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Department of Agriculture, Water and the Environment

AUSTRALIAN Pork

To create and validate best practice truck biosecurity and disinfection guidelines with practical application at export abattoirs

Final Report
APL Projects 2020/0005 & 2020/0005.01

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Research Organisation
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Research Team

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Eric Neumann is the owner of Epi-Insight Limited, an epidemiology consulting business with offices in New Zealand and the United States. He works internationally on projects related to biosecurity, animal health, livestock production, public policy aspects of animal disease management, and risk assessment related to trade in animals and animal products. Dr Neumann has been involved in livestock production, aid and development projects, infectious disease management and research, controlled experimental trials, international project management and collaboration, government-sector biosecurity policy development, and one-health training in locations around the world. He was the manager of veterinary services for a large, integrated U.S. pork producer for 7 years.

William Hall has worked with pigs for 40 years in the USA, Australia and New Zealand in private practice, academia (University of Minnesota and the University of Illinois), and industry. Since his retirement Dr Hall has collaborated with Dr Neumann on several projects for Australian Pork Limited, acted as an external reviewer for the Australian Veterinary Journal and as an external reviewer for the Australian Pesticides and Veterinary Medicine Authority.

Clive Richardson has been working in the meat processing sector for 35 years, first for the private sector and then with the regulator. But for the last 25 years he has been working with the Meat Industry Training Advisory Council (MINTRAC), developing and delivering training courses and materials for the red meat and pork processing sector. In addition, Clive has developed and facilitated professional development networks for trainers, regulators and QA managers. MINTRAC has developed Emergency Animal Diseases training materials and courses for export and domestic abattoirs focusing on awareness, detection and response. As well as developing training materials MINTRAC also delivers train the trainer programs for on-site and Registered Training Organisations trainers.

Jan Dahl worked for 9 years as a private practitioner, working with cattle and pigs. Since 1993 he has been employed by the Danish Agriculture & Food Council as a researcher, epidemiologist and advisor. Jan Dahl is a member of the official Danish expert group on the control of African and Classical swine fever, the Danish expert group on Foot & Mouth Disease, the Danish technical group for control of salmonella in pigs and pork, and the ASF-task force for COPA-COGECA (the European farmers organisation). His main activity has been research in the spread and control of infections in pigs and poultry. He has been the co-author of more than 30 peer-reviewed publications and is currently on the editorial board of Preventive Veterinary Medicine.

Executive Summary

Conclusions and perspectives of the findings

African swine fever (ASF) is a highly infectious viral disease of pigs, first described in Africa during the early part of the twentieth century. It is associated with very high mortality and is spread by both direct contact (pig-to-pig), and indirect contact (contaminated vehicles, equipment, personnel and pork products).

Although biosecurity in this country has made significant advances over the last 40 years, particularly in intensive industries, this project confirmed that compared to countries that live with the reality of FMD, CSF, ASF, PRRS, SVD, etc., Australian biosecurity practices and attitudes towards adoption of biosecurity standards still have a considerable way to go as demonstrated by the Review of Truck Biosecurity at South Australian Pig Abattoirs (Lloyd and Dunstan 2019). In the EU, truck washing/disinfection between farms and between farm and abattoir is routine, with some countries providing designated public facilities and oversight/certification to ensure compliance. Australia does not maintain a similar level of biosecurity vigilance in this regard.

An extensive literature review, conducted during the first phase of this project (APL 2020/0005) focused on the broader epidemiological aspects of ASF as they related to transportation-related biosecurity risks. The second phase of this project (APL 2020/0005.01) set out to examine the ASF/EAD biosecurity risk factors associated with pig transport in Australia (drawing on overseas experience) and then to develop recommendations and transport biosecurity resource materials in conjunction with the Meat Industry Training Advisory Council (MINTRAC) (APL 2021/0006).

The project objectives, developed in conjunction with APL and the ASF Technical Committee, were:

- Conduct a national and international literature search for reports on best practice truck washing/disinfection
- Visit and review the truck washing facilities and procedures at export pig processing facilities
- Engage with all relevant Australian pig industry stakeholders
- Develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials
- Investigate biosecurity issues related to water recycling/re-use, for truck washing

Using the completed literature review as a foundation, the project set out to assess the risks associated with the current pig transport biosecurity arrangements in Australia. This was done by a series of surveys and discussions with pig transporters, pig processors (export and domestic), pig producers and water recycling experts. This was supported by on-site visits when COVID restrictions permitted.

Summary of findings

- ASF is a viral disease of the pigs that was first described in Africa during the early part of the twentieth century. The disease has periodically occurred outside of Africa, including an ongoing epidemic in Europe, Asia, the Dominican Republic and Haiti that started in 2007; the disease has never occurred in Australia or New Zealand.
- Once introduced into a country, spread can occur through direct and indirect routes of transmission. Infected feral pig populations have the potential to act as a long-term reservoir for the virus, making eradication difficult.

- Just before and throughout the period of clinical signs, ASF virus is shed in oronasal fluids, urine, faeces, and blood. This results in contamination of the pig's environment, including flooring, equipment, and vehicles. Transportation-related risk factors therefore may play an important role in ASF spread, though evidence thus far has been largely anecdotal.
- Only a tiny fraction of ASF cases reported to OIE include information about the suspected or confirmed route of exposure; most are simply listed as 'unknown'.
- The ASF virus involved in the Eurasian outbreak is highly virulent and can be considered virtually 100% fatal, with death occurring five to 30 days post-infection. This virus can be assumed to be shed continuously, albeit at decreasing concentrations, for the life of the pig. Although ASFV genotype II is currently prevalent in Asia and is considered to be highly virulent, isolation of lower virulent ASFV genotypes I and II was recently reported in China (Sun *et al.* 2021a; Sun *et al.* 2021b) and their emergence may be related to reports from China of the use of illegal vaccines created by copying ASF vaccines under development (Ito *et al.* 2022). The results of animal experiments with these lower virulence viruses show they can cause chronic infection and are highly transmissible. These lower virulent viruses are characterized by less dramatic and specific clinical symptoms and a long incubation period, which makes early detection of infected animals more difficult. If these lower virulent viruses are quietly spreading throughout China and are released from the country, then this will most likely further complicate any efforts to control ASF in affected countries.
- The literature presents some conflicting evidence on the likelihood pigs will become infected after coming into contact with an ASF virus contaminated environment (e.g. a pig pen or truck compartment). However, as first principles:
    - ASF virus is shed in faeces, urine, saliva and blood, and
    - ASF virus is infectious through oral exposure
    - Therefore, one should assume contaminated environments may remain contaminated for an extended period (weeks to months), depending on temperature, in the absence of cleaning and disinfecting.
- There does not appear to be objective data that describes the frequency or quality of cleaning and disinfection procedures of pig transport vehicles on-farm or at abattoirs in Australia.
- No export processors currently have facilities that would even meet the design criteria that have been proposed for on-farm truck washes in this report (see page 29 of Appendix 7).
- No export processors currently have livestock truck cleanliness policies or procedural manuals
    - Six of seven export processors had truck wash facilities on-site.
    - A parallel survey of 10 domestic processors found that 7 had a truck cleanliness policy, but only 1 processor enforced it.
    - Four domestic processors had a truck wash available, with two having a procedural manual (though compliance with the procedure was apparently inconsistent)
- At export processors, the decision whether to wash a truck or not and to what standard, is left to the discretion of the driver; this was largely mirrored at the domestic plants.
- No export processors currently provide truck disinfecting capability and only 50% have high pressure wash capability
- Australian abattoirs in general (all species) recycle (dispose of) waste water by irrigation onto farmland, following treatment by processes that do not include a final kill step.
- The impact of current abattoir effluent treatments on the survival of ASF is uncertain.
- In order to mitigate human health risks, human effluent treatment requirements prior to irrigation are much more prescriptive than for abattoir effluent. Arguably, however, the

consequences of introduction of an EAD like ASF to the feral pig population, through exposure to irrigated abattoir effluent, could have significant and long-lasting impacts that could span across the Australian pork value chain and likely other segments of the Australian agriculture economy.

- Prior to land irrigation with human effluent, people are excluded from the area; most export pig processors irrigated effluent onto farmland that was not fenced in a manner that would effectively exclude feral pigs.
    - with some reporting feral pigs in the vicinity
- Human effluent recycling (irrigating) requires that soil infiltration rate be greater than the irrigation rate to avoid run-off; abattoirs often had nearby water courses and run off was not normally monitored or controlled.
- Export processor pond holding capacity averaged 2 to 10 day's production and was impacted by storm water ingress (most do not separate storm water from effluent input). NB: Human sewerage treatment aims at a minimum 50-day lagoon retention prior to recycling (irrigating)
- No export processors included an effluent disinfection step prior to recycling (irrigating) whereas this is required for irrigation with human effluent.
- Processor effluent screenings (pre-pondage) are often sent off site for disposal with no follow-up monitoring
- 69% of commercial pig transporters carried less than 5 loads of pigs per week, though approximately 15% transported more than 20 loads per week.
- The majority of loads (65%) had more than 200 pigs on board.
- Amongst commercial transporter survey respondents (n=26), use of cleaned trailers (prior to loading) was common with 94.7% of loads making use of a cleaned trailer.
- According to commercial transporters, 23% of farmers left decisions about truck and trailer hygiene up to them, while 77% made some type of special biosecurity request. Most commonly, these requests were related to driver hygiene (boot and coverall management) and a strict requirement for washing the trailer and at least the outside of the cab.
- Producer survey response rate was disappointing low (n=35; 32%) despite considerable follow up, with the highest response rate in the 501-1000 and 1001-5000 sow categories
- Only 2 producers reported trucks already holding pigs at pick up, i.e., that pigs from other location/s had been picked up prior to arrival of the truck at their premises.
- 55% of producers used only their own trucks to move pigs while 46% used commercial transporters. Of those using their own trucks for pig transport, 55% had their own truck wash facility on their property.
- 79% of those producers using transport contractors had specific biosecurity requests while 21% just trusted the contractor's judgement as to which biosecurity/hygiene processes were necessary.

Conclusion

An incursion of ASF is likely to go unnoticed for several weeks before the first herd is diagnosed with the disease. The implication of this is that infected pigs are likely to have been being processed at an abattoir or abattoirs in advance of an ASF diagnosis, and that on this basis the abattoir may be contaminated, with outward dissemination of the infection from this aggregation point via exiting vehicles.

The apparent lack of capacity and capability to effectively wash and disinfect the country's fleet of livestock transport vehicles, as identified in this project, will exaggerate outward spread of disease in

the period prior to detection, constrain EAD response activities, and increase the risk of further spread of an EAD to uninfected herds. The current processes for handling of wash water and other effluents from slaughterhouses, namely surface irrigation of untreated waste water onto land that can be freely accessed by feral pigs, may also pose a risk for spread of ASF into the feral pig population.

Experience from Europe clearly indicates, that if ASF spreads into wild boar or feral pigs, then unless the incursion is managed very rapidly (within weeks of the first case), it becomes nearly impossible to control or eradicate the infection. There are few instances of ASF eradication in the world that have been successful once the virus becomes endemic in the wild boar or feral pigs, and none in the current pandemic.

This project has also shown that in the case of an ASF outbreak, the current state of Australian truck washing infrastructure will make business continuity challenging for pork farmers because within a very short time-period, truck washing capacity and wash water disinfection/management constraints are likely to be a key rate-limiting step in the response effort. The current management of trucks may also contribute to the spread of endemic diseases between herds.

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1. Background to Research

African swine fever (ASF) is a highly infectious viral disease of the pigs, first described in Africa during the early part of the twentieth century. It is associated with very high mortality and is spread by both direct contact (pig-to-pig), and indirect contact (contaminated vehicles, equipment, personnel and pork products).

