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AUSTRALIAN Pork

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

APPENDICES to the Final Report APL Project 2020/0005 and 2020/0005.01

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INVITED REVIEW

Is transportation a risk factor for African swine fever transmission in Australia: a review

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African swine fever (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.

In addition to the existing AUSVETPLAN ASF plan, efforts should be made 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. No peer-reviewed research was identified that described a specific process for cleaning and disinfecting a livestock truck known to be contaminated with ASF virus, though literature suggests that transportation is an important route of transmission for moving the virus between farms and countries.

Keywords African swine fever; biosecurity; epidemiology; pig; risk factors; transportation

Abbreviations APIQ, Australian Pork Industry Quality Assurance Program; ASF, African swine fever; CSF, classical swine fever; EU, European Union; FMD, foot-and-mouth disease; OIE, World Organisation for Animal Health; PED, porcine epidemic diarrhoea; PRRS, porcine reproductive and respiratory syndrome; TAR, transport-associated routes

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African swine fever (ASF) was first described in Kenya in 1921[1] and has spread to many countries in Europe, Africa and Asia. Of importance to Australia, Indonesia, East Timor and Papua New Guinea have recently become infected as part of the current Eurasian pandemic of the disease that first started in Georgia in 2007. The disease is currently not present in North or South America, Australia or New Zealand.

Once ASF virus enters a country, the disease spreads via direct contact between infected and non-infected pigs, and through indirect contact via contaminated vehicles, equipment, personnel and pork products. In the current Eurasian outbreak, infected feral pigs act as a long-term reservoir for the disease. They may transmit ASF to domestic pigs through direct contact and also indirectly by contaminating the environment, feed stuffs (grains and forages) and bedding (straw) through contact with excrement, body fluids and carcass remnants (from ASF-induced mortality).[2,3]

In an uninfected country, the risk of introducing ASF virus onto a farm can be minimised by good on-farm biosecurity practices.[4] In particular, transportation-related risk factors deserve special attention as they can be both a source of infection for a country (via return of potentially contaminated trucks from infected regions/countries to uninfected regions/countries) and as means of propagating an epidemic once a country becomes infected. Furthermore, the widespread use of contract livestock haulers (rather than farmer-owned transport) is common in the pig industries of many countries including Australia, and biosecurity-relevant behaviours of contracted transport companies and drivers cannot be completely controlled by the farmer.

The proximity of Australia to ASF-infected countries has made the disease a high priority for the Australian pork industry. In preparing for a response to an ASF incursion, the industry has identified a need to strengthen biosecurity across the supply chain,[5] specifically with respect to transportation.

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.

Epidemiology of ASF

General reviews of ASF epidemiology and virology have been recently published and therefore only aspects of ASF epidemiology related to transportation risk are summarised in this review. For readers that require information about other aspects of ASF epidemiology or virology, several open-source, recent reviews are recommended.[6–8]

ASF virus shedding, persistence and transmission

Faeces and urine. The role of contaminated fomites in the spread of ASF within and between farms is particularly important, and therefore some understanding of virus-shedding patterns is important in mitigating the risk of ASF virus being spread among farms.

ASF virus infected pigs are contagious (i.e. shedding virus) during the incubation period of the disease and may shed virus for up to 48 h before showing clinical signs; large amounts of the virus are then shed from the time the disease produces clinical signs of infection (the acute stage) until the pig succumbs or recovers (a rare outcome of the disease in the current Eurasian outbreak), albeit at reduced levels and frequency.[9]

During the acute phase, large quantities of virus are present in oral and nasal fluids, blood, urine and faeces. The high levels found in faeces may be related to the presence of occult blood.[10] The likelihood of virus being shed in semen is contentious but is at least plausible given the remarkably high and persistent viremia that develops with the disease. The World Organisation for Animal Health (OIE) in its Terrestrial Animal Health Code chapter on ASF acknowledges this risk by recommending that semen from ASF infected countries be sourced only from donor males that have been kept since birth or for at least 3 months prior to collection in an establishment in which ASF surveillance demonstrates that no case of ASF has occurred in the past 3 years and that show no clinical sign of ASF on the day of collection of the semen.[11] The European Union recently reviewed the adequacy of their existing regulations related to movement of semen potentially contaminated by ASF virus, agreeing with the OIE that the risk was quantifiable and that explicit measures were required to manage the risk.[12] There are few peer-reviewed publications that provide data that help quantify the risk of ASF virus in semen and the potential for it to be transmitted venereally. One author notes that although sexual transmission of ASF virus in pigs has not been documented, the virus is shed in genital secretions,[13] information which is consistent with a study published in 1970 that detected infectious ASF virus in vaginal swabs of experimentally infected pigs.[14] Evidence of the occurrence of transmission of ASF virus through semen is often attributed to a 1984 paper by Thacker et al but this reference notes the finding only as a personal communication with another scientist, and not as original data.[15]

The earliest excretion of ASF virus usually occurs by the nasopharyngeal route, as early as 1 or 2 days before the onset of fever[14] though the exact time and concentration of virus can vary depending on the strain of the virus. Virus in the secretions of the conjunctiva or lower urogenital tract appears somewhat later and tends not to attain as high of levels. The amount of virus in faeces, secretions and excretions during various stages of infection appears to be related to virus strain.[10]

It has been shown that neither dose nor route of infection (inoculated or naturally infected) has a dramatic influence on virus excretion kinetics or concentration and that a high proportion of persistently infected animals shed virus into the environment for at least 70 days.[16]

A study done in 2017 estimated the half-life of the highly virulent Georgia 2007/1 isolate in faeces and urine.[17] When measured by virus isolation, the half-life was estimated at 8.48 and 15.33 days at 4°C and 3.71 and 2.88 days at 37°C for faeces and urine, respectively. When measured using PCR, the half-life of ASF virus DNA was 8–9 days in faeces and 2–3 days in oral fluids, at all temperatures that were tested. In urine, the half-life of ASF virus DNA was found to be 32.54 days at 4°C, decreasing to 19.48 days at 37°C.

A study examined the likelihood that exposure of healthy pigs to the pen environment of pigs that had died from ASF would result in infection.[18] Following euthanasia of pigs that had been infected with a virulent isolate of ASF virus from Poland, healthy pigs were introduced into the pens either 1, 3, 5 or 7 days later. Pigs that were introduced into the contaminated environment within 1 day of the infected pigs being removed developed clinical disease; however, pigs introduced into the contaminated pens after 3, 5 or 7 days did not develop any signs of ASF infection, and no viral DNA could be detected in blood samples.

Detection of ASF virus shedding in faeces has the potential for use as an ASF diagnostic or surveillance tool. However, in one experiment virus was detected in faeces (by PCR) only around 50%–80% of the time from 0 to 21 days post-infection (dpi), far less sensitive than applying the same diagnostic procedure to a blood or serum sample.[19] This percentage decreased to below 10% after 21 dpi. The authors reported that ASF virus DNA was quite stable in faeces with the half-life ranging from more than 2 years at temperature up to 12°C, to roughly 15 days at temperatures of 30°C. In tissue samples stored at 20°C, half-lives mostly ranged from 1.7 to 7.4 days.

Meat and blood. Meat from pigs slaughtered in the infective stages of ASF provide a ready source of virus to naïve pigs via the practice of feeding uncooked waste food. Pork products fed to pigs as swill that has not been cooked to comply with the World Organisation for Animal Health (OIE) Terrestrial Code (90°C for at least 60 min; or at least 121°C for at least 10 min)[11] poses a significant risk to naïve animals.

ASF virus can be inactivated by heating for 30 min at 60°C[20] or 70 min at 56°C[21] in culture media, but the virus is much more hardy when held in a moist and proteinaceous environment, surviving in blood heated to 50°C for 3 h.[1] Survival of the virus in pig blood kept at 4°C can be as long as 18 months.[20] The virus will survive across a wide range of pH conditions with inactivation occurring below pH 3.9 or above pH 11.5; the virus will survive at pH 13.4 for 20 to 22 h in medium containing 25% serum.[21]

ASF virus will survive in Parma hams for at least 300 days but not 400 days.[22] Data suggest that infectivity of ASF virus is lost by 110 days in chilled deboned meat, bone-in meat or ground pork, and after 30 days in smoked deboned meat.[23] The literature on survival of ASF virus in many pork products has been recently reviewed by at least two authors documenting that a number of tissues (especially blood) are able to provide an environment that enables the virus to persist for hundreds of days, especially when tissue has been chilled to 4°C or less.[24,25]

Transportation-related risk factors

Although contaminated transport vehicles are a plausible and recognised risk factor for the spread of ASF and other diseases among farms,[26] documented cases of such occurrences are rare.[27] It is highly likely that trucks were a significant factor in the spread of ASF in China[28] and trucks have also been considered to be a potentially important risk for spread of ASF into and around Europe[29] though much of the evidence is anecdotal or assumed.

A number of ASF outbreaks that occurred in large commercial farms in Russia and Lithuania were thought to be the result of contact with contaminated fomites related to improper disinfection of clothing and boots or by bringing contaminated pork onto the premises.[30,31] In these cases, authors suggested generally poor biosecurity and inadequate implementation of centralised disease control measures were key anthropogenic factors related to ASF introduction and spread in the region.

The current Eurasian epidemic was initiated when ASF entered Georgia in 2007 followed by spread into Europe in 2014, then China and other countries of East Asia in 2018. During the period from May to September 2019, 655 Romanian pig farms were included in a matched case–control study investigating possible risk factors for ASF incursion into commercial and backyard pig farms.[32] Results of the study showed that proximity to outbreaks in domestic farms was a risk factor in commercial as well as backyard farms. Furthermore, in backyard farms, herd size, wild boar abundance around the farm, number of domestic outbreaks within 2 km around farms, growing crops around the farm (which could potentially attract wild boar), feeding forage from ASF affected areas to the pigs and visits by professionals working on farms were significant risk factors.

Identifying the route of introduction of ASF virus onto infected farms, even at the early stages of an outbreak, can be difficult. During 2015–2017, 26 cases of ASF were identified on backyard and commercial pig farms in Estonia.[33] Detailed investigations of each herd were undertaken, but the specific route of introduction could not be determined on any of the herds, though the belief was that some indirect pathway was likely responsible. None of the outbreaks could be linked to the direct introduction of infected pigs.

Given the lack of experimental and high-quality case study data on between-farm spread, researchers in the Netherlands assembled a group of 45 people considered experts in ’livestock disease control’ to participate in a workshop to elicit quantitative estimates of the relative risks of various activities that contributed to introduction of exotic transboundary diseases into countries of Europe. Among the activities discussed, livestock trucks returning from infected to uninfected countries was assessed to be the activity with the second highest level of risk. The group noted that this was an important finding as the risk was largely able to be controlled at country borders through inspection of trucks for sufficient cleaning and disinfection.[34]

The scientific literature includes numerous efforts by authors to quantify the risk of ASF introduction or spread (into a farm, country or region) through ’transportation’ but typically these papers consider the risk associated with movement of infected pigs, as distinct from a contaminated vehicle itself acting as a fomite.[35–38]

Concern about the spread of ASF from Eastern Europe into countries of the European Union (EU) prompted an effort to estimate the risk of ASF virus introduction into the EU through three types of transport routes: returning trucks, waste from international ships and waste from international planes – these were collectively referred to as transport-associated routes (TAR).[29] A semi-quantitative model based on the weighted combination of risk factors was developed to estimate the risk of ASF virus introduction by TAR. The researchers concluded that the relative risk for ASF virus introduction through TAR in most of the EU countries was low. The risk for ASF introduction associated with returning trucks accounted for 65% of the total TAR risk. Similar modelling work in France reached a similar conclusion with virus transmission from commercial herds almost (99%) exclusively related to pig movements.[39]

Retrospective information from outbreaks of ASF in the Russian Federation was used to assess the most likely source of ASF virus introduction onto farms.[40] The route of introduction into new pig populations (i.e. primary outbreaks) was unidentified in 28.3% of cases. For those situations where there was some certainty around the source of introduction, 97% were through feeding contaminated swill, 2% were through contact with wild boar and 1% were through fomites such as contaminated vehicles. The route of secondary spread was unidentified in 58.1% of cases but when the route of introduction was identified, spread occurred through contaminated vehicles (62.1%), direct contact with pigs or people from holdings nearby (33.3%) or through the introduction of new pigs in the herd (5.6%).

