the animal, management and environment/resource-based welfare indices identified in the literature review.
2. Identify other welfare indicators which may already be in use in industry.
3. Determine a set of indicators which will be piloted on Australian farms to assess their practicality and value in monitoring the welfare of sows, piglets and growing pigs.
4. Develop broad guidelines to assist researchers develop a protocol for the piloting of the tools on-farm.

Meeting Outcomes

The following indices were considered by the Team

Animal-Based Indices

1.	Body condition score	Sow and Grower/Finisher
2.	Lameness	Sow and Grower/Finisher
3.	Body lesion scoring	Sow and Grower/Finisher
4.	Tail lesion scoring	Sow and Grower/Finisher
5.	Vulva lesion scoring	Sow
6.	Bursitis	Sow and Grower/Finisher
7.	Health problems	Sow, Piglet and Grower/Finisher
8.	Coughing and sneezing	Sow and Grower/Finisher
9.	Fear of humans	Sow and Grower/Finisher
10.	Stereotypic behaviour	Sow
11.	Lying/resting behaviour	Sow and Grower/Finisher
12.	Play behaviour	Piglet
13.	Mortality	Sow, Piglet and Grower/Finisher
14.	Morbidity	Sow, Piglet and Grower/Finisher

Indices which were considered to be relevant, useful and practical in their application and which will be piloted utilising a protocol which is under development are:

1. *Body condition scoring*
2. *Lameness scoring*
3. *Body lesion scoring*
4. *Tail lesion scoring*
5. *Vulva lesion scoring*
6. *Coughing and sneezing scoring*
7. *Morbidity scoring*
8. *Stereotypic behaviour scoring*

Environment/Resource-Based and Management-Based Indices

1.	Water	Sow, Piglet and Grower/Finisher
2.	Feeding practices	Sow, Piglet and Grower/Finisher
3.	Space allowance	Sow, Piglet and Grower/Finisher
4.	Group size	Sow, Piglet and Grower/Finisher
5.	Floor type	Sow, Piglet and Grower/Finisher
6.	Bedding	Sow, Piglet and Grower/Finisher
7.	Cleanliness	Sow, Piglet and Grower/Finisher
8.	Environmental temperature	Sow, Piglet and Grower/Finisher
9.	Air quality	Sow, Piglet and Grower/Finisher
12.	Use of 'hospital' pen	Sow, Piglet and Grower/Finisher
13.	Staff Training	Sow, Piglet and Grower/Finisher
14.	APIQ Accreditation	Sow, Piglet and Grower/Finisher

These indices were not considered useful for inclusion in a set of welfare benchmarking tools as they are covered by the code of practice or by industry Quality Assurance schemes.

The project will, therefore, focus on the identified animal-based measures of pig welfare.

Meeting Notes

Why 'Benchmark'?

- to demonstrate the performance appropriate husbandry and management practices on-farm
- in order to improve welfare you need to be able to measure/assess welfare on-farm
- consumer driven
- health and welfare of the animal
- encourage continuous improvement on farm (internal improvement)
- at this stage, the 'welfare assessment' will only be used as a benchmarking tool (potential for future use as an auditing tool)
- the benchmarking tool will not provide 'standards' as it is simply a tool for farmers/producers to measure/monitor the welfare of their animals over time
- benchmarking allows a comprehensive assessment at farm level over time, rather than the common 'snap shot of a single period of time' obtained during an audit
- there is an opportunity for APL to report/use farmers' benchmarking results – could be done anonymously so farmers' can rate there results against the industry?
- benchmarking results could potentially direct future research direction

- farmers/producers appear to be concerned that a 'benchmarking tool' and its results could potentially be used to form a standard or as an auditing tool, which would result in their 'assessment' i.e. pass or fail
- at this stage 'targets' do not need to be determined as the farmers' goal should be an improvement in the welfare of their animals over time

Resource/Environment Measures

- necessary to support the animal-based measures
- may not need to be included (and therefore recorded) in an internal benchmarking protocol as long as they are regularly documented in farm records
    - for example, members of APIC would regularly record a range of relevant environment/resource/management indices to ensure compliance, i.e. feed and water systems
    - therefore, could potentially refer to Cof P or APIC records to obtain environment/resource/management indice measures

Animal-Based Measures

- move mortality and morbidity from environment/resource to animal-based indices
- the suggested/identified animal-based measures include; body condition score (BCS), lameness, body lesion score, coughing and sneezing, stereotypic behaviour, mortality and morbidity

Body Condition Score (BCS)

- BCS to be assessed in sows
- 5-point scoring; the highly validated scoring system
- Critical points for sow assessment are likely to be at weaning and around vaccination (approximately 3-weeks prior to farrowing – it is important for the sow to enter the farrowing crate with a good BCS to ensure she also leaves the farrowing crate with a good BCS); however BCS can be assessed at any time (result will need to be qualified with stage or production in order to get an accurate view of sows condition and the management regime)
- further suggestion to perhaps measure after first mixing, when LS and lameness are assessed
- sample size (statistically significant proportion of the herd) to be determined following pilot

Lameness

- Lameness to be assessed in sows
- Percentage incidence and severity
- 3-point scale (as suggested by Rod Hamann); 0 – normal, 1 – irregular gait, 2 – non-weight bearing (reluctance to bear weight or stand)
- Assessment to occur in pen, at a pre-determined time after the animals have been disturbed and are standing/active
- Initial suggestion for assessment at weaning and vaccination, however it was then recommended that the measure be determined after first mixing when BCS and LS are taken; however assessment of indice can occur at any time