The disease has periodically occurred outside of Africa, including an ongoing epidemic in Europe, Asia, Haiti and the Dominican Republic that started in 2007. Although the disease has never occurred in Australia or New Zealand, its recent detection in Indonesia, East Timor and Papua New Guinea, has raised significant concerns in this country. Of particular concern in the Australian context, beyond impacts on the domestic herd and associated markets, is the potential for infected feral pigs (with population estimates of up to 30 million) to become a long-term reservoir for ASF.

Just before and throughout the period of clinical signs, ASF virus is shed in oronasal fluids, urine, faeces and blood. This results in contamination of the pig's environment, including flooring, equipment and vehicles. Biosecurity and transportation-related risk factors, therefore, are likely to play an important role in ASF spread.

Although biosecurity in this country has made significant advances over the last 40 years, particularly in intensive industries, compared to countries that live with the reality of FMD, CSF, ASF, PRRS, and SVD etc, Australia has a considerable way still to go, both structurally and attitudinally, as demonstrated by the Review of Truck Biosecurity at South Australian Pig Abattoirs (Lloyd and Dunstan, 2018). In the EU, truck washing/disinfection between farms and between farm and abattoir is routine, with some countries providing designated public facilities and oversight/certification to ensure compliance.

This APL project set out to examine the ASF/EAD biosecurity risk factors associated with pig transport in Australia and propose measures for mitigating those risks that are related to pig transportation.

2. Objectives of the Research Project

In August 2020 when this project was initially conceived and funded, work was planned to be completed in three phases. Phase 1 activities were approved and funded by APL at the outset, with provisional activities under Phase 2 and 3 proposed but not committed to at the time of contract signing. APL requested this research approach as a flexible means of adapting the work based on the expectation that issues identified by stakeholders would change as a result of the rapidly developing ASF situation. Modifications to the initially proposed Phase 2 and 3 activities were to be guided by regular communication between the research team and the APL ASF Technical Committee (or if deemed appropriate, other individuals or groups of stakeholders designated by APL).

The five overall objectives identified for the project **at the time of its inception** are shown below:

OBJECTIVE 1: Develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials

OBJECTIVE 2: Conduct a national and international literature search for reports on best practice truck washing/disinfection investigations

OBJECTIVE 3: Engage with all relevant Australian pig industry stakeholders

OBJECTIVE 4: Engage with international agencies experienced with ASF biosecurity to determine the best approach under Australian conditions and provide an international perspective on ASF

OBJECTIVE 5: Visit and review the truck washing facilities and procedures at export pig processing facilities

Meetings and/or teleconferences with stakeholders were conducted over the life of the project to assist in developing the final work plan for the project (Table 1). COVID-related restrictions on travel for project investigators substantially impacted both the pace of work on this project and its deliverables.

Table 1. Summary of key stakeholder engagement activities.

Date	Stakeholder group	Key outcomes
Aug 2020	Seven Point Pork	Review truck wash; discussion with management
	Big River Pork	Review truck wash; discussion with management
	Hahndorf Sewerage Plant	Examine effluent treatment process
	Heather Channon pest CRC	Feral pig issues
	Ross Cutler APL	ASF discussion
	APL ASF Technical committee	Project objectives discussion
	International ASF team zoom	Methodology discussion
Sept 2020	Seilers Transport Qld	Development of trucking survey; interstate contacts
	Big River Pork visit	SA CVO Mary Carr, Andy Pointon
	ASF seminar	John Carr
Dec 2020	Exoflare discussions	Truck tracing
Jan 2021	Diamond Valley Pork visit	Review truck wash; discuss project with OPV
Feb 2021	Farm visits	Review loading protocols
April 2021	APL ASF Technical committee	Review progress-abattoir issues
	Exoflare	Discuss project overlaps and survey
	Rivalea visit	Review truck wash; discussions with management
May 2021	ASF workshop Adelaide	Review abattoir risk factors
Jun 2021	Export plants	Discuss /follow up effluent survey
	PPRG	ASF project discussion

	Dept Ag	Webinar ASF economic consequences
Aug 2021	ASF survey	Producer phone survey
	ASF survey	producers
Sept 2021	SA Water - Gretchen Marshall	Discuss human effluent treatment
	ASF teams meeting	
	Farm visit	Loading protocols
Oct 2021	APL Raymond Chia	ASF project briefing
Nov 2021	APL Raymond Chia	ASF project briefing
Dec 2021	APL ASF Technical Committee	briefing
	SA Water specialist visit	Water re-cycling human effluent
Feb 2022	PPRG	ASF discussions
Mar 2022	Farm visit	Review loading protocols
May 2022	MINTRAC	EAD experience workshop

The project objectives were modified as a result of these stakeholder meetings and with the agreement of APL, resulted in the following **final list of five objectives for the project**.

OBJECTIVE 1: Conduct a national and international literature search for reports on best practice truck washing/disinfection

OBJECTIVE 2: Visit and review the truck washing facilities and procedures at export pig processing facilities

OBJECTIVE 3: Engage with all relevant Australian pig industry stakeholders

OBJECTIVE 4: Develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials

OBJECTIVE 5: Investigate biosecurity issues related to water recycling/re-use for truck washing

A summary of the specific activities under each objective of the project is shown in Table 2.

Table 2. Summary of initial (proposed) and actual (negotiated) activities to support objectives of project.

Phase	Initial (proposed) activities	Actual (negotiated) activities
Phase 1	• Conduct a national and international literature search for reports on best practice truck washing/disinfection investigations, with an emphasis on resistant viral pathogens in general and ASF in particular. o The US and Europe have considerable experience with effective truck disinfection in the presence of EADs to control the spread. We will draw on that experience/knowledge through contacts in the European and US pig industries. o Review the epidemiology of ASF and in particular the experience of countries dealing with outbreaks regarding the role of transport in its spread. • Conduct a telephone survey with the 7 export pig processors to ascertain their individual concerns with the truck wash issue to inform discussion at the workshop below. • Hold an initial online workshop with APL representatives, high level processor representatives and the research team to discuss issues raised in the phone survey and more accurately identify the issues the stakeholders want addressed o To ensure they are incorporated into the project outputs o Establish a steering committee of stakeholders if required • Drawing on the search results, a detailed survey will be prepared and distributed to producers (through APL) and processors to collect initial data on the range of existing facilities and procedures. o The survey will help inform the subsequent on-site inspection process. • Liaise with the APL/ APL ASF Technical Committee to modify the project as required o Including the proposed methodology and the extension and communication outputs for the various stakeholder groups and the appropriate method of delivery	As proposed

Phase	Initial (proposed) activities	Actual (negotiated) activities
Phase 2	• Using the results of the Phase 1 literature search, workshop, and survey as a guide, in conjunction with APL design a program to visit and review, accompanied by Dr Dahl, the truck washing facilities and procedures at export pig processing facilities, and a selection of farms and trucking companies ○ To assess the range of facilities, equipment, and processes currently utilised ○ As required, conduct microbiological assessment of cleaning effectiveness using appropriate indicator organisms, modelling the approach on current international protocols (e.g. TVC, Enterobacteriaceae) ○ Assess existing abattoir staff, farm staff and truck driver biosecurity protocols/practices • Conduct the abattoir, farm, and trucking company reviews	Phase 2 and 3 activities were combined • Visit and review the truck washing facilities and procedures at export pig processing facilities ○ Due to COVID restrictions, Dr Dahl was unable to come to Australia ○ Include investigation of biosecurity issues presented by water recycling/re-use at abattoir-based truck washes • Meet with then coordinate Phase 2/3 outcomes with expert panel charged with providing input around biosecurity aspects of SA abattoir-based truck washes under construction. These experts were identified by APL as a key stakeholder for Phase 2/3 outcomes. • Survey industry stakeholders about transportation biosecurity and use of truck washes (on-farm and off-farm) ○ Australian pork producers ○ Commercial pig transporters ○ Small (non-export) abattoirs • Use information from surveys and Phase 1 literature to develop transportation SOPs and other resource materials for producers ○ Truck washing ○ Feed truck biosecurity ○ Line of Separation ○ Pig Transport Biosecurity: A Resource Guide for Australian Producers ○ Estimate costs and describe best practice facility designs for an on-farm truck wash • Investigate biosecurity issues related to water recycling/re-use for truck washing • MINTRAC-specific activities ○ Training manual: Biosecurity and the transport of pigs (consistent with of actions outlined in the AHC ASF taskforce processor working group output - INCIDENT ACTION PLAN GUIDANCE DOCUMENT: RESOLUTION OF AN ABATTOIR DESIGNATED AS AN PREMISE OR DANGEROUS CONTACT PROCESSING FACILITY IN AN AFRICAN SWINE FEVER OUTBREAK) ○ Training manual: Pig transport washing and disinfection
Phase 3	• In collaboration with the national Meat Industry Training Advisory Council Ltd (MINTRAC) and aligned with relevant AUSVETPLAN principles, develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials, which will be incorporated into industry / MINTRAC EAD and QA training programs and submitted to the AUSVRETPLAN ASF writing group for consideration to be included in the AUSVRETPLAN ASF Manual. ○ MINTRAC are already involved in providing EAD training materials to regulatory authorities ○ More details are provided in the MINTRAC attachment, but this is not prescriptive and will be modified in consultation with APL and/or the steering committee (could include a training video) ○ Continue to meet/ communicate with APL ASF Technical committee, Steering Committee and Animal Health Committee as required to identify the priority groups and messages • On-farm truck wash planning ○ Provide building specifications related to choice of materials for floors, walls, and ceiling. ○ Guidelines will be created that describe requirements for space (height, weight), floor loading, ventilation, power, water, effluent	

Phase	Initial (proposed) activities	Actual (negotiated) activities
	handling, etc. Schematics will be produced that describe construction requirements in moderate detail, though complete 'building plans' are beyond the scope of the project. ○ Efforts will be made to create a design that is modular such that the facility can be scaled up without requiring a complete re-think of the plan. ○ Provide an estimate of the real costs (both fixed and variable) of effective truck disinfection	○ Training video: Pig transport washing and disinfection • Agreement to drop activities planned for microbiological assessment of cleaning effectiveness as were thought to provide low value-for-money with respect to industry needs at the time.

3. Introductory Technical Information

[A detailed review of relevant ASF literature was conducted and published in the Australian Veterinary Journal during this project (Appendix 1). The full-length paper is publicly available through Open Access and readers encouraged to consult it for further details (Neumann, E., Hall, W., Dahl, J., Hamilton, D., & Kurian, A. (2021). Is transportation a risk factor for African swine fever transmission in Australia: a review. Australian Veterinary Journal, 99(11), 459-468. https://doi.org/10.1111/avj.13106). An extract from that paper is included below.]

In 2019, there were an estimated 3,700 pig producers in Australia producing around 420,000 tonnes of pork per year of which around 10% was exported (Anonymous 2019a). However, Australian Pork Limited has estimated that only around 1,500 of these producers raise pigs at a scale from which the owner can claim income from the enterprise (Anonymous 2015). According to the Australian Bureau of Statistics,[1] there were around 2.4 million domestic pigs in the country during 2017, including 273,000 breeding sows. The industry raises approximately 5.3 million pigs for slaughter annually. While there are in excess of 70 abattoirs that are licensed to slaughter pigs in Australia, only seven are registered to process pigs for the export market. These seven abattoirs are responsible for around 90% of the total annual pork slaughter.

PigPass is the national tracking system designed to provide timely information on the movements of all pigs in Australia. The objective of the system is primarily to provide traceability and enable authorities to quickly determine the source of a disease outbreak and extent of potential spread by pig movement. A PigPass National Vendor Declaration form (or if permitted by the states at least a Waybill or Transported Stock Statement -TSS) must be completed (electronically or on paper) any time pigs leave a property regardless if ownership of the pigs' changes or not (Anonymous 2016). Although PigPass has not been systematically reviewed for accuracy or compliance, limited reporting against the available data in 2018 found that approximately 80% of movements recorded in PigPass were to abattoirs, as opposed to movements to other farms or saleyards (Neumann and Hall 2018). Farrow to finish farms were the dominant users of PigPass at the time, accounting for 54% of all recorded movements (47% of which were to abattoirs and 7% to other farms).