A case report of an ASF outbreak that occurred in a large Chinese pig farm was recently published.[28] Despite standard operating procedures being in place to manage biosecurity, infractions related to movement of slaughter pigs off the farm were identified as the most likely route ASF virus was introduced. It is believed that ASF virus was introduced onto the farm during the process of loading slaughter pigs onto a truck (owned by the farm) that had likely been contaminated during a prior trip to an abattoir.

Several authors have suggested that emergency sale of pigs during ASF outbreaks contributes to the spread of ASF with particular examples available from Russia, countries in Africa, China and other countries in southeast Asia.[41]

Published information related to transportation risk is available for other pathogens, which may provide some insight about ASF spread. Researchers assessed the likelihood of pigs becoming infected with classical swine fever (CSF) after coming into contact with the pen environment of pigs experimentally infected with CSF virus, but removed before the naïve pigs were introduced into the same dirty pen.[42] Eight days after experimental infection (when all pigs had been viraemic for at least 3 days), the pens were depopulated and restocked (20 h later) with susceptible pigs, which stayed in these pens for 35 days. During the first 3 weeks of the observation period (during which time the pens were neither cleaned nor disinfected), none of the susceptible pigs became infected. This result indicates that CSF virus spread via excretions may be of minor importance in the early stages of infection. The experiment was designed to correspond as much as possible to a field situation where susceptible pigs are transported with a vehicle that previously transported infectious pigs. Therefore, the incubation period was deliberately limited to 8 days to allow all pigs to become viraemic but to avoid the pigs becoming overtly 'diseased', as visibly diseased animals are unlikely to be transported during a CSF epidemic. The time interval between depopulation and restocking was set to be 20 h, mimicking a vehicle transporting infectious pigs on 1 day and susceptible pigs the next.

In another study of transport risk related to CSF, the rate at which CSF was transmitted by several different types of inter-herd contact during the 1997–98 epidemic in The Netherlands was quantified.[43] During that epidemic, 428 CSF virus-infected pig herds were detected, 403 of which provided data to the study. The estimated rates of transmission were 0.065 per shipment of live pigs, 0.011 per contact by a pig transportation lorry, 0.0068 per person contact, 0.0007 per dose of semen, 0.0065 per contact with a potentially contaminated pig assembly point, 0.027 per week per infected herd within a radius of 500 m and 0.0078 per week per infected herd at a distance of between 500 and 1000 m. In a separate study of the same European CSF outbreak, researchers studied possible origins of the initial introduction of the virus into the Netherlands and other countries involved in the outbreak.[44] It appeared as though the virus was introduced into The Netherlands by a transport lorry that had been in contact with infected pigs or infectious material in Germany, which then returned to The Netherlands and came into contact with the index herd there. Furthermore, CSF was diagnosed in a mixed sow-finishing herd in Belgium (near the border with The Netherlands), which seemed to be associated with the use of a transport lorry that had been returning from The Netherlands.

Inactivation of ASF virus

Of relevance to countries with significant pork exporting activity such as Australia, a major concern is the contamination of abattoirs that would occur as a result of processing pigs infected with an exotic animal disease. Although only healthy animals should be presented for slaughter, it is possible that some pigs acutely infected with ASF would be presented to slaughter during the 'silent spread phase' that occurs between the time of disease incursion and the time when a diagnosis is established. ASF virus and other high-consequence animal pathogens are found in pig products such as blood and faeces and are therefore likely to be present in the tissues of infected animals that arrive to an abattoir, thus jeopardising the export-eligible status of that abattoir.

Faeces

Contact with faeces is a key means by which fomites can become contaminated with ASF virus, and therefore, having a good knowledge of the concentration and inactivation kinetics of ASF virus in faeces is important in developing control strategies focussed on pig transportation. For the purpose of this review, pig waste (faeces and urine) that is contained in external storage or under the pig building, and the waste water used to wash down trucks that have carried pigs will be referred to as slurry.

A possible risk associated with slurries that the material may bypass municipal sewage treatment and be applied directly to a crop as fertiliser, thereby creating a risk of spreading any pathogens present by aerosol or through pig contact with the crop.

The survival of ASF virus on plant material contaminated with slurry containing ASF virus has been studied,[45] prompted by concerns that virus shed by ASF infected wild boars (in urine or faeces), or contaminated by the carcass of a pig that had died of ASF, could lead to contamination of animal feeds that were derived from the plant materials; observations reported from ASF outbreaks in Latvia further support this potential risk.[46] After contaminating six different types of field crops (wheat, barley, rye, triticale, corn and peas) with ASF virus contaminated blood, all remained positive for ASF viral genome even after being dried at room temperature for 2 h, and after being dried and then exposed for 1 h to moderate heat (40°C and 75°C).[45] However, no infectious virus could be detected by virus isolation after 2 h drying.

A study was undertaken to determine the survival time of ASF virus on selected fomites including water, wet soil and wet leaf litter.[47] The samples were tested at −20°C, 4°C, 23°C and 37°C either 0, 3, 7 or 14 days after exposure to culture medium containing ASF virus. Virus was isolated from all water samples at all sampling times. For the other fomites, virus infectivity was lost after 3 days, regardless of temperature. The same study also investigated the survival of ASF virus in putrescent spleen tissue when the tissue was held in these same fomites plus straw, hay and grain (type not specified) and incubated at 4 and 23°C for 56 days. Virus titres were determined at 7, 14, 28 and 56 days. A temperature of 4°C was sufficient to preserve virus viability for at least 56 days in water, straw and hay. Soil and grain samples were inactivated after 28 days, whereas leaf litter resulted in the fastest inactivation of the virus, with its titre decreasing to less than or equal to $10^{1.31}$ haemadsorption in 50% of infected cultures per mL between days 7 and 14. At 23°C, no samples were positive beyond 7 days of incubation (calculated half-life 0.44 days).

Out of concern around the potential for forage and feeds to act as ASF virus fomites, the EU has developed recommendations for management of these materials.[48] Though generally the risk of commercially traded crops, vegetables, hay and straw to contain and maintain infectious ASF virus is considered to be low, if the use of locally harvested grass and straw is considered to represent a risk under local prevailing conditions then the EU recommends that feeding of fresh grass or grains to pigs should be banned unless the materials have been treated to inactivate ASF virus, or be stored out of reach of wild boar for at least 30 days before feeding. Furthermore, the use of straw for bedding of pigs should also be banned unless it has been treated to inactivate ASF virus or stored out of reach of wild boar for at least 90 days before use.

The effectiveness of alkali treatment (NaOH or $Ca[OH]_2$) or heating (4°C or 22°C) for inactivating ASF and swine vesicular disease viruses in pig slurry was investigated in 1999,[49] and based on the findings, the researchers then went on to design a pilot plant for heat inactivation of slurry that could be used in a field setting.[50] In the authors' work with their pilot treatment plant, ASF virus was inactivated by operating the plant at a temperature of 53°C for approximately 5 min at a pH of 8. For the very large volumes of slurry found on modern commercial farms, heat treatment or chemical treatment with either NaOH or $Ca(OH)_2$ may be impractical, but not impossible.[51]

In an older review, the inactivation kinetics of various transboundary pathogens in faeces or slurry were summarised and authors suggested ASF virus may survive in the material for 60–100 days.[52] However, they noted that under practical field conditions, survival time was strongly dependent on many variables such as temperature, pH value and the initial concentration of the pathogen, which are out of the control of a farmer or disease control officials.

There appears to be little evidence available assessing inactivation of ASF virus during composting of manure or animal composting.[53]

Cleaning and disinfection efficacy

Disinfection is a critical step in controlling the spread of ASF virus by fomites. However, disinfection must be preceded by a thorough mechanical cleaning of the space for the disinfectant to be effective. Normal cleaning and disinfection include the following: First, removal of bedding, straw, feed and manure; second, washing using detergents; and third, application of an effective disinfectant. ASF virus is an enveloped virus and therefore tends to be more susceptible to a wider range of disinfectants than nonenveloped viruses, for example, Enteroviruses.[54,55]

The results of in vitro testing of commercial disinfectants against ASF virus using a method similar to that described in the European Standard EN 14675:2015 for quantitative assessment of veterinary chemical disinfectants have been reported.[56] Disinfectants were assessed with or without the presence of organic contaminants (bovine serum albumin = 'low-level' contamination, bovine serum albumin plus yeast extract = 'high-level' contamination). Sodium hypochlorite (3.0, 1.5 and 1.0%), caustic soda (2%), phenol (1%), potassium peroxymonosulfate (3.0, 1.0 and 0.5%) and glutaraldehyde (0.5%–0.1%) were found to reduce virus concentrations by at least fourfold even in the presence of high-level contamination. Other products or concentrations were less effective at inactivating ASF virus. The authors emphasised the substantial effect of organic matter in reducing the effectiveness of all compounds at all concentrations.

An alternative to using disinfectants to kill viral and bacterial pathogens using ozonised water has been reported.[57] A 2-$\log_{10}$ reduction (99%) was observed within 1 min when $10^{5.0}$ $TCID_{50}$/mL wild-type or reporter ASF virus was exposed to 5 mg/L of ozonised water and a 3-$\log_{10}$ (99.9%) reduction in virus was observed within 1–3 min when exposed to either 10 or 20 mg/L of ozonised water. Inactivation kinetics were also similar at higher virus concentrations. In the study, ozonised water was shown to be relatively stable for 1–2 days.

There are multiple choices available for use in disinfecting premises that have been contaminated with ASF virus. However, their exact efficacy in a field setting is uncertain given important variables such as the presence of organic matter, temperature, and physical characteristics of the surface being disinfected are not identical across situations.[58] Lipidic solvents, which destroy the envelope of the virus and commercial disinfectants based on iodine and phenolic compounds, appear to be among the most effective chemicals in inactivating the ASF virus though disease control officials in countries and regions often maintain their own list of 'approved' disinfectant compounds.