Body Lesion Score (LS)

- Severity scoring; possibly a 3-point score

- Body to be divided into sections to be scored (suggestion of 5 body sections – need to refer to literature for most appropriate); therefore assessment will provide an overall body LS and a score for specific areas, i.e. tail score, vulva score, and shoulder score
- LS to be assessed in both sows and growers; sows to be assessed at weaning, vaccination and after first mixing, growers to be assessed at approximately 15 week of age – again assessment is able to be performed at any time
- Tail and vulva lesion score to be determine during LS

Coughing/Sneezing

- Relevant indicator
- Use current index for pilot trial
- Assessed in both sows and growers

Stereotypic Behaviour

- After some disagreement it was decided that stereotypic behaviour would be trialled
- Scan sampling of pen; % of animals performing the behaviour
- Behaviours include champing, teeth grinding, biting of fittings, floor licking, etc (need to be clearly defined in the protocol)

Mortality

- Included as an animal-based measure rather than a resource/environment indice
- Figures to be obtained from farm records
- Percentage of natural and cull/euthanasia deaths; also require reason and age of pig

Morbidity

- Percentage of animals in the population that require intervention, i.e. those animals which have been missed (?)
- Percentage of animals in 'hospital pen'
- Does the 'treatment' provided to compromised animals require assessment?
- How do you determine when an animal requires intervention or is compromised? Definition could potentially be developed using the Australian Pig Vets document

In Addition

- Record and measure percentage of sows culled at weaning and the reasons for the cull; include deaths and euthanasia
- Monitoring of pig care records recommended by Jeff Braun
- Report to be circulated before 280213; including the identified indices, rational for the indices inclusion in the pilot, and clear definition of the indices protocol
- Jeremy to conduct all on-farm assessors in order to reduce inter-assessor variablility

Appendix 3 - Pig Welfare Benchmarking Protocol

The scientific literature demonstrates the opportunity to develop a practical and effective on-site welfare assessment tool, using validated, repeatable and feasible animal-based welfare indices, capable of benchmarking pig welfare in the Australian Pork Industry. A pilot study will test the suitability of the following animal-based welfare indices for inclusion in a practical on-site pig welfare benchmarking tool to be applied by farmers for self auditing purposes; the identified animal-based indices would be able to be employed either collectively as a benchmarking tool, or individually to assess a specific health or welfare issue. The protocol will be applicable to sows and growing/finishing pigs, across all stages of production and within all forms of production system. Consequently, consideration of both the production system and the animal's stage of production will be required when evaluating the results of the assessment.

Order of assessment for the animal-based welfare indices within the benchmarking protocol:

1. Condition scoring; the indices which concern the assessment of the animal's body condition can be measure concurrently; body condition score (BCS), body lesion score (LS), tail lesion score, vulva score, and bursitis
2. Lameness score
3. Coughing and sneezing; to be measured concurrently
4. Stereotypic behaviour (abnormal behaviour)
5. Morbidity

The data collected during the pilot will enable the on-site pig welfare benchmarking tool to be finalised with regard to the animal-based indices warranting inclusion, methodology, and sample sizes.

Animal-Based Welfare Indices

Body Condition Scoring (BCS)

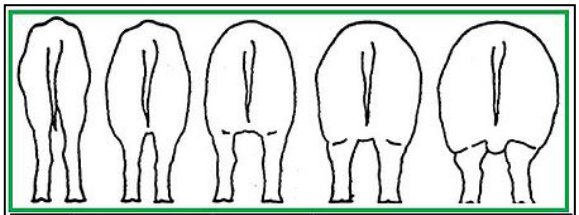
Rationale for inclusion*:* Body condition scoring (BCS) is widely used as an animal health indicator in the welfare assessment of a range of animal species, due particularly to the ease with which a multi-point scoring system can be applied and its ability to detect welfare-relevant malnutrition, under-nutrition and over-nutrition. Malnutrition and under-nutrition observed in thin animals has been associated with reduced welfare, while over-condition and obesity is often associated with reduced levels of fertility and poor health and welfare outcomes. Maintaining a pig's optimal body condition is necessary in order to achieve adequate production levels within a herd and to ensure the health and welfare of the animal. Poor body condition in pigs has been associated with insufficient feed and/or competition around feeding.

Methodology: The use of visual and tactile BCS assessment in sows (performed within the animal's home pen) is commonly reported in the literature; however there is a lack of documented scoring systems for assessing BCS in growing pigs. Whilst a range of scoring scales has been employed, the 1-5 scale remains the most widely used scoring system for this parameter (Patience & Thacker, 1989).

- A condition score from 1 to 5 is assigned to each sow, based on the ease or difficulty of detecting bones at various pressure points (Figure 1); a score of 1 is assigned to a very thin sow, a score of 5 is given to an obese sow and a score of 3 equates to the optimal body condition.
- Whilst the extreme values of this parameter (emaciated and over fat) become the indicators of poor welfare, there are no minimum or maximum thresholds because body condition

score is dependent on the physical state of the animal (i.e. weaning, mid-pregnancy, farrowing, etc) and on genetics.