Australia's response to emergency animal disease incursions are outlined in AUSVETPLAN[2] and procedures for cleaning and disinfection of livestock vehicles are described in the Operational Procedures Manual for Decontamination (Anonymous 2008). The section of the document related to livestock vehicles is very detailed and lists requirements for interior and exterior areas of the truck, cab, and trailer that need to be inspected, cleaned, and disinfected including areas that need dismantling before these steps are undertaken. Importantly, these standards only apply to livestock transport undertaken as part of an emergency animal disease response and do not necessarily apply at other times.

The pork industry in Australia also provides guidance to livestock haulers and farmers that help to support compliance with the Australian Pork Industry Quality Assurance Program (APIQ)

[1] Australian Bureau of Agricultural and Resource Economics and Sciences (2018). Agricultural commodity statistics 2018, Table 14.2 Australian pig numbers, by state and territory, from https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/abares/data/acs2018-meat-pigs.xlsx, retrieved August 21, 2020.

[2] AUSVETPLAN Manuals and Documents. Available from https://www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents/, accessed July 29, 2020.

(Anonymous 2019b). The APIQ Transport Standards and Performance Indicators describes driver behaviour and the requirement for vehicle cleanliness and mandate that: Drivers and vehicles used to carry pigs follow the farm's Biosecurity Standards; facilities promote effective and safe handling of pigs when loading or unloading; that drivers do not enter designated clean areas; that vehicles are cleaned between consignments; that handling, assembly, and loading or unloading of pigs is conducted with care and in a manner that minimises stress to pigs; and that loading facilities and farm roads are designed and maintained to facilitate safe loading and delivery of pigs. While there is a requirement for vehicles to be cleaned between consignments, there is no guidance on how this should be carried out. All producers supplying pigs to export abattoirs are required to be APIQ certified, thus in theory all trucks will have been washed between consignments. Producers supplying 'non-export' abattoirs are not required to meet APIQ standards.

Information about the availability and quality of livestock truck washes in Australia is not readily available. However, two limited reviews have been recently conducted. First in 2016, consultants working for the Tasmanian government undertook a strategic review of truck wash facilities which relied primarily on interviews with haulers, government officials, farmers, and allied industries such as abattoirs (Murphy *et al.* 2016). Though the review was limited to Tasmania (which has relatively few commercial pig farms), the authors reported key findings which they believed were also likely to apply to other parts of the country: Stakeholders believed that clean trucks were an industry responsibility and that transporters themselves (not just their clients) have an overall obligation to assist in controlling the spread of disease through livestock transport; that management and containment of in-transport effluent was a consistent problem; that there was unmet demand for suitable, publicly-accessible livestock truck washdown infrastructure; and that improved truck washdown infrastructure would be likely to deliver additional benefits (aside from biosecurity) including improved workplace health and safety. The authors also noted the existence of the National Truck-wash System which was established in 1993 to provide users with visibility around the location of commercial truck wash facilities in Australia, including indicative user costs for accessing the truck washes. As of August 21, 2020, there were 125 truck washes listed on the website;[3] the completeness of the data on this system in unknown.

A second review of truck washing capacity was completed in 2019 focussing on facilities available at four major pork abattoirs and one saleyard, all in South Australia (Lloyd and Dunstan 2019). The authors noted several challenges found at most of the facilities that had the potential to compromise biosecurity namely: an absence of high-pressure washing equipment, uncoordinated foot and vehicle traffic patterns that contributed to cross-contamination between trucks; no equipment to clean the undercarriage of trucks or trailers; limited ability to disinfect trucks after washing, and limited attention given to drainage and effluent capture on the sites. The authors felt a combination of driver and abattoir staff training as well as increased capital investment in the truck washing facilities themselves were required to bring the truck washing capacity at these facilities to an acceptable level of biosecurity.

[3] AVDATA National Truckwash System. https://avdata.com.au/truckwashes/#Truckwashes-using-our-system

4. Research Methodology

As ASF was a rapidly developing issue, it was agreed with APL that the project scope, approach, and methodology would need to remain flexible and adapt to emerging issues. Adaptions were to be guided by regular communication with the APL ASF Technical Committee, a panel of technical experts recruited and managed by APL.

Five objectives were initially identified for this project. However, in the course of negotiating a plan of work for Phases 2 and 3 of the project, the five objectives were modified to better match identified industry needs at the time.

OBJECTIVE 1: Conduct a national and international literature search for reports on best practice truck washing/disinfection

OBJECTIVE 2: Visit and review the truck washing facilities and procedures at export pig processing facilities

OBJECTIVE 3: Engage with all relevant Australian pig industry stakeholders

OBJECTIVE 4: Develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials

OBJECTIVE 5: Investigate biosecurity issues related to water recycling/re-use for truck washing

A description of the methods used to achieve each objective are described below.

4.1. OBJECTIVE 1: Conduct a national and international literature search for reports on best practice truck washing/disinfection

A review of published literature in PubMed and Web of Science on transportation-related risk factors for spread of ASF virus was conducted using the following Boolean strategy:

((ASF OR 'african swine fever') AND (epidem* OR risk OR 'risk factor' OR biosecur* OR transpor* OR truc* OR disinfectant* OR decontam* OR clean* OR wash* OR manure* OR faeces OR feces OR effluent))

Ad hoc searches were also conducted to find additional relevant material when discovered through study of the sources identified in the peer-reviewed literature. The review aimed to identify key features of this risk that should be considered in the context of Australian pork production systems and transportation methods. The kinetics of virus shedding in faeces and other pig fluids, survival of the virus in the environment, and the efficacy of various cleaning and disinfection protocols in inactivating the virus were therefore included in the review.

4.2. OBJECTIVE 2: Visit and review the truck washing facilities and procedures at export pig processing facilities

4.2.1. Survey of abattoir-based truck washing capabilities and practises

A combination of site visits and a telephone survey was used to collect information about truck washing facilities and issues relevant to transport biosecurity from seven export pig abattoirs. After initial phone contact with each of the seven processors to discuss their general attitude to, and concerns with truck washing, a detailed questionnaire was sent to each on this topic. After the questionnaires were returned, follow up phone calls were utilised for necessary clarification of their responses.

4.2.2. Survey of waste water management practises at abattoir-based truck washes

The ASF project team identified the common Australian processor practice (all species) of disposing of abattoir effluent via irrigation onto uncontrolled farmland as a significant potential risk of ASF (and other EADs) spread. The literature review raised questions as to the how effectively processing waste water through a standard abattoir pondage system, without a final kill/disinfection step prior to irrigation, mitigated that risk. If the same pondage system also received the truck wash waste water, that risk may be further increased.

A second survey of the same seven export abattoirs was therefore conducted to explore this topic.

4.3. OBJECTIVE 3: Engage with all relevant Australian pig industry stakeholders

ASF is a high priority for the Australian pork industry, and it is critical that industry continues to progress work on key gaps, opportunities, and outputs related to ASF preparedness.

The potential risks to pigs from diseases brought into a piggery by people, vehicles, and/or animal movements can be minimized by good on-farm biosecurity practices. Understanding the capability and capacity of truck washing facilities being used at abattoirs, by livestock haulers, and on-farm will help to determine what kind of investment, if any, should be made in infrastructure, training, or compliance activities to minimize the biosecurity risk associated with livestock hauling.

COVID restrictions on travel during 2021-2022 meant that the ability to review farm and abattoir truck biosecurity procedures directly were curtailed, although a number of farms and abattoirs were visited when possible. This hurdle to face-to-face engagement was able to be partly countered by use of on-line surveys, in some cases followed-up with phone contact to encourage response rate.

Three structured surveys of various industry stakeholders were completed to generate objective, descriptive, and quantitative data describing biosecurity behaviour of stakeholders, as well as information about truck wash capability, capacity, and use.

Copies of the complete survey instruments referenced below are available upon request from APL.

4.3.1. Survey of commercial pig transporters

This survey of Australian commercial pig transporters was conducted to identify risks related to pig transportation to Australian abattoirs. The survey was intended to describe the existing biosecurity measures being taken by commercial livestock haulers today and to identify opportunities for developing best practices to help manage transport biosecurity risks in the future.

The data collected was derived from an online survey of commercial livestock haulers who were identified by MINTRAC and pig abattoirs. The survey data were collected during May and June 2021 and the survey was administered using a commercial survey software service (QualtricsXM; Qualtrics, Provo, UT). Survey data was downloaded from the Qualtrics server as a CSV file for local analysis using R version 4.1.0 (The R Foundation for Statistical Computing).

4.3.2. Survey of pork producers that are registered in PigPass

The data was collected through an online survey sent to a sample of producers randomly selected from the APL APIQ Quality Assurance database which includes an estimated 89.6% of pig producers with 8 sows or more.[4] Permission to use information held in the PigPass database was requested through written application to APL (APL form "PigPass Data Application Request").

Biosecurity measures related to pig movements including load-out procedures at farms, truck washing capabilities in the industry, and pig unloading procedures at abattoirs were investigated through the survey.

The timetable for survey data collection was as follows:

- Initial distribution: May 18, 2021
- First reminder: May 25, 2021
- Second reminder: June 1, 2021
- Third reminder: June 8, 2021
- First direct phone contact to random sample of 33 non-respondents: Week of August 9, 2021
- Second direct phone contact to random sample of 33 non-respondents: Week of August 16, 2021
- Third direct phone contact to random sample of 8 miscellaneous farms: September and October 2021

A list of 140 producer emails (and phone numbers when required) was provided by APL, stratified by breeding sow numbers; permission was sought by the investigators to send the survey to all PigPass registered producers, but this was not granted due to privacy declaration issues of PigPass contacts.

The survey was administered using a commercial survey software service (QualtricsXM; Qualtrics, Provo, UT). Survey data was downloaded from the Qualtrics server as a CSV file for local analysis using R version 4.1.0 (The R Foundation for Statistical Computing).

4.3.3. Survey of small (non-export) abattoirs

A non-random sample of small livestock processors in QLD and NSW was surveyed as to their use of truck washes and other biosecurity-related behaviours related to pig transport during November 2020. While this sector of the processing industry interacts only minimally with larger commercial pork producers, the potential for cross-contamination events at abattoirs, truck washes, or through common use of commercial livestock haulers remains a concern.

Outside of this project, MINTRAC conducted a series of meetings with these small processors. As part of the current project, this opportunity was taken to administer a short, voluntary survey participants using a mobile-phone version of a survey managed through the QualtricsXM system (the survey was conducted face-to-face by a MINTRAC staff, with responses entered directly into the mobile online survey interface).

4.4. OBJECTIVE 4: Develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials

[4] Personal communication (2022). Ludvigsen B, Quality Assurance Lead, Australian Pork Limited, ACT.

A key outcome of this project was to develop practical guidance documents to assist producers in managing pig transport biosecurity, especially for the movement of pigs from farm to market, and to contribute material to writing groups and committee groups charged with revisions to AUSVETPLAN manuals and operational plans. Using information gained from completion of Objectives 1-3, three Standard Operating Procedures (SOPs), one guidance manual, two training manuals, and one training video were produced (details in 5.4).

4.5. OBJECTIVE 5: Investigate biosecurity issues related to water recycling/re-use for truck washing

Research has shown that the infective dose of ASF in water is lower than the infective dose in feed (Niederwerder *et al.* 2019). Although it cannot be proven, it is suspected that the first case of ASF in a commercial herd in Romania was caused by virus being introduced into the herd via that farm's use of river water as its water source. It was discovered during investigation of the outbreak that upstream, pigs that had died from ASF had been disposed of by throwing the carcasses into the same river that was supplying water to the commercial farm. Given widespread encouragement by government to reuse/re-cycle water across Australia, it is important to understand how these practices might contribute to spread of ASF if an incursion of the virus were to occur.