Several international agencies have published principle of cleaning and disinfection as they relate to transboundary diseases, including ASF. The main legislation providing the guidance for the control of ASF in the EU is Council Directive 2002/60/EC, which establishes the minimum measures to apply for the control of ASF, including the principles for cleaning and disinfection[59] and attempts to use this guidance in establishing an effective cleaning and disinfection programme for ASF virus are available.[58] The OIE,[60] the Food and Agriculture Organisation of the United Nations[61] and the United States Department of Agriculture have published guidance for appropriate use of disinfectants against important animal pathogens including ASF virus all of which are broadly in agreement with Australia's approved list of disinfectants effective against ASF virus (Table 1).[62]

Efficacy of truck-washing protocols in managing infectious disease risks

No reports were identified in the literature of trials that attempted to directly assess methods to decontaminate trucks or trailers contaminated with ASF virus, though the efficacy of several disinfectants against ASF virus on surfaces found in abattoirs, porous material (likely to be used as bedding in trucks) and hard surfaces (likely to be material used to build trucks) has been reported.[63–65]

Wood shavings, sawdust or chips may be used as bedding when transporting pigs. As there is no standardised method for porous surface disinfection; commercial disinfectants are only certified for use on hard, nonporous surfaces.[64] To model porous surface disinfection in the laboratory, foot-and-mouth disease (FMD) virus and ASF virus stocks were dried on wood surfaces and exposed to citric acid or sodium hypochlorite. It was found that 2% citric acid was effective at inactivating both viruses dried on a wood surface by 30 min at 22°C. Although 2000 ppm sodium hypochlorite was capable of inactivating ASF virus on wood under these conditions, this chemical did not meet the 4-log effective disinfection threshold for FMD virus. The data support the use of chemical disinfectants containing at least 2% citric acid for porous surface disinfection of FMD and ASF viruses. The same authors extended their work to assess the efficacy of drying and disinfectants on steel and plastic surfaces.[65] For ASF, CSF, and FMD viruses, a 2- to 3-log reduction of infectivity due to drying alone was observed. ASF and FMD viruses were susceptible to sodium hypochlorite (500 and 1000 ppm, respectively) and citric acid (1%) resulting in complete disinfection. Sodium carbonate (4%), while able to reduce FMD virus infectivity by greater than 4-log units, only reduced ASF virus by 3 logs. Citric acid (2%) did not totally inactivate dried CSF virus, suggesting that it may not be completely effective for disinfection in the field. Based on these data, the authors recommended disinfectants be formulated with a minimum of 1000 ppm sodium hypochlorite for ASF or CSF virus disinfection, and a minimum of 1% citric acid for FMD virus disinfection.

To assess the situation within an abattoir environment, the authors mentioned earlier evaluated common disinfectants used by the food industry against ASF virus when dried on steel, plastic and sealed concrete surfaces (all commonly found in abattoirs) in the presence of swine faeces, meat juice or blood.[63] The commercial disinfectants used in this study included quaternary ammonia with surfactant (800 ppm, pH 1.8), stabilised sodium hypochlorite (600 ppm, pH 10.8), potassium peroxymonosulfate with surfactant (2% w/v, pH 2.2) and citric acid (2%). Disinfectant activity was greatly inhibited in the presence of dried blood and meat juices. As compared to virus dried in phosphate buffered saline, the efficacy of citric acid and sodium hypochlorite was strongly inhibited in the presence of blood. In swine faeces that were dried on stainless steel, citric acid was effective in inactivating ASF virus, but sodium hypochlorite was not. Commercial disinfectants used by the food industry were generally effective against ASF virus when dried in the absence of swine products on various surfaces. Conversely, when the virus is dried in swine blood and meat juices on steel, disinfection was strongly inhibited, and the disinfectants were unable to completely inactivate ASF virus dried in swine faeces. Taken together, these data reinforce the need to physically remove contaminated swine excretions from surfaces prior to disinfection and to choose effective chemicals to ensure complete virus inactivation.

Though experimental work with ASF virus and truck decontamination appears to be limited, work has been done with porcine reproductive and respiratory syndrome (PRRS) virus and porcine epidemic diarrhoea (PED) virus, both of which are high-consequence pig diseases exotic to Australia. Mechanical fomites consisting of snow and water were contaminated with a field strain of PRRS virus and then adhered to the undercarriage of a vehicle. The vehicle was driven approximately 50 km to a commercial truck washing facility where the driver's boots contacted the fomites after they were washed off the vehicle, which resulted in introduction of the virus into the vehicle cab. The vehicle was then driven 50 km to a simulated farm site where the driver then entered the farm office; the driver's boots were found to have readily spread the virus into the farm premises.[66] By contrast, using the same experimental model in warmer conditions using compacted soil as the fomite found that transfer of PRRS virus was an infrequent event.[67] To evaluate the effectiveness of various trailer cleaning regimes, four cleaning/disinfecting methods were designed and then evaluated using truck-scale models that had been artificially contaminated with PRRS virus, including manual scraping only to remove soiled bedding; a combination of bedding removal, washing, and disinfection; the combined treatments followed by a freezing and thawing cycle; and the combined treatments followed by air drying overnight.[68] Post-treatment swabs were PCR-positive for all treatments except the combination protocol accompanied by drying. Thus, drying appears to be an important component of the truck washing under the prescribed treatment conditions. To further evaluate the efficacy of drying on the inactivation of PRRS virus, the use of forced heating to dry trucks versus overnight drying at environmental temperature was trialled.[69] Scale-model trailer interiors were artificially contaminated with PRRS virus and then treated with one of four treatments: Thermo-assisted drying and decontamination (TADD; or raising the interior surface of the trailer to 71°C for 30 min); air drying only without supplemental heat; overnight (8 h) air drying without supplemental heat; and washing only. Following treatment, swabs were collected from the trailer interiors at 0, 10, 20 and 30 min post-treatment and from the overnight group after 8 h. All tests for the presence of infectious PRRS virus were negative for trailers treated with TADD and overnight drying, with TADD having the advantage of requiring much less time to implement.

PED virus causes watery diarrhoea, dehydration and a high mortality rate among suckling pigs and is present in many parts of the world since a major global pandemic occurred during 2013–2017. In a study of the role of transportation in spread of PED in Italy, a study reported that 14.1% environmental swabs collected at slaughterhouses from trucks after animals were unloaded tested positive for PED virus before the cleaning and disinfection operations were performed.[70] In addition, 7.4% of environmental swabs of the same trucks, collected after routine cleaning and disinfection operations, still tested positive for the virus thus the cleaning and disinfection procedures succeeded in eliminating the virus in only 54% of the trucks that initially tested PED virus positive. More concerning was that 17.3% of the empty trucks that were tested before arriving at farms to load animals were PED virus positive.

The role of trucks in the spread of PED in the United States during the 2013 epidemic was studied by collecting environmental samples from near the rear door of 575 trailers unloading pigs at six different abattoirs.[71] Before unloading, 6.6% trailers were found to be contaminated and of those trailers not found to be contaminated at the time of unloading, 5.2% became contaminated during the unloading process. The authors concluded 'This study suggests that collection points, such as harvest facilities and livestock auction markets, can be an efficient source of contamination of transport vehicles that return to pig farms and likely played a role in rapidly disseminating PED virus across vast geographic regions'.[71]

The situation in Australia

In 2019, there were an estimated 3700 pig producers in Australia producing around 420,000 tonnes of pork per year of which around 10% was exported.[72] However, Australian Pork Limited has estimated that only around 1500 of these producers raise pigs at a scale from which the owner can claim income from the

Table 1. Australian Pesticides and Veterinary Medicines Authority (APVMA) list of approved disinfectants and concentrations for treatment of ASF virus

Disinfectant	Rate	Application[a,b]
494 g/kg of potassium peroxymonosulfate triple salt, 132 g/kg of sodium dodecylbenzene sulfonate, 44 g/kg sulfamic acid and 15 g/kg of sodium chloride (Virkon S) 497 g/kg potassium peroxymonosulfate, 49 g/kg sulfamic acid and 15 g/kg sodium chloride (Virkon Aquatic)	20 g/L	Final dose: 2–3% solution (equivalent to 20 g/L). Soak clothes/small items and equipment for at least 10 min. For surface cleaning, apply at the rate of 1–1.5 L/m^2. Do not use high-pressure sprays. Decontaminate removed organic matter before disposal.
Sodium hypochlorite 125 g/L	40 mL/L	Final dose: 0.5% solution (equivalent to 40 mL/L). Soak clothes, footwear and small equipment for 15–30 min. For surfaces, apply at a rate of 1–1.5 L/m^2 and soak for 15 min on nonporous surfaces and 30 min on porous surfaces.
Calcium hypochlorite 700 g/kg	7.2 mL/L	Final dose: 0.5% solution concentration (equivalent to 7.2 mL/L) for 10–30 min.
Sodium hydroxide 400 g/L	50 mL/L	Final dose: 2% solution (equivalent 50 mL/L). Soak clothes, footwear and small equipment for at least 10 min. For surfaces, apply at a rate of 1–1.5 L/m^2 and soak for at least 10 min.
Sodium carbonate anhydrous	40 g/L	Final dose: 4% solution (equivalent to 40 g/L) for 20 min.
Sodium carbonate washing soda	100 g/L	Final dose: 10% solution (equivalent to 100 g/L) for 30 min.
Glutaraldehyde with quaternary ammonium compounds[c] Available as 150 g/L of glutaraldehyde. One part of 15% glutaraldehyde to 7.5 parts water = 2% final concentration = 133 mL/L.	133 mL/L	Final dose: 2% solution (equivalent to 133 mL/L). Clean equipment with soap or detergent first and then rinse with water. Immerse for minimum of 10 min at 35°C and 20 min at 25°C. Maintain solution at pH > 7. Efficacy may be increased by raising the solution temperature to 60°C.
Citric acid	30 g product/L	Final dose: 3% solution (equivalent to 30 g/L). Nonporous surfaces apply for 15 min; porous surfaces apply for 30 min.

[a] Efficacy of some of the products and proposed uses under this permit has not been thoroughly determined. However, efficacy is reasonably expected due to the broad-spectrum nature of the product.
[b] For all situations, APVMA requires that users clean with soap or detergent first and then rinse with water to remove organic matter before applying disinfectant and that users must comply with their relevant state and territory environmental legislation.
[c] Glutaraldehyde and quaternary ammonium compounds are only available as a combined product. The final concentration is based on the glutaraldehyde% or its ppm.

enterprise.[73] 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. Although there are in excess of 70 abattoirs that are licensed to slaughter pigs in Australia, only seven are qualified to process pigs for the export market. These seven abattoirs are responsible for around 85% of the total annual pork slaughter.

PigPass is the national tracking system designed to provide real-time information on the movements of all pigs in Australia. The objective of the system is primarily to 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 must be completed (electronically or on paper) any time pigs leave a property regardless if ownership of the pigs' changes or not.[74] Since the programme became compulsory in 2018, PigPass has not been systematically reviewed for accuracy or compliance but 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.[75] 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 exotic 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.[61] The section of the document related to

[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. Available at: https://www.agriculture.gov.au/sites/default/files/sitecollectiondocuments/abares/data/acs2018-meat-pigs.xlsx. Accessed 21 August 2020.

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

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 exotic 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).[76] 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 are 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. Although 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.[77] Although 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 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 21 August 2020, there were 125 truck washes listed on the website;[3] the completeness of the data on this system is 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.[78] 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, 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 was required to bring the truck washing capacity at these facilities to an acceptable level of biosecurity.

Conclusions

Transportation-related risk factors likely play an important but as yet unquantified role in the introduction and spread of ASF. In addition to the existing AUSVETPLAN guidance that 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.

There does not appear to be objective data that describe the frequency or quality of cleaning and disinfection procedures of pig transport vehicles on-farm or at abattoirs in Australia. Similarly, data that describe the behaviours (and their effectiveness) that are routinely undertaken by farmers to minimise possible contamination at the time of loading pigs on-farm or unloading at an abattoir by truck drivers or farm/abattoir staff is not currently available. 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.

Initiatives that help to educate and improve farmer and transporter behaviours such as improving the 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 perhaps considering segregation of trucks used for farm-to-farm pig movements from those used for farm-to-abattoir movements would improve exotic 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.