Parameter	Body Condition Score (BCS)
Scope	Animal-based indice: Sows and Grower/finishers
Sample size	Individual level; required sample size to be determined following the pilot
Methodology	Measurement to be taken at pen level; the most appropriate stages for assessment are likely to be post first mixing (after mating or weaning), weaning and vaccination • Ensure all animals are standing • View the animal from behind and alongside; consider the visibility of the pig's bones • Visually inspect and palpitate the pig's spine, hip and pin bones • Assess the pig's condition according to the classification described below and Figure 1
Scoring	1. Emaciated – hips and spine are visually prominent; pig appears very thin 2. Thin – hips and spine visible and are easily felt without pressure applied through the palm 3. Ideal – hips and spine lack visual prominence and are only felt when pressure is applied though the palm 4. Fat – hips and spine are not visible and cannot be felt when firm pressure is applied through the palm 5. Overfat – hips and spine are heavily covered and cannot be felt even when pressure is applied with a single finger; sow appears visually obese



Score	Last rib backfat depth (mm)	Condition	Body Shape
1	<15	Emaciated	Hips, spine prominent to the eye
2	15 – 18	Thin	Hips, spine easily felt without pressure
3	18 – 20	Ideal	Hips, spine felt only with firm pressure
4	20 – 23	Fat	Hips, spine cannot be felt
5	>23	Overfat	Hips, spine heavily covered

	Figure 1. Guide for the visual and tactile body condition assessment in sows. *Percentage of animals with score 1* *Percentage of animals with score 5*

Body Lesion Scoring (LS)

Rationale for inclusion: Body lesions and injuries reflect the impact of the surrounding environment on an animals' body. A lesion score (clinical scoring) is relevant to on-site welfare assessment because it provides information on current health and welfare concerns of the animal, the animal's physical (housing) and social environment, and the management and husbandry practices employed by the stockperson. A number of protocols have been proposed for the assessment of body lesions (LS) in both sows and growers/finishers; ranging from simple skin damage counts, to detailed topographical and qualitative severity scales. In order to simplify assessment, the body of the pig is commonly divided into different regions, which are either assigned a severity score or a count (depending on the assessment method employed); the scores or counts for all regions are then most commonly averaged to produce an overall lesion (skin damage) score (or count). The division of the animal's body into different regions has also been employed when attempting to identify the source of the lesion or injury.

Methodology: Lesion scoring, using a simplified arbitrary scoring system based on de Koning's (1984) well established lesion count, has been successfully employed to investigate the impact of different housing and management practices on the health and welfare of both sows and growers/finishers. The animal-based indice has been reliably scored using a 4-point scale at pen level; skin lesions are recorded by clinical examination of the animal's body, and five specified body regions are given a lesion score.

- Lesions scored can be both surface penetration of the epidermis or actual wounds with penetration of muscle tissue, scratches or round lesions, fresh (red) or old (black) lesions.

Parameter	Body lesion score (LS)
Scope	Animal-based indice: Sows and growers/finishers
Sample size	Individual level; required sample size to be determined following the pilot
Methodology	Measurement to be taken at pen level; the most appropriate stages for assessment in sows are likely to be post first mixing (after mating or

weaning), weaning and vaccination

- Ensure all pigs are standing
- Wounds on the body are clinically examined by observing one side of the pig; select the side of the animal with optimal view for observation
- The pig's body is considered in five separate body regions;
    1. Anterior section (head and ears)
    2. Shoulder section (neck and shoulders)
    3. Central section (flanks and back; back of shoulder to hind quarters)
    4. Causal section (hind quarters; rump and tail)
    5. Legs (fore and hind legs)

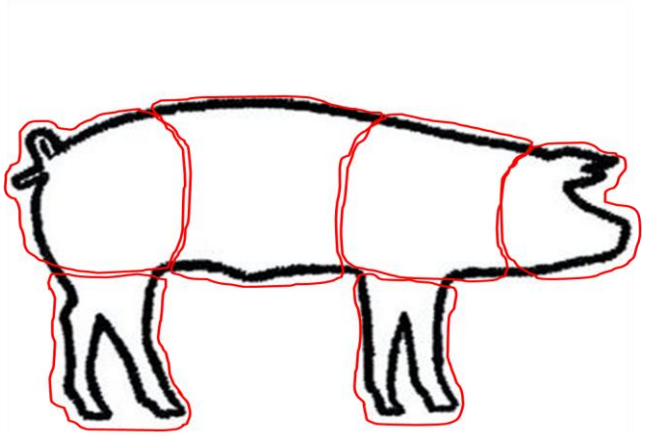


Figure 2. The five body regions of the pig requiring body lesion scoring (LS)

- In order to standardise assessment;
    - If there is less than 0.5cm between two lesions they will be measured as one lesion(i.e. a LS of 1)
    - A group of small lesions with less than 0.5cm between them are scored according to the size of the area; diameter <2 cm equals one lesion (LS of 1), diameter between 2 and 5 cm equals six lesions (LS of 2), diameter >5 cm equals ten lesions (LS of 3)
    - A bleeding lesion between 2 and 5cm, or a healed lesion of

	more than 5cm will be considered as six lesions (i.e. a LS of 2) · A deep and open lesion of more than 5cm will be considered as ten lesions (LS of 3) • Assess each section of the pig's body (Figure 2) for lesions according to the classification described below
Scoring	0. No lesions 1. 1-5 lesions 2. 6-10 lesions 3. >10 lesions *Percentage of animals with score 1* *Percentage of animals with score 2* *Percentage of animals with score 3*

Vulva Lesion Scoring

Rationale for inclusion: Vulva lesions represent a serious welfare concern in sows; they can vary from superficial cuts to the complete removal of the vulva. Whilst vulva biting is regarded as an aggressive act rather than redirected foraging behaviour, the problem appears to be exacerbated by an increase in feeding motivation.