In Australia, the need to recycle limited resources has gained wide acceptance over the last few decades. Water is no exception to this trend, with human sewerage/effluent being utilised for consumption and irrigation after appropriate processing steps in many jurisdictions. Processors currently re-use large volumes of effluent water for irrigation, as a means of disposal. If they install adequate truck washes, they will add to that volume of water needing to be disposed of, even with a degree of recycling within the truck wash itself. Eventually the truck wash waste water is likely to be processed and disposed of with the other abattoir effluent.

There are obvious parallels between the risk associated with irrigation with human effluent in areas where there may be inadvertent contact with people (e.g., ovals or golf courses), and irrigation with abattoir effluent of areas (farmland) where there may be inadvertent contact with susceptible animals (e.g., pigs).

In view of the large volumes of water required for adequate truck washing and abattoir operation, processors need to implement best practices around bio-secure re-use/recycling of this water and consider the implications of land application of water that may contain high-consequence pathogens with which susceptible animals may come into contact.

Discussions were held between the project team and Alex Donald, Manager Environmental Performance and Compliance and Gretchen Marshall, Recycled Water Specialist, from SA Water. A visit was also arranged to the Sewerage Treatment Works at Hahndorf, SA. In addition, relevant scientific literature and Australian regulatory guidance documents were reviewed to identify key risk factors related to the bio-secure re-use/recycling of abattoir waste water stream and land application of the waste water streams.

5. Results and Discussion

5.1. OBJECTIVE 1

Conduct a national and international literature search for reports on best practice truck washing/disinfection investigations

The search results (n = 1,370) were combined, duplicates removed, and the abstract of each paper was reviewed for relevance. One-hundred and fifteen papers were identified and then reviewed in full. An additional 14 publications were subsequently identified as part of ad hoc searches during review of the initial 115 papers resulting in a total of 129 papers being reviewed in full.

There are many recent and comprehensive reviews of the epidemiology of ASF and the agent itself and only aspects of ASF epidemiology related to transportation of live pigs were summarized for this project. For readers that require information about other aspects of ASF or the virus, several recommended open-source, recent reviews of ASF are listed below:

> *Dixon, L. K., Stahl, K., Jori, F., Vial, L., & Pfeiffer, D. U. (2020). African Swine Fever Epidemiology and Control. Annu Rev Anim Biosci, 8, 221-246. doi:10.1146/annurev-animal-021419-083741*
> ***Link**: https://www.annualreviews.org/doi/pdf/10.1146/annurev-animal-021419-083741*
>
> *Schulz, K., Conraths, F. J., Blome, S., Staubach, C., & Sauter-Louis, C. (2019). African Swine Fever: Fast and Furious or Slow and Steady? Viruses, 11(9). doi:10.3390/v11090866*
> ***Link**: https://www.mdpi.com/1999-4915/11/9/866/pdf*
>
> *Mazur-Panasiuk, N., Żmudzki, J., & Woźniakowski, G. (2019). African Swine Fever Virus - Persistence in Different Environmental Conditions and the Possibility of its Indirect Transmission. J Vet Res, 63(3), 303-310. doi:10.2478/jvetres-2019-0058*
> ***Link**: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6749736/pdf/jvetres-63-303.pdf*

The report of this review of the literature was submitted to APL as a stand-alone report under APL 2020/0005 "*Review of research on epidemiological aspects of transportation-related biosecurity for African swine fever: Risk factors for environmental persistence of the virus*" on September 1, 2020, and a revised version of the report was subsequently submitted for peer-review and publication in the Australian Veterinary Journal (*Appendix* 1). The full-length paper is publicly available through Open Access and readers are encouraged to consult it for further details:

> Neumann, E., Hall, W., Dahl, J., Hamilton, D., & Kurian, A. (2021). Is transportation a risk factor for African swine fever transmission in Australia: a review. Australian Veterinary Journal, 99(11), 459-468. https://doi.org/10.1111/avj.13106).

Key points from the review included:

- ASF is a viral disease of the pigs that was first described in Africa during the early part of the twentieth century. The disease has periodically occurred outside of Africa, including an ongoing epidemic in Europe and Asia that started in 2007; the disease has never occurred in Australia or New Zealand.
- Once introduced into a country, spread can occur through direct and indirect routes of transmission. Infected feral pig populations have the potential to act as a long-term reservoir for the virus, making eradication difficult.

- Just before and throughout the period of clinical signs, ASF virus is shed in oronasal fluids, urine, faeces, and blood. This results in contamination of the pig's environment, including flooring, equipment, and vehicles. Transportation-related risk factors therefore are likely to play an important role in ASF spread, though evidence thus far has been largely anecdotal.
- No peer reviewed reports relative to truck washing or cleaning and disinfection, for either full-sized or scale-model trucks contaminated with ASF virus were found.
- Transportation of infected pigs (and return of potentially contaminated trucks from infected regions/farms to uninfected regions/farms) is a recognized risk factor for spread of ASF virus. However, much of the concern is based on this being a plausible risk rather than being supported by any substantial amount of experimental data or case report findings.
- Only a tiny fraction of ASF cases reported to OIE include information about the suspected or confirmed route of exposure; most are simply listed as 'unknown'. There is case report data in the scientific and grey literature that implicates contaminated transport vehicles being the route of virus introduction into farms; these reports have most often come from China and other countries in SE Asia. Trader-networks that rely on commingling pigs for collection and delivery to slaughter have been a significant concern related to the frequency and rate of spread of ASF in China.
- While differences exist amongst regions, feral pigs are believed to act as a persistent, long-term reservoir of ASF virus for infected regions of Europe and Asia. They are likely responsible for a small number of new outbreaks in domestic pigs (usually small holder but also in some high biosecurity herds in wild boar areas) through direct or indirect (contaminated environment, faeces, forages, or carcasses) contact.
- Most new infections in small domestic holdings are related to feeding of ASF virus contaminated swill; unfortunately, this evidence is more often simply based on 'the farm fed untreated swill' rather than evidence that in fact, the swill was contaminated with ASF virus.
    - However, infected high biosecurity herds in the Baltic States and Poland in wild boar areas did not feed swill.
    - Infection always occurs in the summertime, so insect vectors now considered possible in these countries.
- The source of infection in commercial-sized domestic pig holdings to our knowledge has almost always been 'unknown'.
- ASF virus is shed in all body fluids and faeces, though at varying concentrations based on number of days post-infection.
- The ASF virus involved in the Eurasian outbreak is highly virulent and can be considered virtually 100% fatal, with death occurring five to 30 days post-infection. Virus can be assumed to be shed continuously after infection, albeit at decreasing concentrations, for the life of the pig. However, as noted earlier in this report, less virulent strains have recently emerged in Asia, likely due to use of unauthorized live ASF vaccines.
- The literature presents some conflicting evidence on the likelihood pigs will become infected after coming into contact with an ASF virus contaminated environment (e.g. a pig pen or truck compartment). However, as first principles:
    - ASF virus is shed in faeces, urine, saliva, and blood, and
    - ASF virus is infectious through oral exposure
    - Therefore, one should assume contaminated environments may remain contaminated for an extended period (weeks to months) in the absence of cleaning and disinfecting.
- Many reports exist that suggest a wide range of disinfectants are active against ASF virus.

    - ASF virus resists inactivation by disinfectants or desiccation when in the presence of proteinaceous fluids such as blood or meat juice, or in faeces. Some disinfectants are formulated to include surfactants which can improve their performance.
    - Detergents are not a substitute for disinfectants. They should not be used alone, without the follow-up application of an approved disinfectant as part of the truck cleaning process.
    - Citric acid is not usually the best choice for ASF virus but can be effective when used at high concentration (>= 3%) and when given at least 30 minutes of contact time. Acids at this concentration are particularly corrosive to aluminium and therefore may present a problem for trailer disinfection.
    - Alkalis are generally more effective than acids (concentration varies depending on which chemical is used). Many alkalis, when used at effective concentrations, are corrosive to materials and can present a particular hazard to human health.
    - Aldehydes (including formalin and formaldehyde gas) are effective against ASF virus, however there are potential OHS implications.
    - Alone, drying is unlikely to provide sufficient inactivation of ASF virus under the time constraints related to truck and trailer cleaning.
    - Virkon S (1% for 30 minutes, 2% for 10 minutes) is very effective at inactivating ASF virus. The APVMA has published a list of approved chemicals and usage rates for ASF, including Virkon which is recommended to be used at a 2-3% concentration.[5] Other effective disinfectants have also been approved.[6]
    - Other commercial products, often formulated as a combination of chemicals, are available and some of these have label claims against ASF virus.
- Wood and unsealed concrete are challenging to clean and to disinfect.
- There is no evidence in the literature that supports a 'minimum downtime' is required after depopulation, cleaning and disinfection (in a farm or for a truck). Essentially, an environment can be considered either 'disinfected, or not'. Downtime serves only to provide some extra security around not being able to reliably ascertain if a surface is in fact disinfected. The EU requires a minimum of 40 days downtime (plus sentinels for 45 days OR on-going monitoring in the new population for 45 days) as part of their OIE recognised ASF control strategy. If there is evidence that tick vectors were involved in the original outbreak, repopulation is prohibited for six years.
- There have been two reviews of truck washes in AU (South Australia – 2019, Tasmania – 2016). There were relatively few commercial pig farms involved in the studies.
    - Stakeholders believed that clean trucks were an industry responsibility and that transporters themselves (not just their clients) have an overall obligation to assist in controlling the spread of disease through livestock transport;
    - Management and containment of in-transport effluent was a consistent problem;

[5] PERMIT TO ALLOW MINOR USE OF REGISTERED AND UNREGISTERED AGVET CHEMICAL PRODUCTS FOR USE AS DISINFECTANTS FOR TREATMENT OF EQUIPMENT, FABRIC AND SURFACES IN CASE OF AN OUTBREAK OF AFRICAN SWINE FEVER OR CLASSICAL SWINE FEVER (PERMIT NUMBER – PER88135). Available at https://permits.apvma.gov.au/PER88135.PDF (accessed August 20, 2022).

[6] PERMIT TO ALLOW MINOR USE OF A REGISTERED AGVET CHEMICAL PRODUCT FOR DISINFECTING HARD SURFACES, EQUIPMENT AND AIR SPACES IN CASE OF AN OUTBREAK OF VIRAL DISEASES (PERMIT NUMBER – PER90975). Available at https://permits.apvma.gov.au/PER90975.PDF (accessed August 20, 2022)

    - There was unmet demand for suitable, publicly-accessible livestock truck washdown infrastructure; - existing washes were financial losers (either not/couldn't charge enough to cover costs)
    - Improved truck washdown infrastructure would be likely to deliver additional benefits (aside from biosecurity) including improved workplace health and safety.
    - The authors also noted the existence of the National Truckwash System which was established in 1993 to provide users with visibility around the location of commercial truck wash facilities in Australia, including indicative user costs for accessing the truck washes. As of August 21, 2020, there were 125 truck washes listed on the website; the completeness of the data on this system in unknown.
- There does not appear to be objective data that describes the frequency or quality of cleaning and disinfection procedures of pig transport vehicles on-farm or at abattoirs in Australia.

5.2. OBJECTIVE 2

Visit and review the truck washing facilities and procedures at export pig processing facilities

5.2.1. Survey of abattoir-based truck washing capabilities and practises

Overall, the export pig processors do not currently have adequate truck washing facilities or procedures in place to effectively control the risk of spreading ASF (and EADs in general) back to farms. The truck washing itself, and decisions about the adequacy of the wash is generally left completely in the hands of drivers. A summary of the truck wash capability survey data is shown in Table 3.