Conflicts of interest and sources of funding

The authors Neumann, Hall and Hamilton have previously applied for and received funding for research from Australian Pork Limited. None of the authors have any other potential conflicts of interest to declare that are relevant to this publication.

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

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Transporter Survey Report

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Report run date: March 15, 2022

1 Study Background

African swine fever (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.

This survey of Australian commercial pig transporters is part of a larger study, funded by producers through Australian Pork Limited (APL) levies, to identify risks related to pig transportation to Australian abattoirs The survey is intended to describe the existing biosecurity measures being taken by commercial haulers today and also to identify opportunities for developing best practices to help manage transport biosecuity risks in the future.

The data presented in this report is derived from an online survey of commercial livestock haulers as identified by MINTRAC (National Meat Industry Training Advisory Council Limited) through their role as a company which represents the industry on training matters. This information will help to identify opportunities for improvements in biosecurity related to pig transportation that could be implemented at either an individual operator level or through whole-of-industry actions.

The online survey was conducted on behalf of APL. The survey data were collected during May and June 2021 and 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).

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 transporters. Of these, 28 transporters (68%) completed the survey and 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 questions followed a logic path that only required respondents to answer questions specifically applicable to their operations, based on information provided by the respondent as they moved through the survey questions.

2 General observations of pig transport by commercial haulers

2.1 Frequency and load size of commercial pig transport

Of the 26 respondents that indicated they transported pigs, Sixty-nine percent transported “5 or less” loads per week. The distribution of the weekly frequency of pig transportation events for survey respondents is shown in Figure 1.

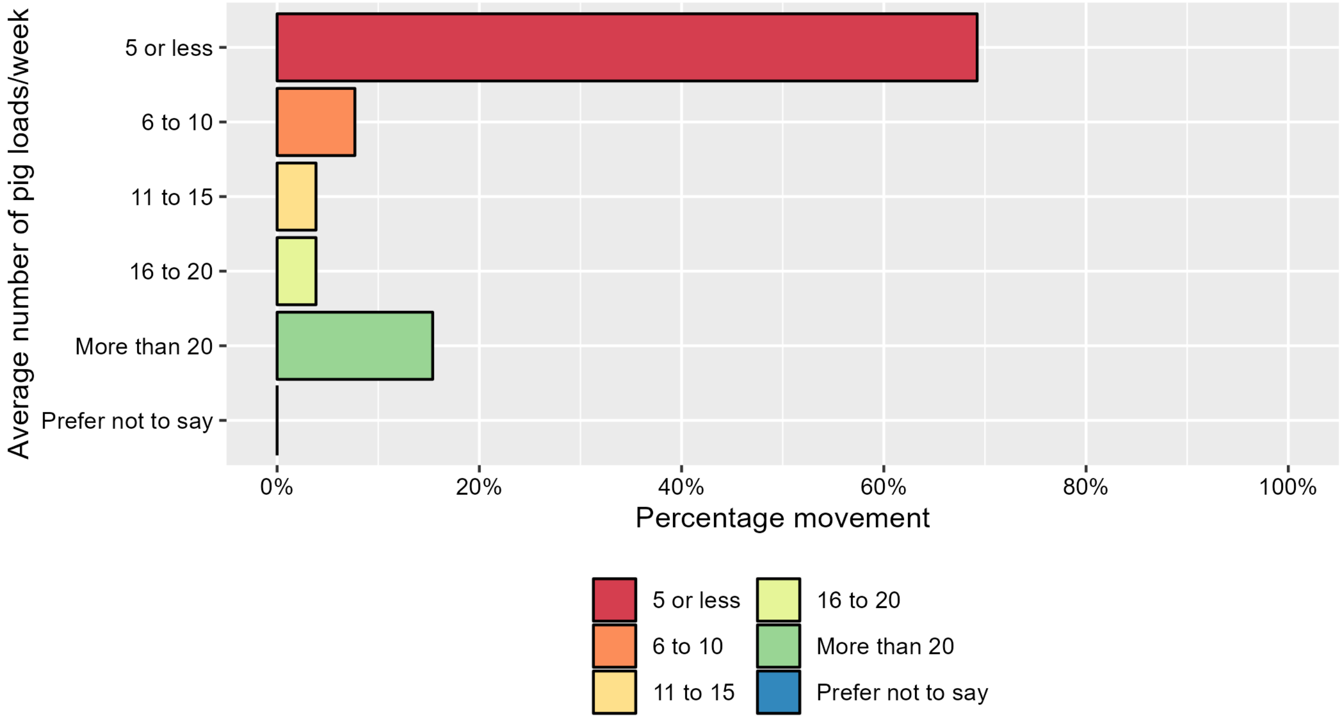

Figure 1: Average number of loads of pigs transported in a week by each respondent.

Sixty-five percent of respondents transported “More than 200” pigs per load. The distribution of typical load sizes (number of pigs per load) reported by the respondents is shown in Figure 2.

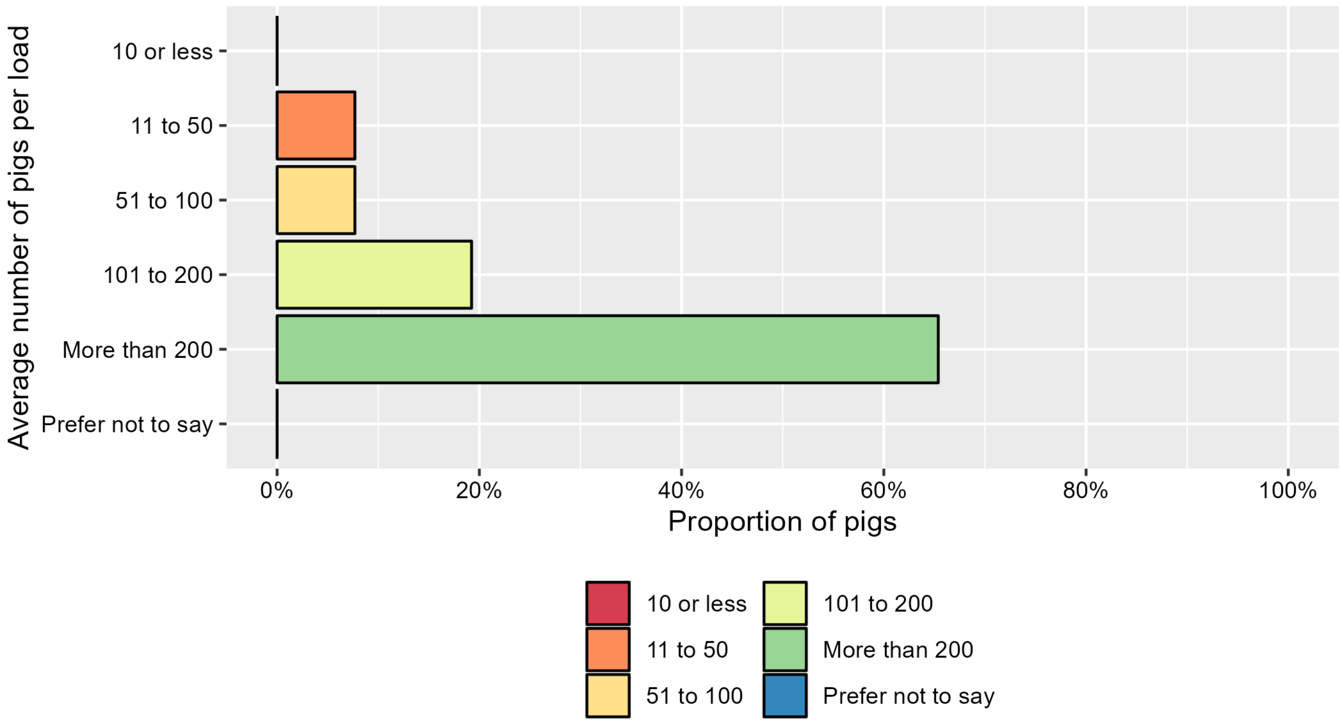

Figure 2: Average number of pigs per load.

2.2 Typical expectations of pig truck and trailer hygiene when transporting pigs

Amongst respondents, use of cleaned trucks (prior to loading) was common with 94.7% of loads making use of a cleaned trailer.

When asked “What percentage of pig farmers request that specific biosecurity measures be taken before your truck and driver arrive on their site?”, only 6 of the 26 (23%) of the respondents that hauled pigs answered "None. They trust us to do what we think is best or is 'normal practice' for the industry." while 20 of the 26 (77%) of the respondents that hauled pigs answered "Some or all. At least some farmers make biosecurity requests around our transport service.".

The types and frequency of requests made by those respondents that asked their commercial hauler to undertake special biosecurity measures is shown in Figure 3.

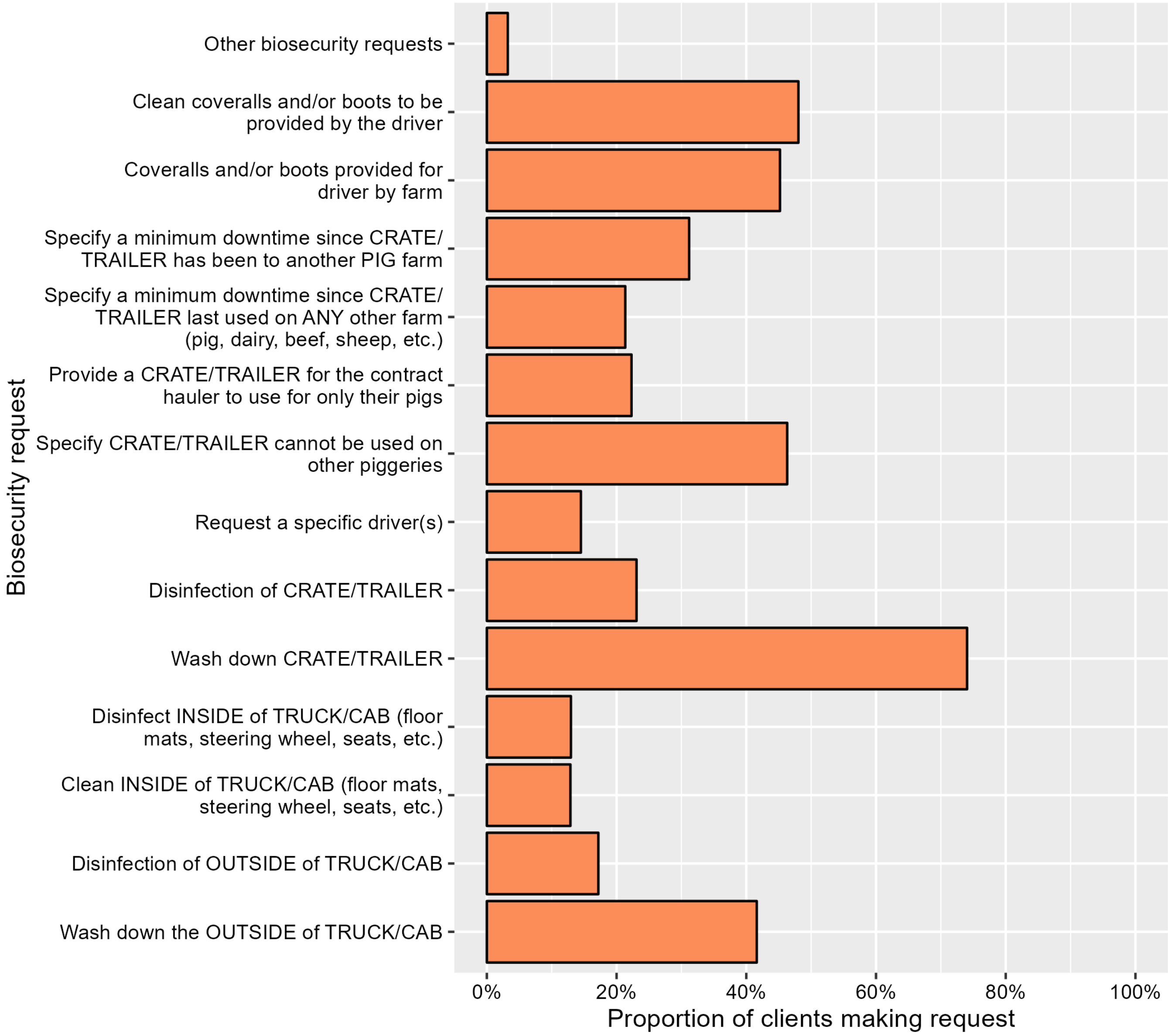

Figure 3: Specific biosecurity requests made by farmers to haulers prior to picking up pigs from a farm for delivery to an abattoir.