Methodology: Despite the implications for sow welfare, documented methodologies for assessing the severity of vulva wounds are lacking.

- appears to occur most commonly in late gestation (3-4 weeks pre-farrow)

Parameter	Vulva lesion score
Scope	Animal-based indice: Sows
Sample size	Individual level; required sample size to be determined following the pilot
Methodology	Measurement to be taken at pen level; the most appropriate stages for assessment are likely to be in post first mixing (after mating or weaning) and/or late gestation (3-4 weeks pre-farrow) • Ensure all sows are standing • Observe the sow from behind; examine the vulva for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or deformed vulva) • Assess the severity of vulva lesions in the sow according to the classification described below
Scoring	0. No damage to the vulva 1. Small lesion (<2cm) or scar tissue is visible 2. A healing injury larger than 2cm (scab or crust formed), or a deformed vulva 3. An injury that is larger than 2cm and bleeding *Percentage of animals with score 1* *Percentage of animals with score 2* *Percentage of animals with score 3*

Tail Lesion Scoring

Rationale for inclusion: Tail biting is a serious welfare problem in growers/finishers; however it is often difficult to representatively assess over time due to its sporadic and unpredictable nature, and the need to euthanase severely affected animals. Whilst the majority of literature employs a simple yes/no scoring system for the presence or absence of wounds on the pig's tail, a number of qualitative severity scoring methods have been developed.

Methodology: The recording of tail wounds as present or absent is a quick and simple process, however it may not provide an accurate representation of the scale of the problem. Alternatively, qualitative severity scoring may potentially provide more information on the nature of the tail biting problem at the time of sampling (i.e. the presence or absence of active tail-biters).

- Tail lesion score is a parameter concerning damage to the tail in growers/finishers; the damage can range from superficial bites along the length of the tail to the absence of some or all of the tail.

Parameter	Tail lesion score
Scope	Animal-based indice: Growers/finishers
Sample size	Individual level; required sample size to be determined following the pilot
Methodology	Measurement to be taken at pen level • Ensure all pigs are standing • Observe the grower/finisher from behind; examine the tail for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or missing tail section) • Assess the damage to the tail in the grower/finisher according to the classification described below
Scoring	0. No damage to the tail; no evidence of tail biting 1. Superficial wounds along the length of the tail, but no evidence of fresh blood or of any swelling 2. Wound with evidence of fresh blood is visible on the tail; there may be evidence of swelling and infection, part of the tail may be missing, and a crust could have potentially formed *Percentage of animals with score 1* *Percentage of animals with score 2*

Bursitis

Rationale for inclusion: Bursitis develops as a result of a pressure injury on the weight-bearing points of the leg and is characterised by fluid filled sacks (bursa); it is a health concern commonly found in pigs, and is thought to be indicative of unsuitable housing/flooring. It is often included as an animal-based welfare indice in on-site welfare assessments because the welfare challenge associated with the condition may not be detected by other indices such as LS and lameness score.

Methodology: Bursae are most prevalent in the hock region of the hind-limbs; however they can occur in other locations.

Parameter	Bursitis
Scope	Animal-based indice: Sows and Growers/finishers
Sample size	Individual level; required sample size to be determined following the pilot
Methodology	Measurement to be taken at pen level; the most appropriate stages for assessment in sows are likely to be post first mixing (after mating or weaning), weaning and vaccination • Ensure all pigs are standing • Stand less than one meter away from the side of the animal to be observed; select the side of the pig with optimal view for observation • Inspect one side of the animal for evidence of bursae on both the fore and the hind limbs, paying particular attention to weight bearing points of the limbs, i.e. hocks • Bursae can be classified as following; · Small bursae: 1.5-2.0cm diameter; comparable in size to a grape · Medium bursa: 2.0-5.0cm in diameter; comparable to a walnut · Large bursae: 5.0-7.0cm in diameter; comparable to an orange • Score the animal according to the classification described below
Scoring	0. No evidence of bursae 1. One or several small bursae on the same leg, or one medium bursae 2. Several medium bursae on the same leg, one large bursae, or any bursa that is eroded

	Percentage of animals with score 1 *Percentage of animals with score 2*

Lameness

Rationale for inclusion: Leg injuries and lameness are common in the swine industry, and are considered major welfare concerns that have the potential to induce pain and discomfort for extended periods of time, and reduce the ability of the animal to cope with its environment. Restricting an animal's freedom of movement may limit the performance of social and feeding behaviour, and increase the risk of further injury through falling. Lameness has been widely employed as an animal-based welfare parameter in pigs; predominantly using either a simple observation from within the pen where the animal is assigned a score (2 or 3-point scoring scale) regarding weight baring ability, or an evaluation of standing posture and gait, in a location outside the animals home pen, scored on a 4 or 5 point scale where 0 is normal/not lame and 4/5 is unable/reluctant to stand and/or move. Given the valid, repeatable (does require training) and feasible nature of the parameter, the assessment of lameness in pigs from within the pen, using a 3-point scale (for practicality and repeatability), is recommended.