During the latter stages of completing activities for this project, the project team was made aware of a government-private-industry initiative in SA to improve truck wash capacity at export abattoirs in that state. Changes made (or planned to be made) at the affected abattoirs in SA are not reflected in the data collected in Objective 2 as the surveys were undertaken to benchmark the current situation rather than assessing future potential changes.

Key points from the survey included:

- No export processors currently have facilities that would even meet the design criteria that have been proposed for on-farm truck washes in this report (see page 29 of Appendix 7).
- No processors currently have livestock truck cleanliness policies or procedural manuals.
- The decision whether to wash a truck or not and to what standard, is left to the discretion of the driver.
- Only 50% have high pressure wash capability.
- No processors currently provide truck disinfecting capability.

Table 3.Summary of major points from abattoir transport biosecurity survey of the seven export pig abattoirs.

Question	Plant 1	Plant 2	Plant 3	Plant 4	Plant 5	Plant 6	Plant 7
Truck cleanliness policy?	N	N	N	N	N	N	N
Truck wash procedural manual?	N	N	N	N	N	N	N
Have truck wash?	Y	Y	Y	N	Y	Y	Y
High Pressure?	Y	Y	Y	n/a	N	N	N
Low pressure?	N	N	N	n/a	Y	Y	Y
Disinfectant?	N	N	N	n/a	N	N	N
Hot water?	N	N	N	n/a	N	N	N
Roof?	Y	N	N	n/a	N	N	N
Divider walls?	Y	partial	Y	n/a	N	N	N
Doors?	N	N	N	n/a	N	N	N
Impervious floor?	Y	Y	Y	n/a	Y	Y	Y
Only driver washes?	Y	Y	Y	n/a	Y	Y	Y
Post wash inspection?	N	N	N	n/a	N	N	N
Fee charged for wash use?	Y	N	N	n/a	N	Y	N
Fee based on?	/minute or /litre	n/a	n/a	n/a	n/a	/minute or /litre	n/a
Waste water disposal?	farmland	farmland	farmland	n/a	farmland	farmland	farmland
Do you disinfect recycled wash water?	Y	n/a	Possible but not used	n/a	n/a	n/a	n/a
Plans to upgrade?		Adding solids separator	N	Maybe	Y	Y	N
N = no; Y = yes; n/a = not applicable.							

5.2.2. Survey of waste water management practises at abattoir-based truck washes

A survey of the seven export pig abattoirs was conducted to collect data on current abattoir effluent processing practices, which depending on the processor may include waste from both the abattoir and an on-site truck wash. The survival of ASF virus in water is greatly influenced by temperature, pH, the presence of organic material, the presence of solid pieces pig tissue e.g. spleen, and pondage holding/processing time. Summarized results of the survey can be found in Table 4.

Key points from the survey included:

- Most processors irrigated effluent onto farmland, that whilst it may be fenced, would be ineffective at excluding feral pigs.
- Most had nearby water courses.
- Some reported feral pigs in the vicinity.
- Processor pond holding capacity varied from only two day's production to six months. These holding times had the potential to be significantly impacted by storm water ingress (most do not separate storm water from effluent input). NB: Human sewerage treatment aims at a minimum 50-day lagoon retention prior to recycling (irrigating).
- Processor effluent screenings (pre-pondage) are often sent off site for disposal with no follow-up monitoring.
- No processors included an effluent disinfection step prior to irrigating.

Table 4. Summary of major points from effluent survey of export pig abattoirs.

Question	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G
Internal or external expertise	internal	internal	internal	internal	internal	internal	Internal maintenance, external monitoring
Effluent monitoring	EPA licence- as per irrigation water	Yes	Quarterly-COD,N,TDS,EC,pH,P -No regulatory stds.	BOD,SS,NH3,N		Coliforms, metals, Ca,Mg,N,NH3,Cl, NO3,BOD,COD,TDS,P, pH, grease, nutrients, organics to anaerobic ponds	pH,N,P, BOD, temp
Preliminary screening	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grid size	Unknown	5mm	20 x 1.5mm	0.75mm	Unknown	2mm	Unknown
Screening disposal	Mixed with coal ash then off-site	Off-site composting	Off-site rendering	Off-site compost/landfill	Sent to garden compost producer	Off-site rendering	Off-site worm farm
Physiochemical treatment	No	No	No	Yes	Yes	No	No
Biological treatment	Anaerobic pond	Anaerobic pond	Anaerobic pond	No ponds	Anaerobic pond	Anaerobic pond	Anaerobic pond
	Aerobic pond	No aerobic pond	Tertiary storage ponds	No ponds	No aerobic pond		Aerobic pond + holding
Wetlands	No	No	No	No	No		Reeds in some ponds
Treatment areas fenced	Yes	No	Yes	Yes	Yes	Yes	Yes
Advanced oxidation process	No	No	No	No	No	No	No

Question	Plant A	Plant B	Plant C	Plant D	Plant E	Plant F	Plant G
Effluent disinfection step	No	No	No	No	No	No	No
Effluent irrigation	Yes	Yes	Yes	No	Yes	Yes	Yes
Daily volume	Ave 1300kL (0 - 4,000kL)	Unknown	?? mixed with farm effluent	n/a	900kL	800kL	1000kL
Area irrigated	125+ Ha	Unknown	300 Ha	n/a	50 Ha	3.6 Ha	72 Ha
Is area fenced	No	Not pig proof	Not pig proof	n/a	Not pig proof	Not pig proof	No-golf course
Nearest water course	Wet drainage from paddock	50M	11 Km	n/a	2 Km	1Km	Edge of golf course
Municipal disposal	No	No	No	Yes	No	No	No
Number days effluent holding capacity	2-3 days	7 days (dry season)	6 months	1 day	Unknown	10-20 days (weather dependent)	5 days
Truck wash effluent included	Yes	Yes	Yes	n/a		Yes	Yes
Storm water kept separate	Yes	No	No	n/a	No	Yes, then combined	No
Annual rainfall	779mm	2000mm	700mm	n/a		201mm	1089mm

5.3. OBJECTIVE 3

Engage with all relevant Australian pig industry stakeholders

5.3.1. Survey of commercial pig transporters

The data were checked for errors and duplicates. Only the data for respondents who finished the survey were included in this analysis.

Data was collected from a total of 41 commercial livestock transporters. Of these, 28 transporters (68%) completed the survey but two of these indicated they had not transported pigs in the last year. Data from these two respondents were removed from the dataset leaving 26 respondents that provided data about pig transportation by commercial livestock haulers that were included in the final analysis.

The survey was structured in a way that biosecurity questions related to truck washing could deal separately with commercial haulers that use only their own truck wash, those that used only third-party truck washes (at abattoirs, piggeries, or at a commercial truck wash facility), or those that used a combination of different truck wash facilities.

A copy of the full report of survey data is included as *Appendix* 2 with key findings extracted below.

Key points from survey of commercial pig transporters.

- 69% transported less than 5 loads of pigs per week, though approximately 15% transported more than 20 loads per week.
- The majority of loads (65%) had more than 200 pigs on board.
- Amongst respondents, use of cleaned trailers (prior to loading) was common with 94.7% of loads making use of a cleaned trailer
- 23% of farmers left decisions about truck and trailer hygiene up to the transporter, while 77% made some type of special biosecurity request of the hauler (see Figure 1 below). Most commonly, these requests were related to driver hygiene (boot and coverall management) and a strict requirement for washing the trailer and at least the outside of the cab.
- Chemical disinfection was available for use at approximately 55% and 40% of transporter-OWNED truck washes and COMMERCIAL truck washes, respectively. However, disinfection was almost never available at ABATTOIR or SALEYARD-based truck washes described by the survey respondents.

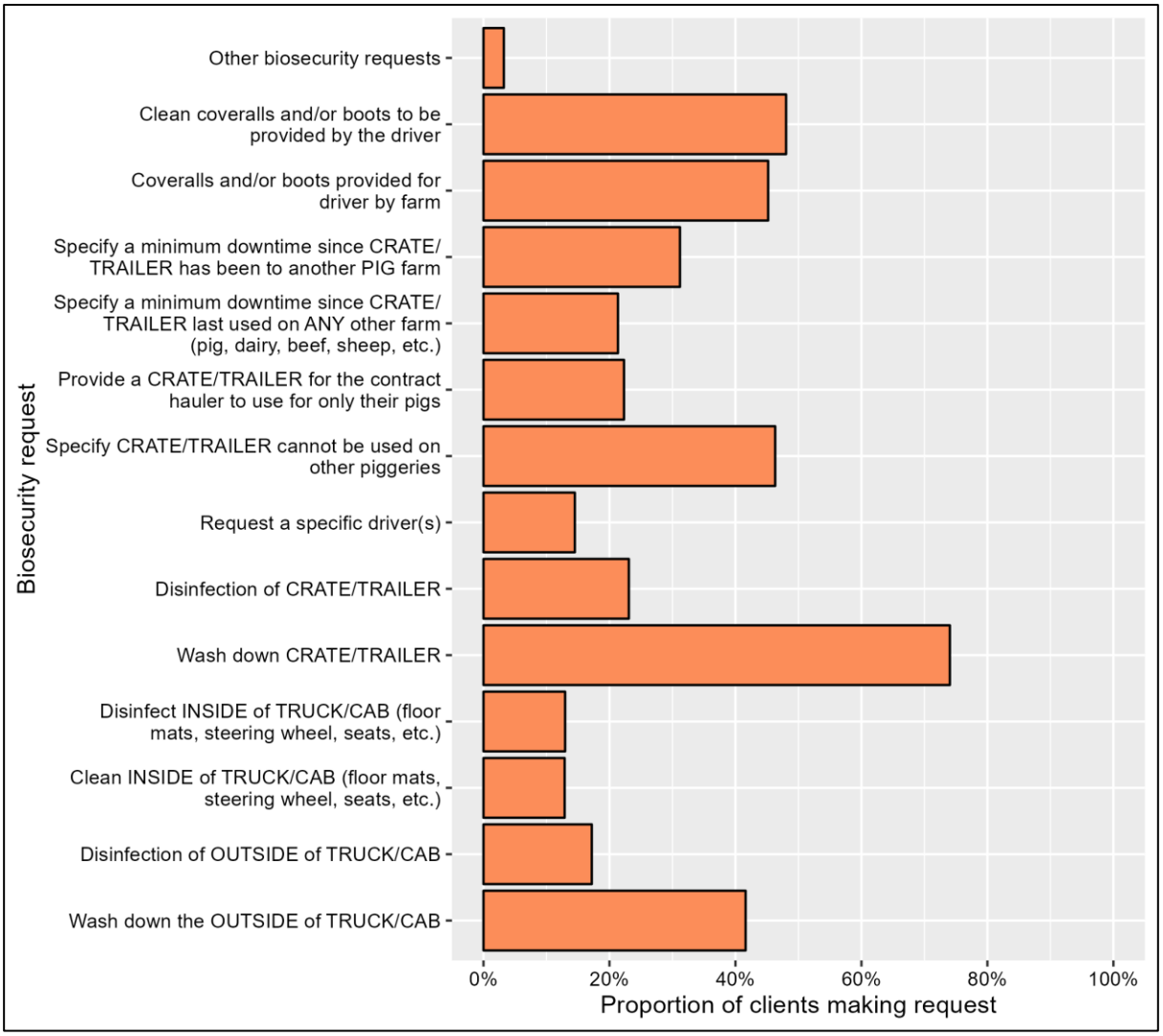

Figure 1. Specific biosecurity requests made by farmers to haulers prior to picking up pigs from a farm for delivery to an abattoir (see Figure 3 in Appendix 2).