3 Truck wash facilities used by commercial pig transporters

From the survey data presented above, it appears that there is good awareness of the importance of using clean trucks and trailers to transport pigs from farms to abattoirs. However, truck washing options available to commercial haulers vary in terms of their location and capabilities. In the survey, respondents were asked whether they used a truck washing facility that they OWNED (or had control over), whether they used truck washes managed by a third-party (such as one located at an ABATTOIR, a SALEYARD, a COMMERCIAL TRUCK WASHING FACILITY, or at a client's PIGGERY), or used a combination of these options. Depending on their answer, respondents were asked a series of questions about all of the truck washing facilities that they used and this information is presented below in separate sections.

Of those transporters that hauled pigs, 54% (14 of 26) had their own truck washing facility and 92% (24 of 26) used truck washes owned by a THIRD-PARTY (ABATTOIR, SALEYARD, COMMERCIAL TRUCK WASH, or a truck wash at a PIGGERY). In this survey, 92.9% of transporters that OWNED their own truck washes also used THIRD-PARTY truck washes.

3.1 Truck washing facilities OWNED (or controlled) by the transporter

3.1.1 Capabilities and their usage

Respondents who OWNED a truck wash facility (n = 14) were asked to describe the various cleaning, disinfection, and biosecurity management capabilities available at their facility. Respondents were presented with a list of ten common capabilities that might be expected to be found at a truck wash designed for cleaning livestock transport vehicles. The proportion of transporter-OWNED facilities that had each capability are shown in Figure 4, along with the likelihood that each would be used during a pig truck cleaning process.

At 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 uncommonly present (57%) amongst respondents with transporter-OWNED truck washes and when this capability was present, it was only utilized 38% of the time.

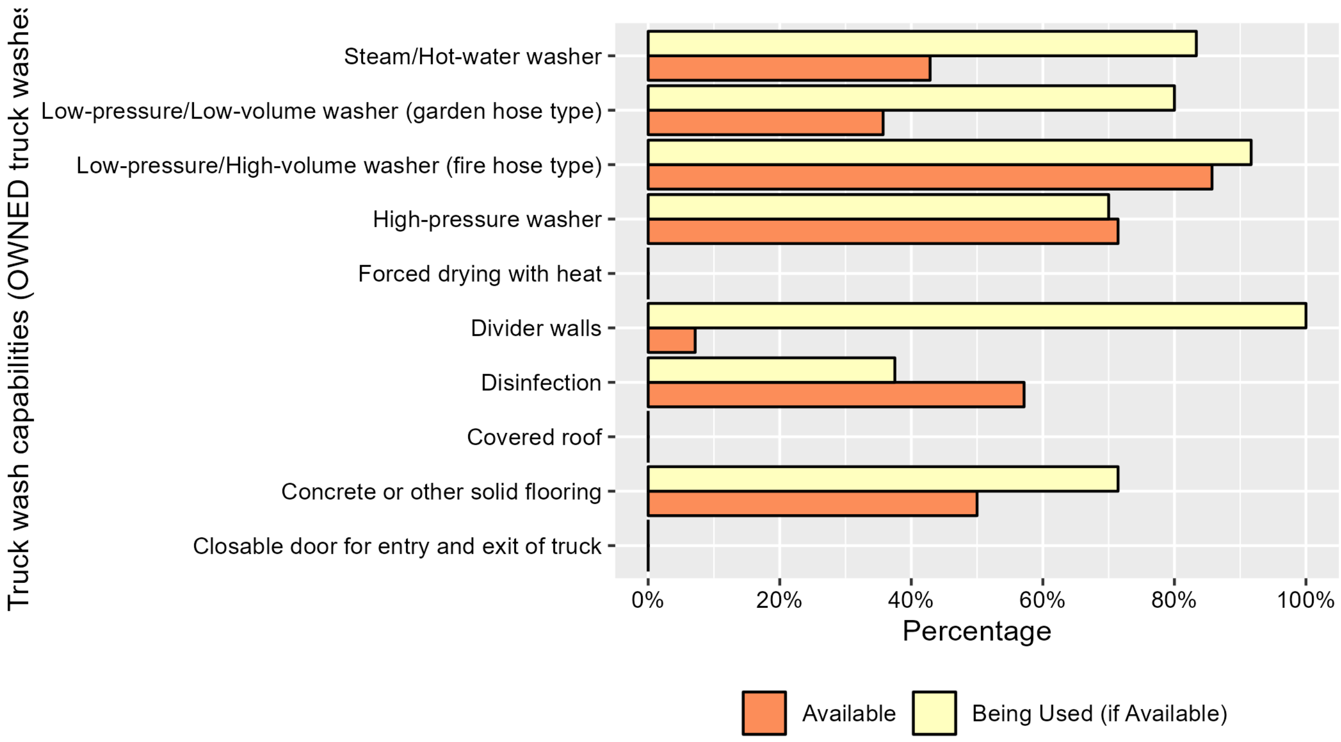

Figure 4: Availability of various cleaning, disinfection, and biosecurity management capabilities at transporter-OWNED truck wash facilities.

3.1.2 Truck washing procedures and quality assurance

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 (Table 2).

Around 79% of respondents indicated that it takes “At least one hour, but less than two hours” to wash the crate and trailer (Table 3).

Table 1: Person responsible for carrying out the actual truck washing process in a transporter OWNED facility.

Person responsible for washing	No. of respondents	Pct. of respondents
Driver	10	71.4%
Facility staff	0	0.0%
Varies	4	28.6%

Table 2: Use of quality assurance procedure after washing in a transporter OWNED facility.

Quality assurance after washing	No. of respondents	Pct. of respondents
No inspection	9	64.3%
Yes, and a record of inspection is kept	1	7.1%
Yes, but no record of inspection is kept	4	28.6%

Table 3: Time required to wash a truck and crate in a transporter OWNED facility.

Time required for washing	No. of respondents	Pct. of respondents
Less than an hour.	1	7.1%
At least one hour, but less than two hours.	11	78.6%
Two hours or more.	2	14.3%

3.1.3 Cost of truck washing at an OWNED facility

Survey participants were asked about the total cost (fixed and variable cost) involved in washing crates/trailers at their truck washing facility. Respondents indicated the average cost was $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".

3.1.4 Disposal of waste water and effluent from a truck washing facility OWNED by a transporter

Livestock transporters that also OWN a truck washing facility need to manage how effluent and waste water from that facility are managed. Respondents were asked questions about whether this wastewater was contained in some manner, and if so, were any treatments applied to it prior to land application or discharge (Table 4).

While 57% indicated the truck wash effluent was "Contained in a dedicated tank or pond for later disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar).", a surprisingly high proportion (29%) indicated the effluent was simply "Uncontained.".

Two transporters discharged their truck wash effluent in a manner that was "Contained, but in the same tank or pond used for holding pig farm effluent, with eventual disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar)".

Table 4: Methods of effluent containment generated at transporter-OWNED truck washes.

Method of effluent containment	Pct. of respondents
Contained in a dedicated tank or pond for later disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar).	57.1%
Contained, but in the same tank or pond used for holding pig farm effluent, with eventual disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar).	14.3%
Discharged directly into a municipal treatment system (or similar).	0.0%
Uncontained.	28.6%

Amongst the 10 transporters that contained their truck wash effluent in some manner, it was rare for any further processing or treatment to be done to the effluent before discharge (Table 5).

Table 5: Use of further processing or treatment methods on effluent contained after collection at transporter-OWNED truck washes. Total does not equal 100 percent.

Possible types of effluent treatment	Proportion of farms
Addition of disinfectant or other chemical disinfectant	10.0%
Addition of other chemicals for breaking down solids, but not necessarily a disinfectant	0.0%
Minimum hold time of waste before being applied to land	20.0%
Other	0.0%
Solids separator	20.0%
Water from truck washing is recycled for use back in TRUCK WASH	0.0%
Water from truck washing is recycled for use in cleaning PIG FACILITIES	10.0%

3.2 Use of THIRD-PARTY truck wash facilities that are located at an ABATTOIR

3.2.1 Capabilities and their usage

Respondents who used a truck wash facility located at an ABATTOIR (n = 20) were asked to describe the various cleaning, disinfection, and biosecurity management capabilities available at that facility. Respondents were presented with a list of ten common capabilities that might be expected to be found at a truck wash designed for cleaning livestock transport vehicles. The proportion of ABATTOIR-owned facilities that had each capability are shown in Figure 5, along with the likelihood that each would be used during a pig truck cleaning process.

At ABATTOIR-owned truck washes, the availability of a "High-pressure washer" was substantially less available than at transporter-owned truck washes. However, "Concrete or other solid flooring" was more often present when compared to transporter-owned truck washes; the availability of "Disinfection" processes was about the same at both types of truck washes.

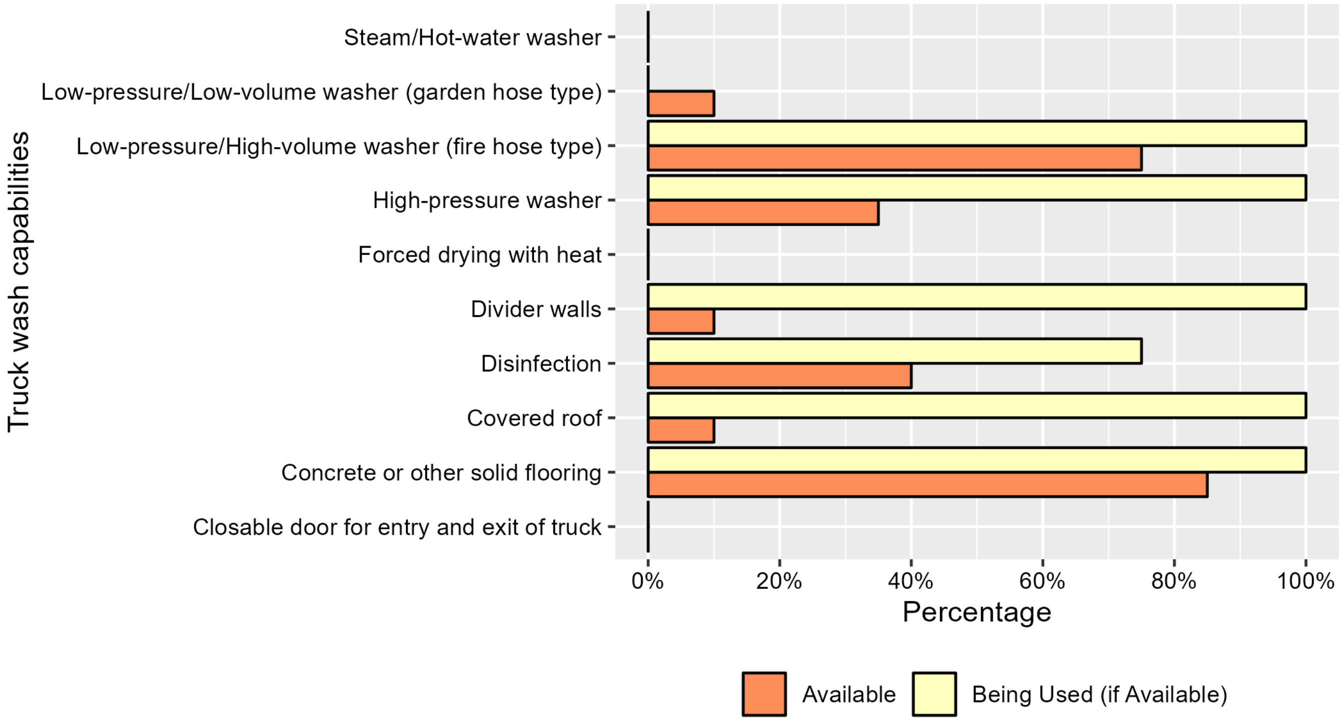

Figure 5: Availability of various cleaning, disinfection, and biosecurity management capabilities at ABATTOIR-owned truck wash facilities.