Methodology: Lameness has been widely used as an animal-based welfare parameter in sows and growers/finishers predominantly in a location outside of the home pen; scored reliably using a 4-point scale. Lameness is the inability to use one or more limbs in a normal manner, which results in an irregular gait. It can vary in severity from reduced ability to bear weight, to total recumbency. This parameter is measured visually at pen level by observing the locomotion of individual animals in both sows and growers/finishers. Given the assessment of lameness in pigs will occur in the animal's home pen, the more practical and repeatable 3-point scoring system will be employed.

- In order to reduce the influence potential stiffness may have on the assessment, ensure the sow has been standing for at least 5 minutes before commencing the lameness observation.

Parameter	Lameness score
Scope	Animal-based indice: Sows and growers/finishers
Sample size	Individual level; required sample size to be determined following the pilot
Methodology	Measurement to be taken at pen level; the most appropriate stages for assessment in sows are likely to be post first mixing (after mating or weaning), weaning and vaccination • Ensure all pigs have been standing for at least five minutes before observations commence • Observe the animal from in front, behind and alongside; whilst walking and standing still • Assess the pig's gait according to the classification described below
Scoring	0. Normal gait 1. Lame – a visible degree of difficulty in walking or a visible reluctance to bear weight on the affected limb, but still using all four legs; swagger of caudal body while walking, shortened stride 2. Non-weight bearing – no weight bearing on affected limb; total recumbency *Percentage of animals with score 0* *Percentage of animals with score 1* *Percentage of animals with score 2*

Coughing and Sneezing

Rationale for inclusion: Clinical diseases, including those concerning the respiratory system, result in a disturbance in the general health and condition of the animal, typically involve pain and discomfort and generally indicate a potential welfare risk.

Methodology: The incidence and/or severity of coughing and sneezing, as indicators of respiratory problems in pigs, have been successfully employed using a prevalence or classification scale.

- The incidence of coughing and sneezing can be recorded for the pen during the same five minute observation period

Parameter	Coughing
Scope	Animal-based indice: Sows and Growers/finishers
Sample size	Group level
Methodology	Measurement to be taken at pen level • Commence observation at least five minutes after entering the pen (to allow time for the animals to settle) • Observe the pen for a period of five minutes • Record the total number of pigs in the pen coughing during the five minute observation period
Scoring	*Percentage of animals coughing* (number of animals coughing/number of animals in pen)

Parameter	Sneezing
Scope	Animal-based indice: Sows and Growers/finishers
Sample size	Group level
Methodology	Measurement to be taken at pen level • Commence observation at least five minutes after entering the pen (to allow time for the animals to settle) • Observe the pen for a period of five minutes • Record the total number of pigs in the pen sneezing during the five minute observation period
Scoring	*Percentage of animals sneezing* (number of animals sneezing/number of animals in pen)

Stereotypic Behaviour (Abnormal Behaviour)
Rationale for inclusion: Stereotypies are repetitive, unvarying and apparently functionless behaviour patterns commonly believed to indicate animal welfare concerns. Stereotypic behaviour is believed to be associated with feeding frustration in gestating sows, however their expression may also be enhanced by a barren environment; stereotypies are rarely reported in lactating sows.
Methodology: Stereotypic behaviour is generally measured by obtaining stereotypic scores through observation. The stereotypic scores can relate to the number of animals in the housing system performing stereotypic behaviour (group level), or the amount of time an animal spends performing the behaviour (individual level).

Parameter	Stereotypic behaviour
Scope	Animal-based indice: Sows
Sample size	Group level
Methodology	Measurement to be taken at pen level • Assessment should occur in the morning (when pigs are most active), outside of feeding times (at least 30 minutes after the scheduled feeding) • Commence observation at least five minutes after entering the pen (to allow time for the animals to settle) • Stereotypic behaviour is defined as a sequence of invariant motor acts, which provide no obvious gain. The stereotypic behaviours to be evaluated include; · sham chewing (where the sow has nothing in its mouth), · tongue rolling, · teeth grinding, · the biting of pen fittings (bar/trough/feeder), and · floor licking • Observe the pen for a period of five minutes, recording the number of animals that perform stereotypic behaviour • Score the animal according to the classification described below
Scoring	*Percentage of animals performing stereotypic behaviour* (number of animals performing stereotypic behaviour/number of animals in pen)

Morbidity

Rationale for inclusion: An important measure of health and welfare in livestock is the incidence of disease. Injury and disease are clear signs of reduced welfare, and housing and management systems that increase their incidence or frequency represent a serious welfare concern. Morbidity data has yet to be used as part of on-site animal welfare assessment protocols.

Methodology: Determine the morbidity measures by inspecting and evaluating the animal for each of the conditions described in the reference tool for identifying 'compromised' pigs (see Appendix 1).