- 54% of the commercial transporters had their own truck wash but 92% also used a third-party wash (abattoir, saleyard, commercial, piggery) suggesting most haulers probably use more than one truck wash facility.
- At transporter-OWNED truck washes, "Low-pressure/High-volume washer (fire hose type)" and "High-pressure washer" were the most common cleaning methods available with 86% and 71% of respondents respectively, indicating these cleaning methods were present. "Concrete or other solid flooring" was present at 50% of transporter-OWNED truck washes but other building-related attributes that could help to ensure good biosecurity such as a "Covered roof", "Divider walls", or a "Closable door for entry and exit of truck" were rarely in place.
- Disinfection processes were sometimes present (57%) amongst respondents with transporter-OWNED truck washes. However, when this capability was present, it was only utilized 38% of the time (detailed view in Figure 2 below).

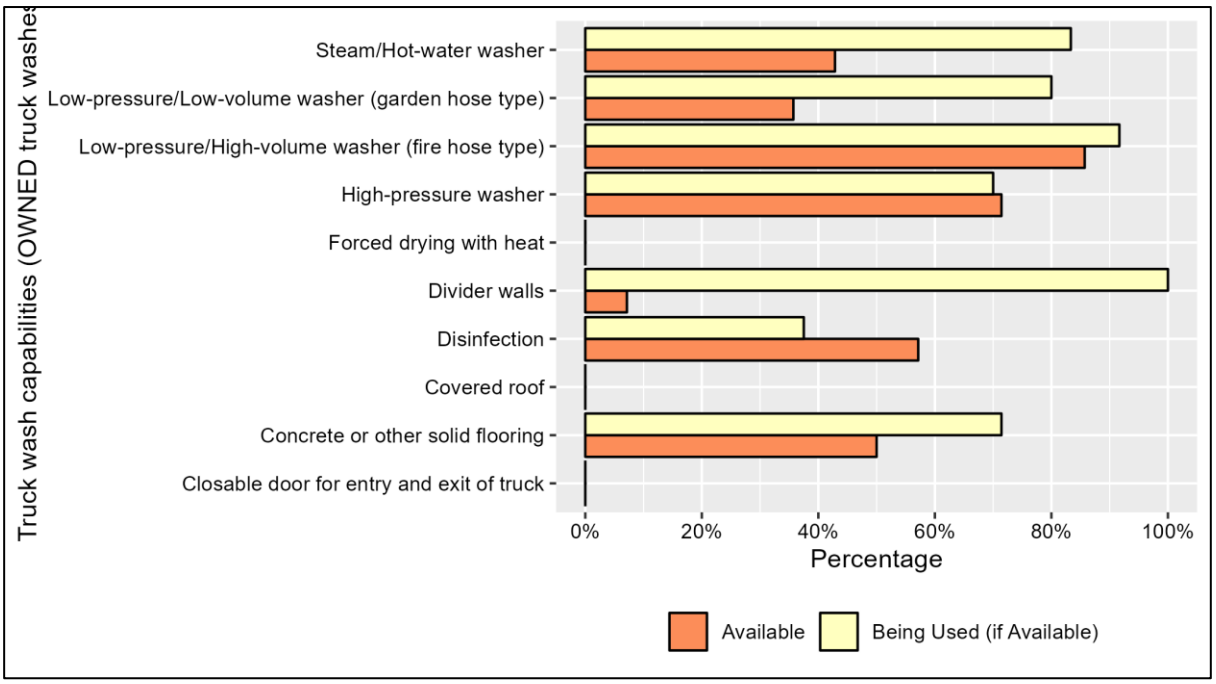

Figure 2. Availability of various cleaning, disinfection, and biosecurity management capabilities at transporter-OWNED truck wash facilities (see Figure 4 in Appendix 2).

- Of the 14 respondents who had their OWN truck washing facility, the majority (71%) indicated that the truck driver, rather than specialized staff, was responsible for washing the trailer and/or truck in that facility (Table 1). Approximately 64% responded that there was "No inspection" done after washing at the facility though one did indicate that not only was inspection completed but that a record of the inspection was kept on file.
- Around 79% of respondents indicated that it takes "At least one hour, but less than two hours" to wash the crate and trailer.
- At transporter OWNED wash facilities, respondents estimated the total cost (fixed and variable cost) involved in washing crates/trailers at their truck washing facility averaged $127 AUD but ranged from a low of $10 AUD to a high of $400 AUD. When asked about how this cost was recovered from the client, 14 of 14 respondents answered that the "Cost is built-in to the transportation charge" as compared to "Pass cost along to the client"
- 29% of transporter owned truck washers did not contain the wash water effluent, while those that did contain it generally did not treat it before final disposal.
- Only 8 of 26 haulers (31%) indicated they had developed an EAD manual. Of the ones that did have an EAD manual, 75% indicated they had updated it within the last year.
- Only 1 transporter (4%) routinely used bedding (in this case, straw for weaners or young growers).
- In this survey, approximately 9% of the trailers used to transport pigs had wooden floors.

5.3.2. Survey of pork producers that are registered in PigPass

A unique link to the survey was sent by email to a total of 130 producers. Of these, 57 producers (44%) clicked on the survey link and at minimum, viewed the introductory web page of the survey. A total of 41 farms completed the survey (32% of total sent, or 72% of those that clicked on the link) on their own or through a follow-up telephone call made by the research team.

The producers that were contacted for participation in the survey were randomly selected by APL from their current list of Australian producers. This sampling was required as APL was unwilling to allow surveys to be sent to the entire list of producers. At the request of the research team, the random selection done by APL was purposefully stratified by farm size; farm size definitions were provided by APL. The overall response rate to the survey was 32%. For questions that related to movement of pigs off farm, respondents were asked to consider only those activities occurring in the previous 12-month period. The survey was structured to deal separately with producers that only used their own trucks to transport pigs, those that only used contractors to transport their pigs, and those that used a combination of these two methods for pig transport. Separate questions were asked about producers' use of on-farm truck washes versus third-party owned truck washes.

A copy of the full report of survey data is included as *Appendix* 3 with key findings extracted below.

Key points from the survey of pork producers

- Sow numbers of the farms that were to be selected for participation in the survey were categorized into the following groups: 1-100; 101-500; 501-1000; or 1001-5000 sows.
- The overall producer survey response rate was 32% (n=35), with the highest in the 501-1000 (44%) and 1001-5000 (36%) categories.
- Only 4.9% (n=2) of farmers reported that a truck already had pigs on board at the time the truck arrived at their farm, in the last 12 months.
- 55% of producers used only their own trucks to move pigs while 46% used contractors. Of those using their own trucks for pig transport, 55% had their own truck wash.
- 79% of those using transport contractors had specific biosecurity requests while 21% just trusted the contractor's judgement as to which biosecurity/hygiene processes were necessary. The types of special biosecurity requests (by the 79% of farmers that did request them) and level of compliance with those requests is shown in Figure 3 below.

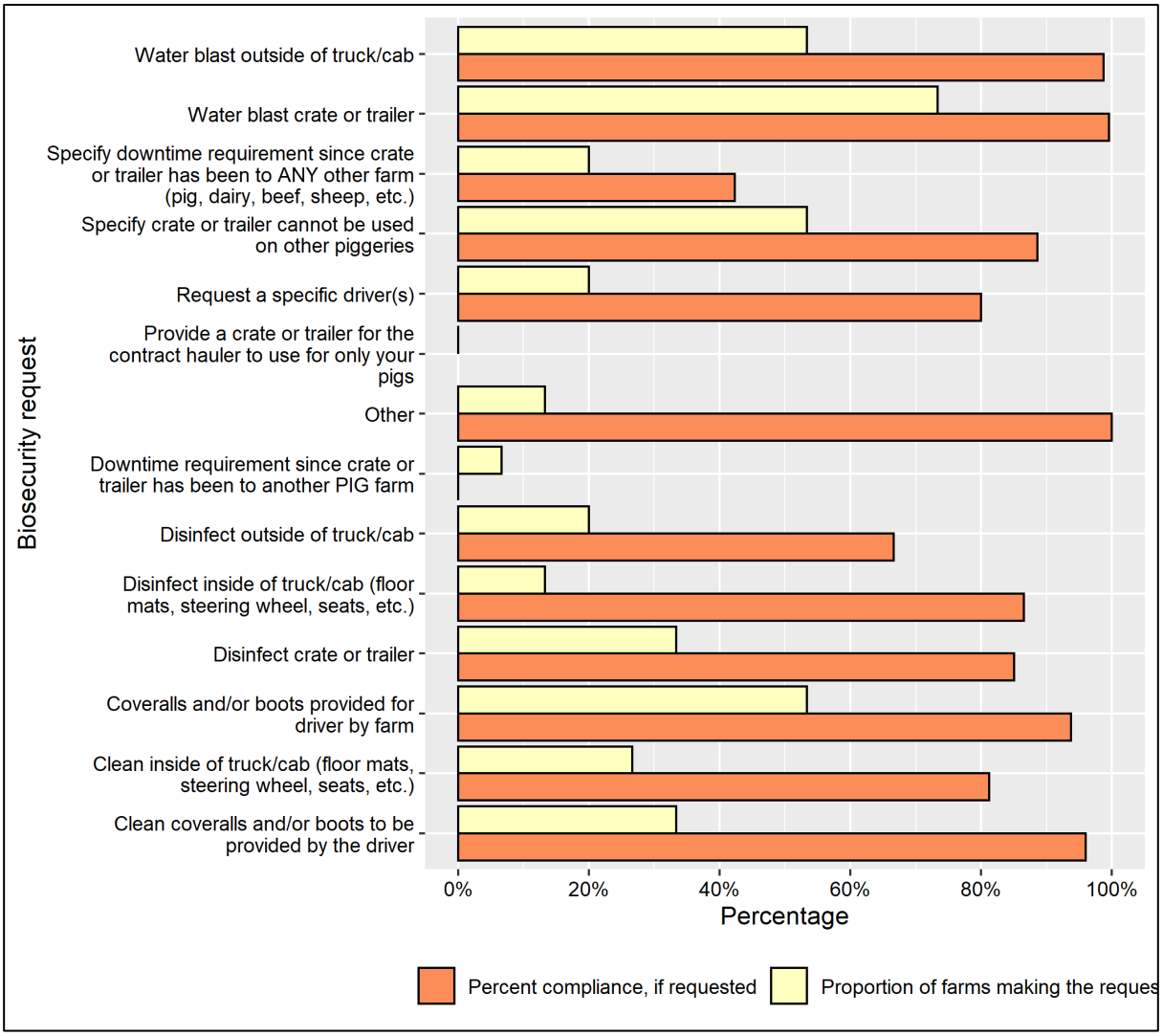

Figure 3. Types and number of requests on biosecurity made to contract haulers by farmers (see Figure 11 in Appendix 3).

- Overwhelmingly, the most common activity on respondent farms was "raising pigs for commercial slaughter". There were no boar studs in the survey and no genetic supplier herds.
- 30% of fatteners were loaded out using some form of on-farm lairage facility while 60% were loaded out direct from shed. These numbers were similar regardless of whether the producer used his own truck or a contract hauler.
- There was a large disparity around respect for the on-farm "Line of Separation" (LOS) during load-outs.
    - For those producers using their own truck, 75% of respondents said the driver could walk anywhere (trailer, load chute, or building) and they felt that virtually 100% of the time, cross-contamination was occurring. While perhaps this is not a major risk when using one's own truck, this "bad habit" would likely put the producer at high biosecurity risk if they happened to change methods and start using contractors (or if they do a poor job washing their own trucks).
    - For producers relying on contract haulers, 75% of producers limited the driver's movement to either the truck, or the truck and the chute (i.e. driver should not enter the shed) but estimated that 50% of time cross-contamination occurred.