3.2.2 Truck washing procedures and quality assurance

Of the 20 respondents who used a truck washing facility owned by an ABATTOIR, all indicated that the truck driver, rather than specialized staff, was responsible for washing the trailer and/or truck in that facility (Table 6). Approximately 80% responded that there was "No inspection" done after washing at the facility with fewer indicating that inspection was completed but with varying level of records kept around the activity (Table 7).

Respondents reported that it took longer to wash at an ABATTOIR-owned truck wash than at a facility owned by a transporter but the reason for this is unknown based on the survey data. Around 30% of respondents indicated that it takes “Two hours or more” to wash the crate and trailer at an abattoir compared to only 14% that required this much time when washing at a transporter-owned truck wash (Table 8).

Table 6: Person responsible for carrying out the actual truck washing process in an ABATTOIR-owned facility.

Person responsible for washing	No. of respondents	Pct. of respondents
Driver	20	100.0%
Facility staff	0	0.0%
Varies	0	0.0%

Table 7: Use of quality assurance procedure after washing in an ABATTOIR-owned facility.

Quality assurance after washing	No. of respondents	Pct. of respondents
No inspection	16	80.0%
Yes, and a record of inspection is kept	1	5.0%
Yes, but no record of inspection is kept	3	15.0%

Table 8: Time required to wash a truck and crate in an ABATTOIR-owned facility.

Time required for washing	No. of respondents	Pct. of respondents
Less than an hour.	1	5.0%
At least one hour, but less than two hours.	13	65.0%
Two hours or more.	6	30.0%

3.2.3 Cost of truck washing

Survey participants were asked about the costs involved in washing crates/trailers at an ABATTOIR-owned truck washing facility. Respondents indicated the average cost was $102 AUD but ranged from a low of $1 AUD to a high of $300 AUD. When asked about how this cost was recovered from the client, 17 of 20 respondents answered that the “Cost is built-in to the transportation charge” as compared to “Pass cost along to the client”.

3.3 Use of THIRD-PARTY truck wash facilities used by a transporter that are located at an SALEYARD

3.3.1 Capabilities and their usage

Respondents who used a truck wash facility located at a SALEYARD (n = 17) were asked to describe the various cleaning, disinfection, and biosecurity management capabilities available at that facility. Respondents were presented with a list of ten common capabilities that might be expected to be found at a truck wash designed for cleaning livestock transport vehicles. The proportion of truck wash facilities located an an SALEYARD that had each capability are shown in Figure 6, along with the likelihood that each would be used during a pig truck cleaning process.

At SALEYARD-owned truck washes, the availability of various cleaning processes were similar in many respects though the availability of “Disinfection” processes at SALEYARD-owned facilities was substantially lower (6%) than both transporter-OWNED (57%) and ABATTOIR-owned (40%) facilities.

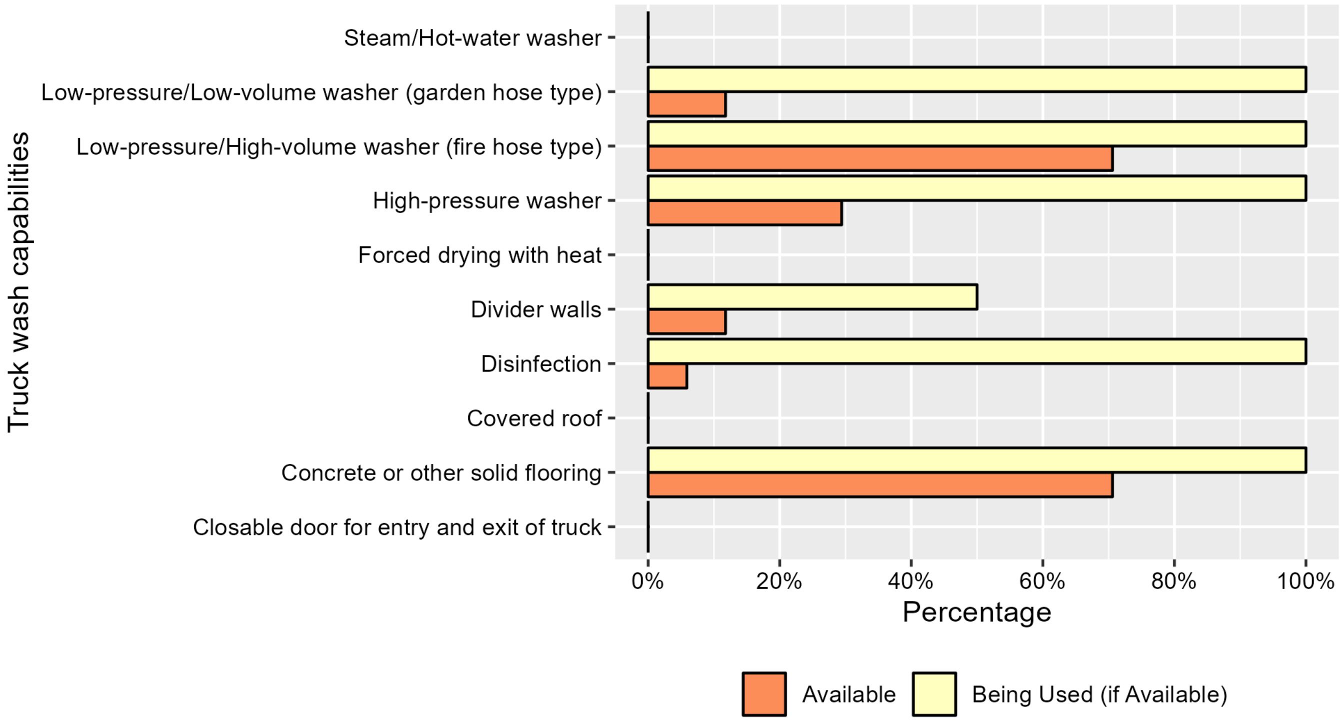

Figure 6: Availability of various cleaning, disinfection, and biosecurity management capabilities at SALEYARD-owned truck wash facilities.

3.3.2 Truck washing procedures and quality assurance

Of the 17 respondents who used a truck washing facility owned by a SALEYARD, all indicated that the truck driver, rather than specialized staff, was responsible for washing the trailer and/or truck in that facility (Table 9). Approximately 76% responded that there was "No inspection" done after washing at the facility with fewer indicating that inspection was completed but with varying level of records kept around the activity (Table 10).

Respondents reported that it took about the same time to wash at a SALEYARD-owned truck wash than at a facility owned by a transporter; a majority of respondents (76%) indicated that it takes "At least one hour, but less than two hours" to wash the crate and trailer at a SALEYARD (Table 11).

Table 9: Person responsible for carrying out the actual truck washing process in an SALEYARD-owned facility.

Person responsible for washing	No. of respondents	Pct. of respondents
Driver	17	100.0%
Facility staff	0	0.0%
Varies	0	0.0%

Table 10: Use of quality assurance procedure after washing in an SALEYARD-owned facility.

Quality assurance after washing	No. of respondents	Pct. of respondents
No inspection	13	76.5%
Yes, and a record of inspection is kept	0	0.0%
Yes, but no record of inspection is kept	4	23.5%

Table 11: Time required to wash a truck and crate in an SALEYARD-owned facility.

Time required for washing	No. of respondents	Pct. of respondents
Less than an hour.	2	11.8%
At least one hour, but less than two hours.	13	76.5%
Two hours or more.	2	11.8%

3.3.3 Cost of truck washing

Survey participants were asked about the costs involved in washing crates/trailers at a SALEYARD-owned truck washing facility. Respondents indicated the average cost was $161 AUD but ranged from a low of $46 AUD to a high of $440 AUD. When asked about how this cost was recovered from the client, 14 of 17 respondents answered that the “Cost is built-in to the transportation charge” as compared to “Pass cost along to the client”.

3.4 Use of THIRD-PARTY truck wash facilities used by a transporter that are operated as a COMMERCIAL TRUCK WASH

3.4.1 Capabilities and their usage

Respondents who used a COMMERCIAL TRUCK WASH facility (n = 3) were asked to describe the various cleaning, disinfection, and biosecurity management capabilities available at that facility. Respondents were presented with a list of ten common capabilities that might be expected to be found at a truck wash designed for cleaning livestock transport vehicles. The proportion of COMMERCIAL TRUCK WASH facilities that had each capability are shown in Figure 7, along with the likelihood that each would be used during a pig truck cleaning process.

At COMMERCIAL TRUCK WASHES, the availability of various cleaning processes were similar in many respects though “Disinfection” processes were not available at any of the facilities.