Parameter	Morbidity
Scope	Animal-based indice: Sows and Growers/finishers
Sample size	Group level
Methodology	• Morbidity is the relative incidence of a particular illness or disease in a specific locality • Data concerning morbidity, morbidity management and morbidity rates would need to be obtained from health inspections and assessments of the herd and farm/production records • Assessment would occur at three levels; target pigs/pens, target shed, and hospital pens
Scoring	– The percentage of 'compromised' animals in the herd which have not been identified for treatment – The percentage of animals in the herd which require euthanasia – The percentage of animals in the herd being treated in hospital pens – The percentage of animals in the hospital pens receiving inappropriate treatment (a check to see if hospital pens are being used appropriately) – *assess the animals in the hospital pens according to the APV checklist and evaluate their treatment according to the guidelines described in the APV document* – The number of hospital pens

Reference tool for identifying 'compromised' pigs (derived from the Australian Pig Veterinarians Sick and Injured Pig Guidelines document)

Condition	Symptoms	Action/Treatment
Body Condition	Pig in condition score 2 or less	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Pig less than 50% of average weight of pen mates	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
Ear		
Aural Haematoma	Ear swollen or misshapen with signs of infection, broken skin and/or discharging wound	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
Ear biting	Ear not intact with evidence of bleeding and/or infection and/or haematoma formation	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Ear extensively damaged with bleeding +/- infection +/- haematoma formation +/- exposure of deeper tissue	→ Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours

Head tilt	Symptoms of middle ear infection; head tilt, head/ear shaking, +/- otherwise bright, alert and responsive and eating and drinking normally, +/- symptoms similar to meningitis if sever (see neurological)	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Eye		
Blind	Blind in both eyes	→ Immediate euthanasia
	Blind in one eye	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
Other eye	Any ocular condition resulting in impediment to pigs ability to walk, eat, drink and behave normally	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Intestine		
Diarrhoea/scours	Profuse and/or bloody scours	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
	Scours associated with poor body condition, concurrent systemic illness, or impacted ability to access feed and water	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
	Scours of any nature associated with extreme abdominal pain	→ Immediate euthanasia

Pot belly pig	Bloated abdomen	→ Immediate euthanasia
Rectal stricture	Losing condition, bloated abdomen, +/- history of rectal prolapsed	→ Immediate euthanasia
Hernia		
Scrotal/umbilical	Extensively damaged, infected, ulcerated, bleeding, fly blown, or with concurrent poor condition/other disease	→ Immediate euthanasia
	Hernia resulting in impediment to pig's ability to walk, eat, drink and behave normally	→ Immediate euthanasia
	Any hernia larger than 30cm or touching the ground	→ Immediate euthanasia
Limbs		
Limb or digit injury/illness	Limb broken	→ Immediate euthanasia
	Completely non weight-bearing on a limb	→ → Immediate euthanasia
	Partial weight-bearing on a limb	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
	Swelling at any joint to more than twice normal size regardless of impact on gait and/or ability to access feed and water	→ Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Digit missing and/or underlying	→ Immediate euthanasia

	bones/tendons missing		
	Marked superficial wounds affecting multiple limbs and/or extensive areas of the individual limb	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
	Erosive or ulcerated skin lesion exposing to muscle, bone or tendon	→	Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Difficulty standing	Paralysis	→	Immediate euthanasia
	Downer pig, recumbent and unable to stand and/or walk	→	Immediate euthanasia
	In extreme distress when encouraged to stand	→	Immediate euthanasia
Difficulty walking	Freely able to stand and bear weight on all limbs, but in extreme distress when encouraged to walk	→	Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
	Freely able to stand and bear weight on all limbs but ability to access feed and water affected, or predisposed to bullying	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
CNS/Neurological			
Difficulty standing	Paralysis	→	Immediate euthanasia
	Downer pig, recumbent and unable	→	Immediate euthanasia

	to stand and/or walk		
	Symptoms of meningitis; recumbent, paddling, reduced awareness and/or responsiveness, abnormal eye movements	→	Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Head tilt/abnormal behaviour	Symptoms of middle ear infection; head tilt, head/ear shaking, +/- otherwise bright, alert and responsive and eating and drinking normally, +/- symptoms similar to meningitis if sever (see neurological)	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Symptoms of meningitis; recumbent, paddling, reduced awareness and/or responsiveness, abnormal eye movements	→	Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Prolapses			
Rectal prolapse	Small (< trotter size), fresh and intact prolapsed in an otherwise bright, alert and responsive pig that is eating and drinking normally	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days (can be transported to abattoir individually within 72 hours)
	Extensively damaged, bleeding, infected or fly blown prolapse	→	Immediate euthanasia
	Prolapsed that is unable to be replaced by a competent person, using pain relief, within 48 hours	→	Immediate euthanasia

	Any untreated prolapsed > 72 hours old	→	Immediate euthanasia
Uterine prolapse	Any uterine prolapse without effective veterinary intervention within 6 hours	→	Immediate euthanasia
Vaginal prolapse	Any vaginal prolapsed without effective veterinary intervention	→	Immediate euthanasia
Reproductive			
Mastitis	Mild to severe mastitis with or without associated ill thrift, erosion/ulceration/abscessation of mammary tissue	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Uterine prolapse	Any uterine prolapse without effective veterinary intervention within 6 hours	→	Immediate euthanasia
Vaginal discharge	Profuse and/or malodourous and/or purulent vaginal discharge and/or bloody urine	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
Vaginal prolapse	Any vaginal prolapsed without effective veterinary intervention	→	Immediate euthanasia
Respiratory	Difficulty breathing and/or coughing with evidence of lost condition and/or systemic or other concurrent illness or impediment	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours

	to feed and water intake		
	Severe respiratory distress	→	Immediate euthanasia
Skin			
Abscess	Multiple abscesses or a localised abscess with signs of concurrent ill thrift	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Abscess resulting in impediment to pig's ability to walk, feed, drink and behave normally	→	Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Erysipelas	A pig demonstrating signs of ill trift, fever, deterioration, lameness/stiffness/reluctance to move, extensive skin lesions and/or inability to access adequate feed and water	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Wounds and pressure sores	Superficial wounds affecting an extensive area or multiple parts of the animal's body	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Erosive or ulcerated skin lesion exposing to muscle, bone or tendon	→	Immediate euthanasia; Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 24-48 hours
Tail			