- 100% of owners washed their trucks "always" or "most of the time".
- In general, on-farm truck washes were poorly equipped with only 75% having high-volume low-pressure hoses (i.e. fire hoses), only 30% had high-pressure water blasters, and only 60% were set up to routinely use disinfectant (see Figure 4 below).

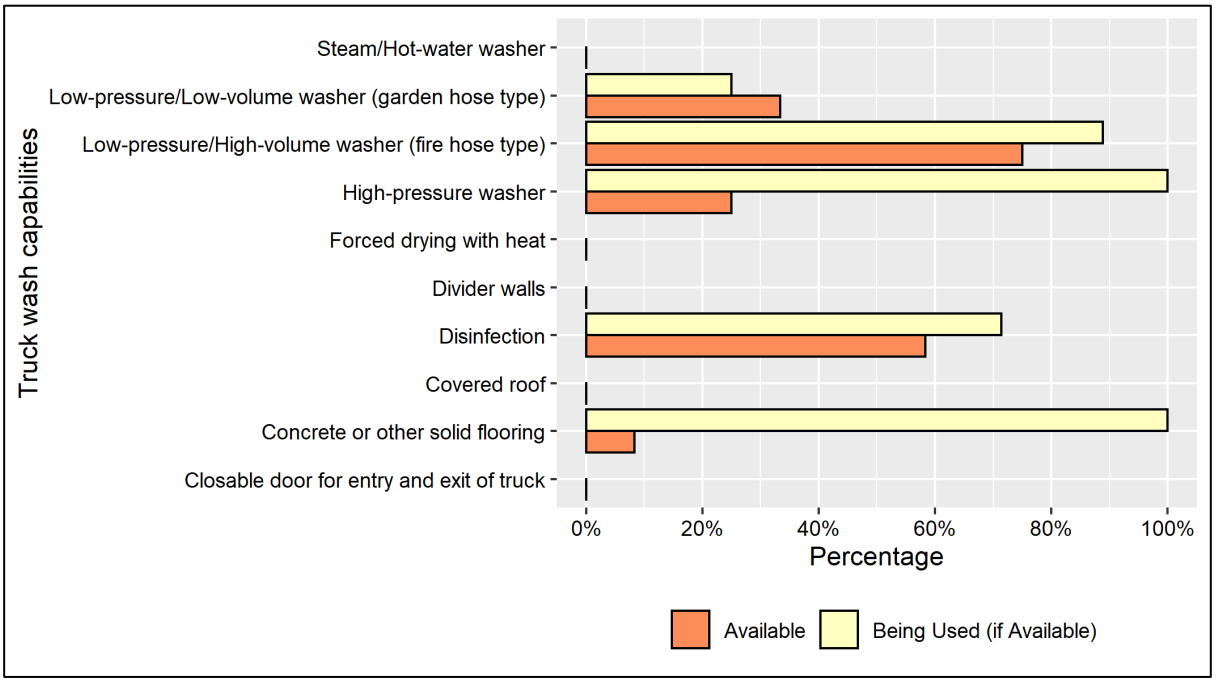

Figure 4. Truck washing capabilities (and usage) found amongst farms that had their own on-farm truck wash (see Figure 8 in Appendix 3).

- Third-party truck washes also tended to be poorly equipped with only 50% equipped with a fire hose, 40% with water blaster, and 50% with concrete floor.
- 67% of on-farm truck washes did not contain their effluent and around 10% did any kind of treatment prior to discharge.

5.3.3. Survey of small (non-export) abattoirs

The survey of small abattoirs was limited in geographic scope (two states) and only resulted in useable responses from 10 abattoirs; the data below should therefore be interpreted with caution.

Key points from survey of small (non-export) abattoirs

- 11 of 14 respondents completed the survey; 1 of the 11 did not process any pigs leaving a total of 10 abattoirs contributing data to the analysis. 5 of 10 said they receive pigs almost every day.
- 7 of 10 respondents had a policy around truck cleanliness but only 1 indicated they enforced the policy through consequences applied to the hauler/farmer.
- 4 of 10 respondents had an on-site truck wash. 2 of 4 said they had a truck washing procedural manual available, but use of the manual was not consistent.
- 3 of 4 respondents with an on-site truck wash had high-pressure wash available; 2 of 4 had disinfectant available.
    - No on-site truck washes were covered, used divider walls, or had closable doors; 2 of 4 had concrete floor surface.

    - In 3 of 4, drivers were responsible for doing the cleaning (rather than truck wash/abattoir staff). In all 4 cases, the cost of operating the truck wash was recovered as part of the overall cost of operating the abattoir.
    - In 3 of 4 on-site truck washes, the waste water was contained, but in the same tank or pond used for holding wastewater from the site, with eventual disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar).
- Only 3 of 10 respondents indicated they had a procedure manual that describes what changes they would make to their operation if an emergency animal disease (EAD) such as foot-and-mouth disease or ASF were to occur in their area.

5.4. OBJECTIVE 4

Develop a best practice truck biosecurity and disinfection manual and detailed SOPs and training materials

Six practical guidance documents designed to assist producers in managing pig transport biosecurity, especially for the movement of pigs from farm to market, were developed as described below.

5.4.1. Development of Standard Operating Procedures relevant to transport biosecurity

- Anonymous. Standard Operating Procedure "Pig transport vehicle cleaning and disinfection APL-001, ver. 1.0", Australian Pork Limited, Deakin, ACT, Project 2020/005, 6 pp., effective date: 30 June 2022 (*Appendix* 4).
- Anonymous. Standard Operating Procedure "Feed delivery biosecurity APL-002, ver. 1.0", Australian Pork Limited, Deakin, ACT, Project 2020/005, 3 pp., effective date: 30 June 2022 (*Appendix* 5).
- Anonymous. Standard Operating Procedure "Line of Separation APL-003, ver. 1.0", Australian Pork Limited, Deakin, ACT, Project 2020/005, 2 pp., effective date: 30 June 2022 (*Appendix 6*).

5.4.2. Development of a resource guide for pig transport biosecurity

- Anonymous. "Pig Transport Biosecurity: A Resource Guide for Australian Producers", Australian Pork Limited, Deakin, ACT, Project 2020/005, 30 pp., 30 June 2022 (*Appendix* 7).

5.4.3. Development of industry training materials related to transport biosecurity

MINTRAC, through one of the project team members (Clive Richardson) was recruited to develop training materials that can be deployed across various parts of the pork industry (pig producers, processors and the livestock transport industry) to improve compliance with the SOPs developed as part of this project. MINTRAC is a company which represents the industry on training matters with the objective of improving the skills of workers in the industry through the provision of recognised and accredited training from entry level through to senior management.

Three training tools were developed as part of this project. In particular, SA had an urgent need for resource and training materials that would help them in planning operational requirements for the government-private-industry initiative in that state that was focussed on investing in improved truck wash capacity at export abattoirs. That initiative needed to align with the AHC ASF taskforce processor working group output - "INCIDENT ACTION PLAN GUIDANCE DOCUMENT: RESOLUTION OF AN ABATTOIR DESIGNATED AS AN PREMISE OR DANGEROUS CONTACT PROCESSING FACILITY IN AN AFRICAN SWINE FEVER OUTBREAK" so the training materials were created with that specific "customer" in mind. The training tools use simple, easy-to-use language that can facilitate skill transfer across all workers in the industry.

- Anonymous. Training manual "Biosecurity and the transport of pigs", Meat Industry Training Advisory Council Ltd (MINTRAC), Caringbah, NSW, APL Project 2020/005, 31 pp., 24 January 2022 (*Appendix* 8).
- Training video: "Pig transport washing and disinfection" to accompany training manual above. the final version of which will be completed when access to transporter-OWNED and COMMERCIAL truck wash facilities is no longer restricted due to COVID.

5.5. OBJECTIVE 5

Investigate biosecurity issues related to water recycling/re-use for truck washing

Re-use/recycling of water is encouraged throughout much of Australia and certainly in areas where commercial pig farming and pig processing occurs. Information gathered from the survey of export abattoirs, pork producers, and commercial livestock transporters suggested biosecurity risks associated with re-use/recycling of water at abattoirs, farms, and truck washes was of keen interest to the industry and therefore as a first step, efforts were made to understand the philosophy and approach to biosecurity taken by water supply authorities to ensure that recycled/re-used water for irrigation and other purposes is fit for purpose.

As was described above, it is suspected that the first case of ASF in a commercial herd in Romania was caused by virus being introduced into the herd via that farm's use of river water as its water source. The widespread re-use of abattoir or truck wash waste water in Australia, without appropriate treatment, creates a risk of contaminating previously uncontaminated areas regardless of whether the water is used for irrigation or re-use in a farm or truck washing facility.

To manage the similar risk in a human waste scenario, Australian jurisdictions follow the National Guidelines for Water Recycling: Managing Health and Environmental Risks (2006)[7] (though a new 2020 draft is currently being distributed for public comment).[8]

The ASF project team reviewed the Recycled Water Management Plan for the town of Mannum (SA) Waste Water Treatment Plant (Anonymous 2021). The treatment works produces up to 500 kL of effluent /day, which is then used to irrigate a local golf course.

As the effluent output and disposal method in this Plan was not dissimilar to that of a typical Australian pig abattoir, review of the Mannum Plan served as a mini-case study to compare the risk mitigation requirements designed by SAWater to minimise inadvertent/occasional exposure of golfers to pathogens.

The rationale for drawing these comparisons was based on a number of factors:

- The Mannum daily effluent output volume is similar to that of a typical pig abattoir.
- The aim of the Water Management Plan is to minimise the risk of inadvertent/occasional exposure of the public to pathogens, including viruses, in the effluent (comparable to minimising the risk of possible exposure of feral pigs to EADs like ASF).

[7] Downloaded from https://www.waterquality.gov.au/sites/default/files/documents/water-recycling-guidelines-full-21.pdf

[8] Downloaded from the qldwater website (https://qldwater.com.au/public/Australian%20Guidelines%20for%20Water%20Recycling%20Consultation%20Draft%20Revised.docx).

- The effluent treatment processes are similar to those used in an abattoir: Effluent screening, aerobic/anaerobic lagoons, and irrigation with processed effluent to dispose of excess water.

Although logically abattoirs' effluent disposal (all species) should similarly aim to minimise inadvertent/occasional exposure of susceptible animals (e.g. feral pigs) to EADs and other endemic animal diseases, in reality there has historically been little consideration of this risk, a fact recognised in a recent APL report written concurrently with this project (Richards *et al.* 2021).

Key points

- Processers may wish to utilise water sourced from their effluent pondage system, at least for the initial wash down.
- Mannum Management Plan has a minimum acceptable lagoon retention time prior to re-use (irrigation) of 50 days at peak flows. This is compared with pork processors averaging 2 to 10 days based on our survey.
- Mannum Management Plan waste water from effluent processing is chlorinated prior to re-use (irrigation). This is compared with pork processors not disinfecting effluent at all prior to irrigation.
- At Mannum, golf course soil infiltration rate must be greater than irrigation rate to avoid run off. This is compared with irrigated effluent runoff from pork processors not generally being monitored or controlled.
- At Mannum golf course, people are excluded during irrigation periods from irrigated area. This is compared with feral pigs not being effectively excluded from areas in which processors

The controls required for human effluent re-use (irrigation) are considerably more restrictive than those currently applied to abattoir effluent. However, the consequences of a breakdown in human effluent risk-mitigation might be considered relatively limited (i.e. a small number of people getting sick with low likelihood of a large-scale outbreak), whilst the consequences of an EAD such as ASF infecting the feral or domestic pig population may be much more significant due to the potentially long-term effects of ASF on farm productivity and impacts on trade in pork and other pig products. In the Mannum example, golfers that become infected as a result of contact with contaminated city effluent would be likely to seek medical assistance and therefore be rapidly diagnosed and treated (and therefore the consequence rectified). However, in the case of feral pigs becoming infected with ASF through contact with contaminated truck wash or abattoir effluent, a lengthy period may pass before the infection was detected in the feral pig population, substantially reducing the opportunity for eradication of the disease.