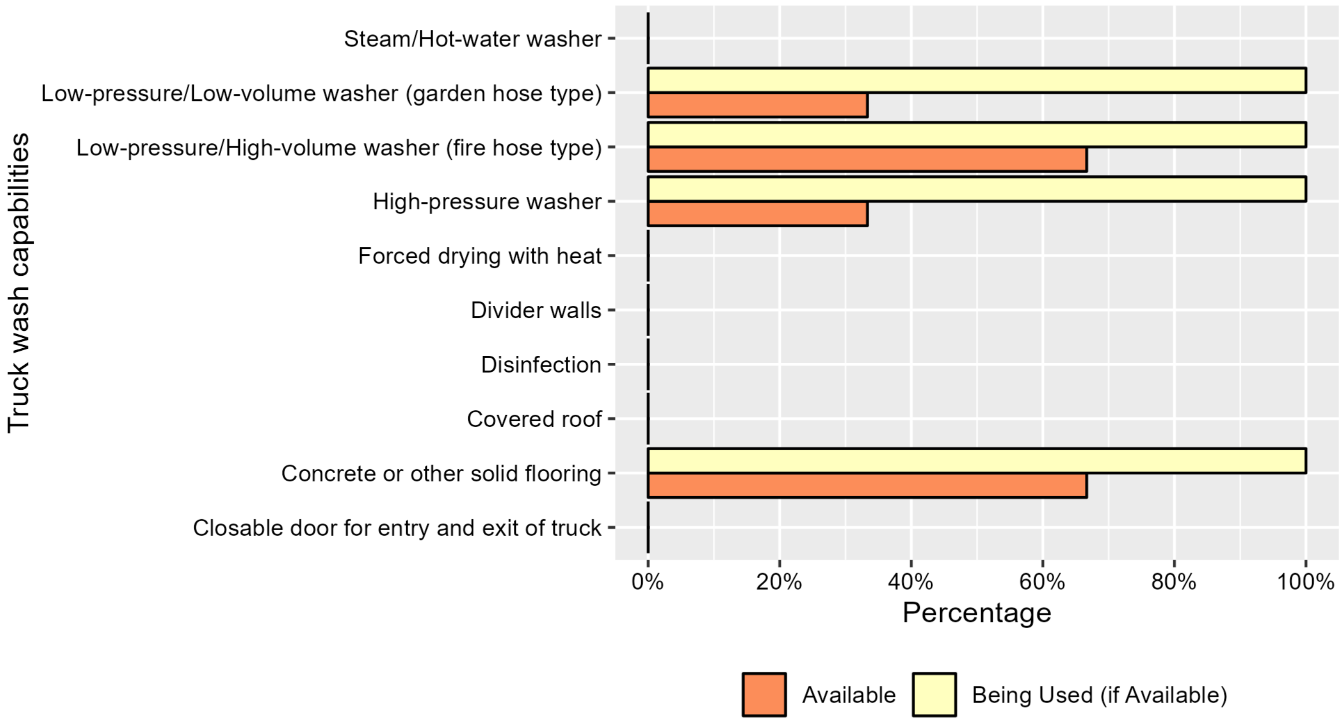

Figure 7: Availability of various cleaning, disinfection, and biosecurity management capabilities at COMMERCIAL TRUCK WASH facilities.

3.4.2 Truck washing procedures and quality assurance

Of the three respondents who used a COMMERCIAL TRUCK WASHING facility, all indicated that the truck driver, rather than specialized staff, was responsible for washing the trailer and/or truck in that facility (Table 12). Approximately 67% responded that there was “No inspection” done after washing at the facility with fewer indicating that inspection was completed but with varying level of records kept around the activity (Table 13).

Respondents reported that it took about the same time to wash at a COMMERCIAL TRUCK WASH as at a facility owned by a transporter; a majority of respondents (67%) indicated that it takes "At least one hour, but less than two hours" to wash the crate and trailer at a COMMERCIAL TRUCK WASH (Table 14).

Table 12: Person responsible for carrying out the actual truck washing process in an COMMERCIAL TRUCK WASH facility.

Person responsible for washing	No. of respondents	Pct. of respondents
Driver	3	100.0%
Facility staff	0	0.0%
Varies	0	0.0%

Table 13: Use of quality assurance procedure after washing in an COMMERCIAL TRUCK WASH facility.

Quality assurance after washing	No. of respondents	Pct. of respondents
No inspection	2	66.7%
Yes, and a record of inspection is kept	0	0.0%
Yes, but no record of inspection is kept	1	33.3%

Table 14: Time required to wash a truck and crate in an COMMERCIAL TRUCK WASH facility.

Time required for washing	No. of respondents	Pct. of respondents
Less than an hour.	0	0.0%
At least one hour, but less than two hours.	2	66.7%
Two hours or more.	1	33.3%

3.4.3 Cost of truck washing

Survey participants were asked about the costs involved in washing crates/trailers at a COMMERCIAL TRUCK WASHING facility. Respondents indicated the average cost was $142 AUD but ranged from a low of $66 AUD to a high of $201 AUD. When asked about how this cost was recovered from the client, 3 of 3 respondents answered that the "Cost is built-in to the transportation charge" as compared to "Pass cost along to the client".

3.5 Use of THIRD-PARTY truck wash facilities used by a transporter that are located at a PIGGERY

3.5.1 Capabilities and their usage

Respondents who used a used a truck washing facility located at a PIGGERY (n = 3) were asked to describe the various cleaning, disinfection, and biosecurity management capabilities available at that facility. Respondents were presented with a list of ten common capabilities that might be expected to be found at a truck wash designed for cleaning livestock transport vehicles. The proportion of facilities located at a PIGGERY that had each capability are shown in Figure 8, along with the likelihood that each would be used during a pig truck cleaning process.

The authors do not have detailed information to describe under what circumstances a commercial livestock hauler would use an on-farm truck wash as the practice has significant biosecurity implications. Our assumption is that this is occuring under unique and limited conditions such as:

- The truck is washed somewhere else first (heavy wash) then is re-washed (light wash, plus disinfection) before loading pigs at the piggery that owns the truck wash
- The result of a negotiated agreement between a farm and a commercial transporter where remoteness means no other truck washing facilities are available, or

- There is a complete absence of other pigs in the area (and/or among the transporter's other clients).

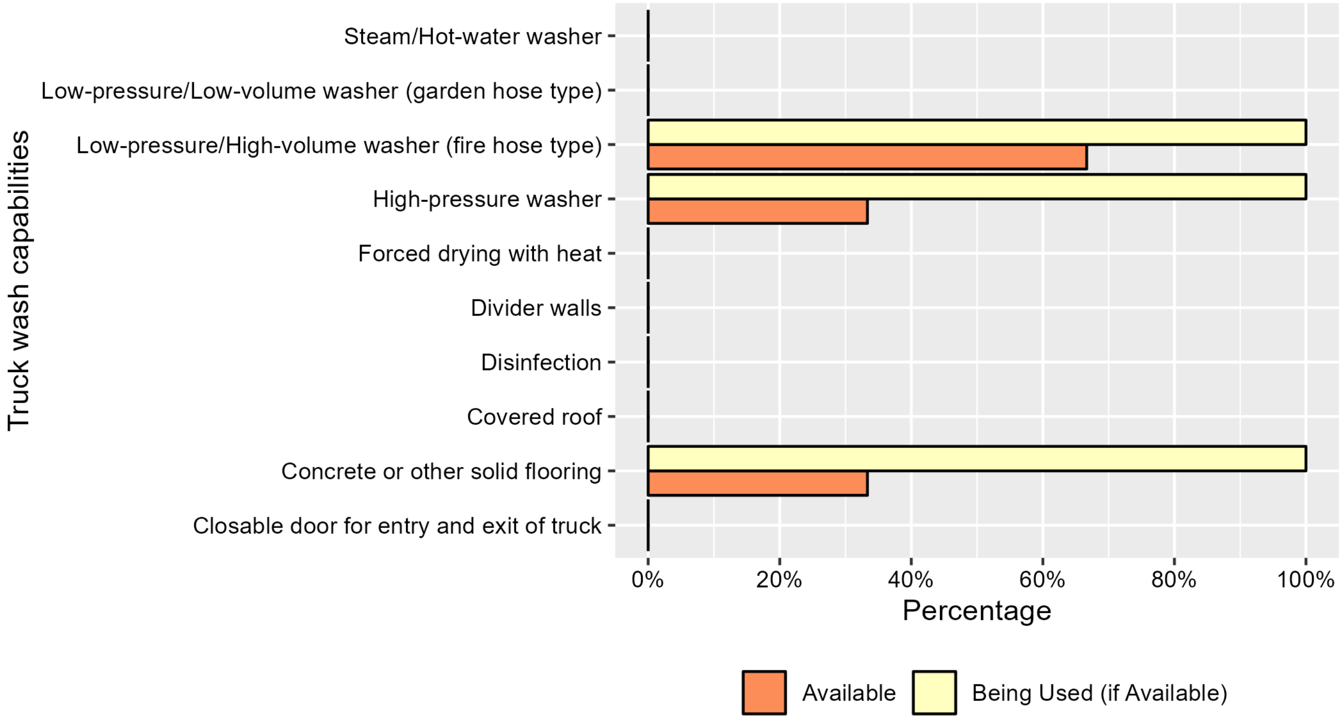

Figure 8: Availability of various cleaning, disinfection, and biosecurity management capabilities at truck washing facilities located at a PIGGERY.

3.5.2 Truck washing procedures and quality assurance

Of the three respondents who used a truck washing facility at a PIGGERY, all indicated that the truck driver, rather than specialized staff, was responsible for washing the trailer and/or truck in that facility (Table 15) in a situation similar to all other third-party controlled truck washes. Approximately 67% responded that there was "No inspection" done after washing at the facility with fewer indicating that inspection was completed but with varying level of records kept around the activity (Table 16).

Respondents reported that it took about the same time to wash at a truck wash located at a PIGGERY as at a facility owned by a transporter; a majority of respondents (67%) indicated that it takes "At least one hour, but less than two hours" to wash the crate and trailer at a truck wash located at a PIGGERY (Table 17).

Table 15: Person responsible for carrying out the actual truck washing process in a truck wash located at a PIGGERY.

Person responsible for washing	No. of respondents	Pct. of respondents
Driver	3	100.0%
Facility staff	0	0.0%
Varies	0	0.0%

Table 16: Use of quality assurance procedure after washing in a truck wash located at a PIGGERY.

Quality assurance after washing	No. of respondents	Pct. of respondents
No inspection	2	66.7%
Yes, and a record of inspection is kept	0	0.0%
Yes, but no record of inspection is kept	1	33.3%

Table 17: Time required to wash a truck and crate in a truck wash located at a PIGGERY.

Time required for washing	No. of respondents	Pct. of respondents
Less than an hour.	1	33.3%
At least one hour, but less than two hours.	2	66.7%
Two hours or more.	0	0.0%

3.5.3 Cost of truck washing

Survey participants were asked about the costs involved in washing crates/trailers at a truck washing facility located on a PIGGERY but only 1 of the 3 transporters using these indicated there was a cost associated with this. This respondent indicated the cost was $100 AUD. When asked about how this cost was recovered from the client, 1 of 1 respondents answered that the “Cost is built-in to the transportation charge” as compared to “Pass cost along to the client”.

4 Miscellaneous biosecurity topics

4.1 Emergency animal disease (EAD) preparedness

Survey participants were asked if 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 African swine fever were to occur in their operational area (or if one of their clients were involved). Only 8 of 26 (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. Respondents were asked what type of staff members in their organisation, from the following list, would be expected to be familiar with the contents of their EAD procedure manual:

- Owners/Directors
- Managers
- Administrative staff
- Operational staff
- Casual staff

Responses to the question are shown in Figure 9.