Tail biting	Tail not intact with evidence of bleeding and/or infection	→	Hospitalise, treat, review at least twice daily, euthanase if no response to treatment within 2-10 days
	Tail extensively damaged or missing and deeper tissue exposed; would may extend into base of spine	→	Immediate euthanasia

Appendix 4

PIG WELFARE BENCHMARKING PROTOCOL PILOT DATA SHEET

Farm: _____

Date: _____

Assessor: _____

Number of sows: _____

Number of growers/finishers: _____

	Mating/Service	Gestation	Farrowing
Number of pens/crates/stalls			
Number of sows/pen			
Housing type			

	Weaners	Growers/finishers
Number of sheds		
Type of shed		
Number of pens/shed		
Number of animals/shed		
Number of animals/pen		
Age		

Parameter Score (Group level)	Sows	Weaners	Growers/finishers
Coughing			
Sneezing			

Stereotypic behaviour in sows ***Score:***	Assessment should occur in the morning, outside of feeding times (at least 30 minutes after the scheduled feeding) • Commence observation at least five minutes after entering the pen (to allow time for the animals to settle) • The stereotypic behaviours to be evaluated include; · sham chewing (where the sow has nothing in its mouth), · tongue rolling, · teeth grinding, · the biting of pen fittings (bar/trough/feeder), and · floor licking • Observe the pen for a period of five minutes, recording the number of animals that perform stereotypic behaviour **Percentage of animals performing stereotypic behaviour (number of animals performing stereotypic behaviour/number of animals in pen)**

Farm: _____

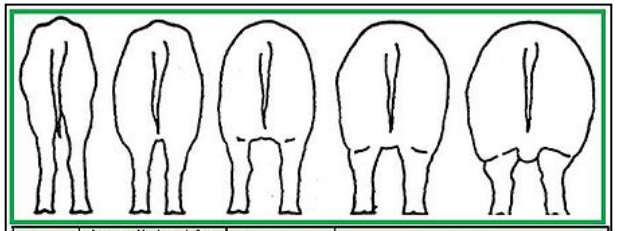
Date: _____

Sow ID: _____

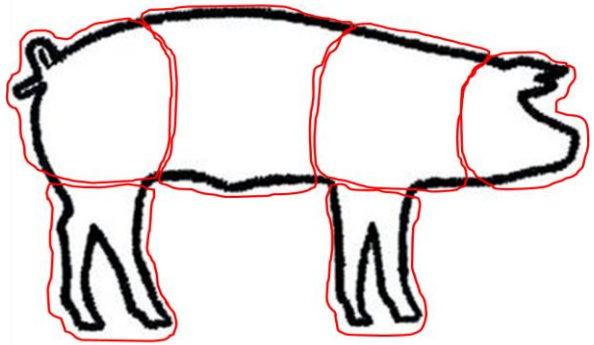
Production stage: _____

Housing type: _____

Parameter & Score	**Parameter Methodology & Scoring Scale**
Body Condition Score ***BCS:***	*View the sow from behind and alongside; consider visually inspect and palpitate the sow's spine, hip and pin bones* 1. **Emaciated** – hips and spine are visually prominent; sow appears very thin 2. **Thin** – hips and spine visible and are easily felt without pressure applied through the palm 3. **Ideal** – hips and spine lack visual prominence and are only felt when pressure is applied though the palm 4. **Fat** – hips and spine are not visible and cannot be felt when firm pressure is applied through the palm 5. **Overfat** – hips and spine are heavily covered and cannot be felt even when pressure is applied with a single finger; sow appears visually obese



Score	Last rib backfat depth (mm)	Condition	Body Shape
1	<15	Emaciated	Hips, spine prominent to the eye
2	15 – 18	Thin	Hips, spine easily felt without pressure
3	18 – 20	Ideal	Hips, spine felt only with firm pressure
4	20 – 23	Fat	Hips, spine cannot be felt
5	>23	Overfat	Hips, spine heavily covered

Body Lesion Scoring ***LS (overall):*** ***1. Anterior section LS:*** ***2. Shoulder section LS:*** ***3. Central section LS:*** ***4. Causal section LS:*** ***5. Legs LS:***	*Inspect one side of the pig; select the side of the animal with optimal view for observation* **0. No lesions** **1. 1-5 lesions** **2. 6-10 lesions** **3. >10 lesions** · If there is less than 0.5cm between two lesions they will be measured as one lesion · A group of small lesions with less than 0.5cm between them are scored according to the size of the area; diameter <2 cm equals one lesion, diameter between 2 and 5 cm equals six lesions, diameter >5 cm equals ten lesions A bleeding lesion between 2 and 5cm, or a healed lesion of more than 5cm will be considered as six lesions · A deep and open lesion of more than 5cm will be considered as ten lesions	 The pig's body is considered in five separate body regions; 1. Anterior section (head and ears) 2. Shoulder section (neck and shoulders) 3. Central section (flanks and back; back of shoulder to hind quarters) 4. Causal section (hind quarters; rump and tail) 5. Legs (front and hind legs)
Vulva Lesion Scoring ***Vulva LS:***	*Observe the sow from behind; examine the vulva for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or deformed vulva)*	**0. No damage to the vulva** **1. Small lesion (<2cm) or scar tissue is visible** **2. A healing injury larger than 2cm (scab or crust formed), or a deformed vulva** **3. An injury that is larger than 2cm and bleeding**