In order to manage this risk, processors (all species) need to review their waste water management in line with the key points above, with the aim of introducing multiple hurdles to the spread of both EADs and endemic disease. This may include lagoon retention time, water disinfection prior to irrigation, fencing to exclude feral pigs from irrigated areas and monitoring and controlling run off.

6. Conclusions/ Summary of Findings

Although biosecurity in this country has made significant advances over the last 40 years, particularly in intensive industries, this project demonstrated that compared to countries that live with the reality of FMD, CSF, ASF, PRRS, SVD, etc., Australia has a considerable way to go, both structurally and attitudinally. In the EU, truck washing/disinfection between farms and between farm and abattoir is routine, with some countries providing designated public facilities and oversight/certification to ensure compliance. Australia does not maintain a similar level of biosecurity vigilance in this regard.

Transportation related risk factors have likely played an important, but as yet unquantified role in the introduction and spread of ASF in Europe, Asia, and Oceania and the same could be expected if the disease were to be introduced into Australia. In addition to the existing AUSVETPLAN Operational Manual on Decontamination which focuses primarily on truck washing, efforts should be made by the industry to improve the biosecurity around all aspects of pig transport from the time a pig leaves the farm of origin through to its destination.

Transport biosecurity has been embraced by pig industries in other countries and examples such as the Danish Specific Pathogen Free Program (https://spfsus.dk/en), established in 1971, demonstrate that systemic control of pig transport biosecurity could be adopted by the Australian pork industry. Producers and abattoirs should understand that ASF virus contaminated trucks represent a significant threat to the Australian industry and that this risk is controllable. In addition, under the current truck biosecurity regime, it may be that trucks are spreading endemic disease between herds. In fact, it was to minimise endemic disease spread, rather than EADs, that Denmark introduced its SPF protocols some 50 years ago.

An incursion of ASF is likely to go unnoticed for several weeks before the first herd is diagnosed with the disease. The apparent lack of capacity and capability to effectively wash and disinfect the country's fleet of livestock transport vehicles, as identified in this project, will exaggerate potential spread of disease prior to detection, constrain EAD response activities and increase the risk of further spread of an EAD to uninfected herds. The current processes for handling of wash water and other effluents from both slaughterhouses and farms, namely surface irrigation of untreated waste water onto land that can be freely accessed by feral pigs, may also pose a risk for spread of ASF into the feral pig population.

Experience from Europe clearly indicates, that if ASF spreads into wild boar or feral pigs, then unless the incursion is managed very rapidly, it becomes impossible to control the infection. There are few instances of ASF eradication in the world that have been successful once the virus becomes endemic in the wild boar or feral pigs.

Research has shown that the infective dose of ASF in water is lower than the infective dose in feed. Although it cannot be proven, it is suspected that the first case of ASF in a commercial herd in Romania was caused by virus being introduced into the herd via that farm's use of river water as its water source. It was discovered during investigation of the outbreak that upstream, pigs that had died from ASF had been disposed of by throwing the carcasses into the same river that was supplying water to the commercial farm. This has implications as to the risk of ASF transmission as a result of waste water from abattoirs and abattoir-based truck washes disposed onto non-secured farmland, municipal amenities such as golf courses or parklands, or water courses where feral pigs could have access.

This project has also shown that in the case of an ASF outbreak, the current state of Australian truck washing infrastructure will make business continuity challenging for pork farmers because within a very short time-period, truck washing capacity and wash water disinfection/management constraints are likely to be a key rate-limiting step in the response effort. Survey respondents identified a wash cycle (mostly without recommended steps of disinfection and drying) requiring between 1 to 2 hours. The current management of trucks is also likely to contribute to the spread of endemic diseases between herds.

Summary of key Project findings

- The literature presents some conflicting evidence on the likelihood pigs will become infected after coming into contact with an ASF virus contaminated environment (e.g. a pig pen or truck compartment). However, as first principles:
    - ASF virus is shed in faeces, urine, saliva and blood, and
    - ASF virus is infectious through oral exposure
    - Therefore, one should assume contaminated environments may remain contaminated for an extended period (weeks to months) in the absence of cleaning and disinfecting.
- There does not appear to be objective data that describes the frequency or quality of cleaning and disinfection procedures of pig transport vehicles on-farm or at abattoirs in Australia.
- Data from the project surveys suggest that none of the of the existing pork export processors in Australia currently have facilities sufficiently capable of providing cleaning and disinfection process for livestock trucks that would be effective, at a sufficient throughput level, to meet biosecurity challenges presented by an outbreak of ASF.
- No export processors currently have livestock truck cleanliness policies or procedural manuals
- A parallel survey of 10 domestic processors found that 7 had a truck cleanliness policy, but only 1 processor enforced it.
    - 4 had a truck wash available, with 2 having a procedural manual (though use was inconsistent).
- Australian abattoirs in general (all species) recycle or dispose of waste water by irrigation onto farmland without introducing a "kill step" for pathogens, prior to the land application.
- Most export pig processors irrigated effluent onto farmland that does not effectively exclude feral pigs, with some processors reporting the presence of feral pigs in their vicinity.
- Export processor pond holding capacity averaged 2 to 10 day's production and was impacted by storm water ingress (most do not separate storm water from effluent input).
- It is recommended that an effluent disinfection step be introduced at COMMERICIAL or ABATTOIR-based truck wash facilities, using principles similar to those that guide land discharge of human effluent.
- Amongst commercial transporter survey respondents (n=26), use of cleaned trucks (prior to loading) was common with 94.7% of loads making use of a cleaned trailer.
- According to commercial transporters, 23% of farmers left decisions about truck and trailer hygiene up to them, while 77% made some type of special biosecurity request. Most commonly, these requests were related to driver hygiene (boot and coverall management) and a strict requirement for washing, but not disinfecting, the trailer and at least the outside of the cab.
- Producer survey response rate was disappointing low (n=35; 32%) despite considerable follow up, with the highest response rate in the 501-1000 and 1001-5000 sow categories.

- 55% of producers used only their own trucks to move pigs while 46% used commercial transporters. Of those using their own trucks for pig transport, 55% had their own truck wash.
- 79% of those producers using transport contractors had specific biosecurity requests while 21% just trusted the contractor's judgement as to which biosecurity/hygiene processes were necessary. Most on-farm truck washes did not have disinfection facilities.

Initiatives that help to educate and improve farmer and transporter behaviours such as improving use of electronic real-time submission of movement data into PigPass, minimising cross-contamination events during loading/unloading, better containment and treatment of effluent generated during truck washing, increasing the quality of cleaning and disinfection procedures at load-out facilities, loading ramps, and lairage areas, and segregation of trucks used for farm-to-farm pig movements from those used for farm-to-abattoir movements would improve emergency disease preparedness and minimise spread of endemic diseases in the country. Collection of data that could quantify the capabilities and capacity of Australia to clean and disinfect livestock trucks would help to understand if further private and/or public sector investment should be made in this important area of biosecurity.

7. Implications & Recommendations

In addition to the relevant AUSVETPLAN manuals and other resource manuals such as the Animal Health Australia National Farm Biosecurity Manual for Pork Production, efforts should be made across the pork industry to improve transportation biosecurity, from the time a pig leaves the farm to its destination. Collection of data that could quantify the capabilities and capacity of Australia to clean and disinfect livestock trucks would help to determine if private and/or public sector investment should be made in this area of biosecurity. The peer-reviewed literature on ASF suggests that transportation is an important route of transmission for moving the virus between farms and countries.

Issue 1

Abattoirs provide the most frequent common contact point between farms via transport vehicles. They can therefore potentially play a pivotal role in the spread of ASF and other EADs. Despite being defined as animal quarantine areas, abattoirs have traditionally only taken an interest (if at all) in the state of trucks when they arrive, not when they leave their premises. Most processors have had neither the facilities nor the procedures in place, to adequately address what has long been considered a transporter-farmer issue.

Recommendations

1. *That APL work with Animal Health Committee, state governments, and the other livestock industries to develop a set of minimal biosecurity related infrastructure and procedural standards to apply to all livestock transporters delivering pigs to abattoirs, and that these be incorporated into AUSVETPLAN documentation.*
2. *That APL work with other animal industries to create a nationally recognized standard for truck wash facility design and operation that is available for any carrier of livestock to minimise the transmission risk before and during an EAD event.*

Issue 2

Australian abattoirs (all species) frequently recycle (dispose of) large volumes of effluent via farmland irrigation after minimal treatment that may not adequately control the risk of ASF/ EAD spread through incidental contact with susceptible species or through environmental contamination caused by surface run-off.

Recommendations

1. *That APL initiate discussions through the Pig Processor Referral Group (PPRG) on ways to effectively exclude access of susceptible species to farmland irrigated with effluent water from truck wash and lairage washdown.*
2. *That APL, through the PPRG and livestock transport associations, discuss options for implementation of treatment(s) or process(es) for lowering the level of contamination in effluent water from abattoirs and truck washes before being used for irrigation or disposal.*
3. *That APL initiate discussions with other animal industries, livestock transport associations, state and local governments, veterinary authorities, wildlife experts and water recycling experts on ways to effectively monitor and minimise this risk of pathogen transmission via effluent wash water irrigation practices.*

Issue 3

Processors commonly send initial effluent screenings off site to dispose of through landfilling, composting, rendering, etc. It is uncertain the degree of risk this poses to ASF/EAD spread as it was beyond the scope of this project to pursue in detail.

Recommendation
That APL initiate discussions with other animal industries and veterinary authorities to quantify the potential risk and develop appropriate control and monitoring procedures if required.

Issue 4
Pig producers are aware of the transport biosecurity risks they face but many are uncertain as to what standard they can reasonably demand of their pig transporters. The lack of a widely accepted and applied transport biosecurity standard, combined with a general lack of convenient truck washing facilities to service the livestock transport industry, exacerbates the problem. As this is an issue confronting all livestock producers, and livestock carriers often service a number of species, it makes sense to approach this issue as a whole of livestock industry problem rather than an exclusive pig problem.

Recommendation
That APL initiate discussions with other livestock industries and transport associations to develop a whole-of-industry approach to this issue.

Issue 5
The farm gate serves as the final control point for the producer to manage pig transport biosecurity. However, well-designed on-farm truck wash facilities and on-farm lairage appear to be scarce in the pork industry.

Recommendation

1. *That producers make a personal investment in improving transport biosecurity infrastructure on-farm. Effective controls at this point in the value chain have the potential to mitigate many of the risks presented by other parties (transporters, contractors, truck washes, abattoirs, other farm customers or suppliers, etc.) that are out of the direct control of the farmer.*
2. *That APL develop minimum standards for truck washing procedures that form part of the APIQ Biosecurity module and that will comply with AUSVETPLAN Operational Manual on Decontamination.*

Issue 6
Two important limitations of the project work should be highlighted: Firstly, the survey of Australian pork producers completed during this project may not be representative of the behaviours of the entire commercial industry due to the limited number of producers that participated. Secondly, identifying existing Australian truck washes that could serve to model "best-practice" for the purpose of developing a training video was challenging and has resulted in a delay on the delivery of a video of recommended truck wash procedures at a commercial abattoir.

Recommendation

1. *APL to work with South Australia processors to assist in the filming of the truck wash procedure using footage from the facilities expected to be finished upgraded in early 2023.*
2. *APL to identify a producer with an on-farm truck wash operating to the biosecurity principles and standards described in this report. APL will negotiate access to the on-farm facility for the purposes of developing a training video for the benefit of the industry. The on-farm truck wash should also be managing collection and disposal of bedding and wash water in a bio-secure manner.*

8. Intellectual Property

Not applicable

9. Technical Summary

Not applicable

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