Bursitis ***Bursitis score:***	*Inspect one side of the animal for evidence of bursae on both the fore and the hind limbs, paying particular attention to weight bearing points of the limbs* Bursae can be classified as following; • Small bursae: 1.5-2.0cm diameter; comparable in size to a grape • Medium bursa: 2.0-5.0cm in diameter; comparable to a walnut • Large bursae: 5.0-7.0cm in diameter; comparable to an orange	**0. No evidence of bursae** **1. One or several small bursae on the same leg, or one medium bursae** **2. Several medium bursae on the same leg, one large bursae, or any bursa that is eroded**
Lameness ***Lameness score:***	*Ensure all pigs have been standing for at least five minutes before observations commence* • Observe the animal from in front, behind and alongside; whilst walking and standing still	**0. Normal gait** **1. Irregular gait** – an visible degree of difficulty in walking, but still using all four legs; swagger of caudal body while walking, shortened stride **2. Severely lame** – a visible reluctance to bear weight on the affected limb **3. Non-weight bearing** – no weight bearing on affected limb; total recumbency

Farm: _____

Date: _____

Grower/finisher ID: _____

Production stage: _____

Housing type: _____

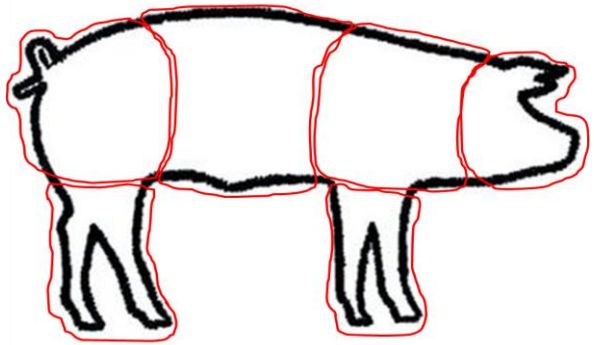
Parameter & Score	**Parameter Methodology & Scoring Scale**
Body Condition Score ***BCS:***	*View the grower/finisher from behind and alongside; consider the visibility of the grower's bones* • Visually inspect the grower/finisher's spine, hip and pin bones **0. Good body condition** - hips and spine lack visual prominence **2. Lean animal** – hips and spine are visually prominent

Body Lesion Scoring

LS (overall):

1. ***Anterior section LS:***
2. ***Shoulder section LS:***
3. ***Central section LS:***
4. ***Causal section LS:***
5. ***Legs LS:***

Inspect one side of the pig; select the side of the animal with optimal view for observation



0. **No lesions**
1. **1-5 lesions**
2. **6-10 lesions**
3. **>10 lesions**

- If there is less than 0.5cm between two lesions they will be measured as one lesion
- A group of small lesions with less than 0.5cm between them are scored according to the size of the area; diameter <2 cm equals one lesion, diameter between 2 and 5 cm equals six lesions, diameter >5 cm equals ten lesions A bleeding lesion between 2 and 5cm, or a healed lesion of more than 5cm will be considered as six lesions
- A deep and open lesion of more than 5cm will be considered as ten lesions

The pig's body is considered in five separate body regions;

1. Anterior section (head and ears)
2. Shoulder section (neck and shoulders)
3. Central section (flanks and back; back of shoulder to hind quarters)
4. Causal section (hind quarters; rump and tail)
5. Legs (front and hind legs)

Tail Lesion Scoring ***Tail LS:***	*Observe the grower/finisher from behind; examine the tail for evidence of fresh injuries (evident by the presence of blood or a red lesion) and older injuries (scar tissue and/or missing tail section)*	**0. No damage to the tail; no evidence of tail biting** **1. Superficial wounds along the length of the tail, but no evidence of fresh blood or of any swelling** **2. Wound with evidence of fresh blood is visible on the tail; there may be evidence of swelling and infection, part of the tail may be missing, and a crust could have potentially formed**
Bursitis ***Bursitis score:***	*Inspect one side of the animal for evidence of bursae on both the fore and the hind limbs, paying particular attention to weight bearing points of the limbs* Bursae can be classified as following; • Small bursae: 1.5-2.0cm diameter; comparable in size to a grape • Medium bursa: 2.0-5.0cm in diameter; comparable to a walnut • Large bursae: 5.0-7.0cm in diameter; comparable to an orange	**0. No evidence of bursae** **1. One or several small bursae on the same leg, or one medium bursae** **2. Several medium bursae on the same leg, one large bursae, or any bursa that is eroded**

Lameness ***Lameness score:***	*Ensure all pigs have been standing for at least five minutes before observations commence* • Observe the animal from in front, behind and alongside; whilst walking and standing still	**0. Normal gait** **1. Irregular gait** – an visible degree of difficulty in walking, but still using all four legs; swagger of caudal body while walking, shortened stride **2. Severely lame** – a visible reluctance to bear weight on the affected limb **3. Non-weight bearing** – no weight bearing on affected limb; total recumbency