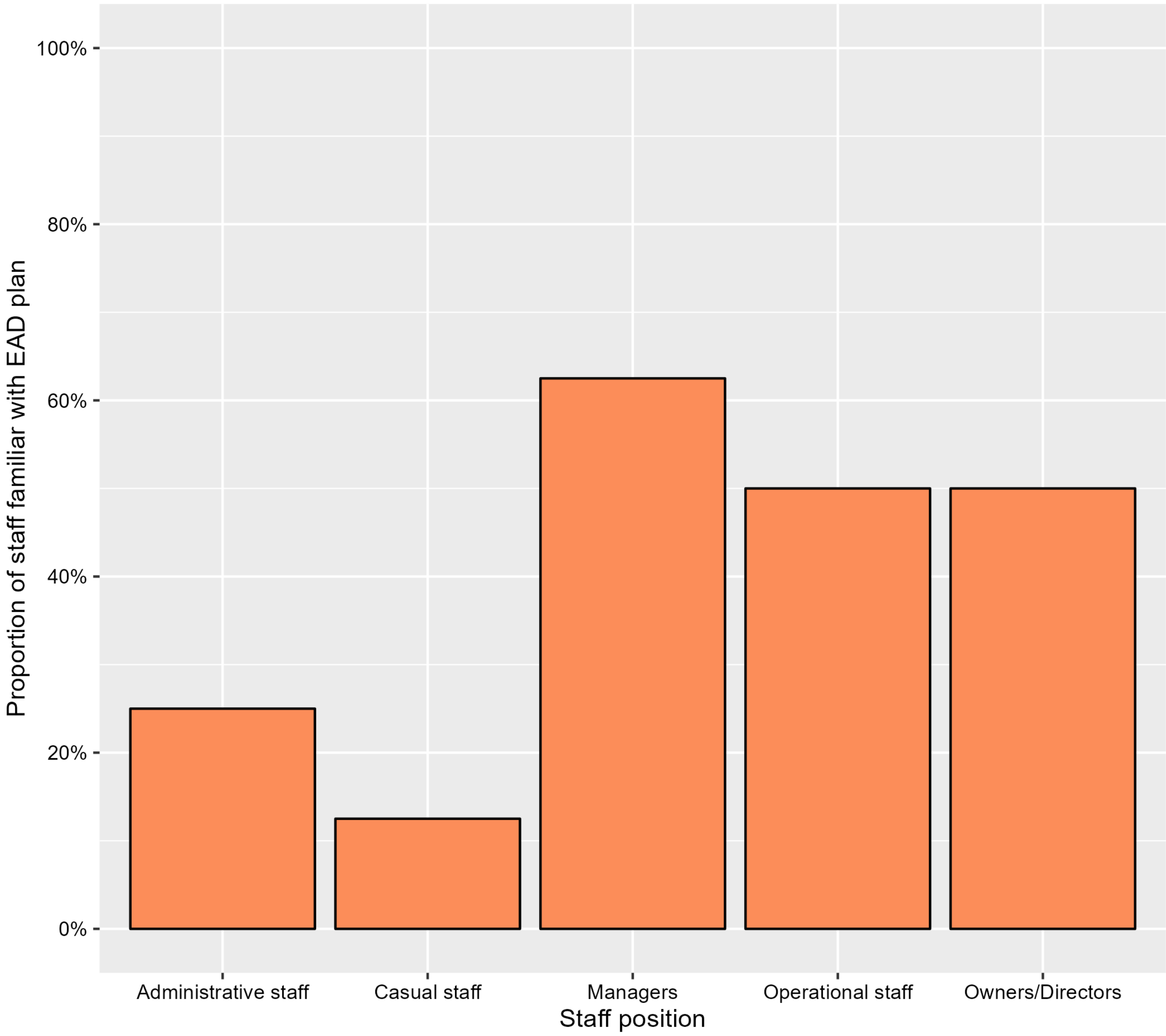

Figure 9: Proportion of commercial livestock transport company staff members expected to be familiar with an EAD plan (amongst those that had developed an EAD plan).

4.2 Use of bedding in pig trailers or crates

Only 1 of 26 (4%) indicated they used bedding when hauling pigs, regardless of the age or production phase of the pig being hauled.

The survey participant that responded "Yes" to use of bedding was asked about the type of bedding they used for various stock classes and the frequency with which they used bedding, from the following choices:

Frequency of use

- Always
- Sometimes
- Never

Type of bedding material used

- Straw
- Wood chips
- Other, or varies

Stock classes for which they may choose to use bedding

- Weaned pigs (8-15 kgs)
- Young growers (approx. 16-30 kgs)
- Fatteners (to slaughter)
- Breeding boars
- Breeding females (replacement gilts)
- Cull sows and boars
- Cull weaners or growers

A summary of this participant's use of bedding materials, based on the above choices, is shown in Table 18.

Table 18: Type and frequency of bedding use by stock class.

Frequency of use	Type of bedding used	Pct. of time bedding type is used with this age pig	Pig age/class
Sometimes	Straw	100%	Weaned pigs (8-15 kgs)
Sometimes	Straw	100%	Young growers (approx. 16-30 kgs)
Never	Other, or varies	100%	Fatteners (to slaughter)
Never	Other, or varies	100%	Breeding boars
Never	Other, or varies	100%	Breeding females (replacement gilts)
Never	Other, or varies	100%	Cull sows and boars
Never	Other, or varies	100%	Cull weaners or growers

4.3 Trailer details and flooring type

In Australia, livestock transport trailers/crates are configured in many different ways. In particular, the type of flooring type in a trailer has a substantial effect on ease of cleaning, and therefore contributes to the biosecurity risk associated with pig transport. Commercial haulers in this survey were asked to report what proportion of their fleet that was used to haul pigs, had each of three different types of flooring: Wood, metal, and Other. A detailed list of the responses (listed by anonymous TransporterID) is shown in Table 19. A summary of this data across all pig transporters is shown in Table 20

Table 19: Type and frequency of bedding use by stock class.

TransporterID	Pct of fleet with wooden flooring	Pct of fleet with metal flooring	Pct of fleet with other type of flooring
R_9Qw80PVajoyaabf	0%	100%	0%
R_3sAOLp0DZrldSga	0%	100%	0%
R_1mU8gR1bBZXCF7k	5%	95%	0%
R_2BbTw5OLMyw2B9w	0%	0%	100%
R_3q8tlDKHL4inyAK	50%	50%	0%
R_27PT9e44KYOu1av	0%	100%	0%
R_1eRGsuhOlxAT7ej	14%	86%	0%
R_3k7zsbbDQbOg5JT	34%	66%	0%
R_1FyAV9hts6liR9s	0%	100%	0%
R_3Iaaos6q3SwXrAF	33%	67%	0%
R_2YMaOck1f2B7dAL	24%	76%	0%
R_2xM1WKnKG2YSJUH	0%	100%	0%
R_1KvAwKxFAjmiEMA	0%	100%	0%
R_24vDknjKGUqmQGh	0%	100%	0%
R_3KPlGDlPfeoEV8r	0%	100%	0%

TransporterID	Pct of fleet with wooden flooring	Pct of fleet with metal flooring	Pct of fleet with other type of flooring
R_2RUJxS5pfFilDbY	0%	100%	0%
R_8hPZY1FNVQcR409	0%	100%	0%
R_z8YueWVUjLjF4U9	0%	100%	0%
R_ah4C71vhuAuujQt	0%	100%	0%
R_1lzOYZ1n5rftM82	0%	100%	0%
R_2AXZmMml8ARmAN4	33%	66%	1%
R_D8H5AILr9tcdOWB	0%	100%	0%
R_d7r0Y9vxea6gieB	0%	100%	0%
R_1OMJBtcteFRp7yF	0%	100%	0%
R_3n2XFC3tTu4VKpL	0%	100%	0%
R_2VOPvpUkwaGo5zq	30%	70%	0%

Table 20: Average percent of pig transportation fleet using trailers or crates with different flooring types.

Average % of fleet with wooden flooring	Average % of fleet with metal flooring	Average % of fleet with other type of flooring
9%	88%	4%

Finally, transport operators were asked an open-ended question to help determine the extent to which they may have made any custom modifications to the design of their pig hauling trailers/crates in order to make them easier to clean or disinfect. The comments received are shown in Table 21.

Table 21: Comments from respondents describing any modifications done to pig-hauling trailers or crates designed to make them easier to clean or disinfect.

Comment from transporter
Drains fitted on 1st and 2nd decks for effluent to run down designated points. Floor profile runs front to back for effluent to run freely to rear of trailer. Trailers fitted with effluent tanks to catch effluent.
They stand on a melwire base which drains droppings and urine into a pan.
Some crates have a sprinkler system designed for cooling but this can also be used to make washing easier.
have put in sprinklers in them.
Only modification is the flooring runs length ways to allow flow of water to rear drain holes
Changed from steel to aluminium
Yes added new Al decking which makes it easier to clean

Producer Survey Report

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1 Study Background

African swine fever (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.

This survey of Australian pork farms is part of a larger study, funded by producers through Australian Pork Limited (APL) levies, to identify risks related to pig transportation on Australian pork farms. The survey is intended to describe the existing biosecurity measures taking place on farms today and also to identify opportunities for developing best practices to help manage transport biosecuity risks.

The data presented in this report is derived from an online survey sent to a sample of producers randomly selected from the APL farmer database. Within the scope of this project, 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. This information will help to identify opportunities for improvements in biosecurity related to transport that could be implemented at either an individual farm level or through whole-of-industry actions.

The online survey was conducted on behalf of APL. 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

The list of producer emails (and phone numbers when required) was provided by APL.

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).

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 by proxy during one of the follow-up telephone calls 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 sample frame by farm size and the respective response rates for each are shown in Table 1. The overall response rate to the survey was 32%.

Table 1: Sampling frame and response rate of farms invited to participate in the survey. Table only includes farms that could be matched against the APL farm class definitions (i.e. direct phone contact surveys not included in table).

APL farm class	No. of surveys sent	Proportion sent by class	No. complete surveys	No. uncompleted surveys	Proportion finished by class	Response rate by class
Sows<51andGrowers>50	56	43%	10	46	29%	18%
SowHerd51-100	18	14%	5	13	14%	28%
SowHerd101-500	27	21%	8	19	23%	30%
SowHerd501-1000	18	14%	8	10	23%	44%
SowHerd1001-5000	11	8%	4	7	11%	36%

2 Demographics of survey respondents

2.1 Pigs numbers and types

The average daily inventory of pigs on their farm, by pig type, was reported by each respondent.

- Breeding sows: 969
- Pre-weaning (suckers): 885
- Post-weaning (weaners + growers + finishers): 11,022
- Breeding boars: 10
- Total pigs: 12,885

2.2 Main piggery enterprise (type of piggery)

In Australia given the broad range of production types, people's motivation for raising pigs, and the fact that pig production may only constitute a part of a farm's overall farming enterprise, traditional piggery enterprise types such as "farrow-to-finish" or "farrow-to-wean" are often difficult to assign. For this survey, respondents were asked "What is the relative proportion (%) of each of the following activities on the piggery?" with the total of their answer(s) equalling 100%.

- Sell commercial weaners to other farms or saleyards
- Sell commercial porkers/baconers to slaughter
- Sell genetic gilts or boars (any weight) to other farms
- Sell or produce semen for use by other farms
- Not really a commercial piggery, I just raise a few to eat, trade, or as a hobby

The details on various activities based on which each of the respondents business type can be classified for all the 41 farms is shown in Table 2.

Table 2: Average proportion of a respondent's effort directed toward different types of pig enterprise activities.

Type of piggery activity	Proportion of piggery effort directed at that activity
Sell commercial weaners to other farms or saleyards	7.0%
Sell commercial porkers/baconers to slaughter	91.6%
Sell genetic gilts or boars (any weight) to other farms	1.2%
Sell or produce semen for use by other farms	0.0%
Not really a commercial piggery, I just raise a few to eat, trade, or as a hobby	0.2%

By a large margin, the most common activity on farms that responded to the survey was "Sell commercial porkers/baconers to slaughter", with 91.6% of the typical respondent's effort directed towards this activity. This does not mean that 91.6% of respondents were involved in "Sell commercial porkers/baconers to slaughter". 0.0% of respondents reported that they "Sell or produce semen for use by other farms".

2.3 Movement of pigs off the farms

97.6% of respondents reported having some type of movement(s) of live pigs off their farm during the last 12 month period.

The most common destination for movements of pigs off of farms was to an abattoir with 65.9% of respondents indicating this movement took place at least on a weekly basis. The frequency of movements to various destinations for all the farms is shown in Figure 1.

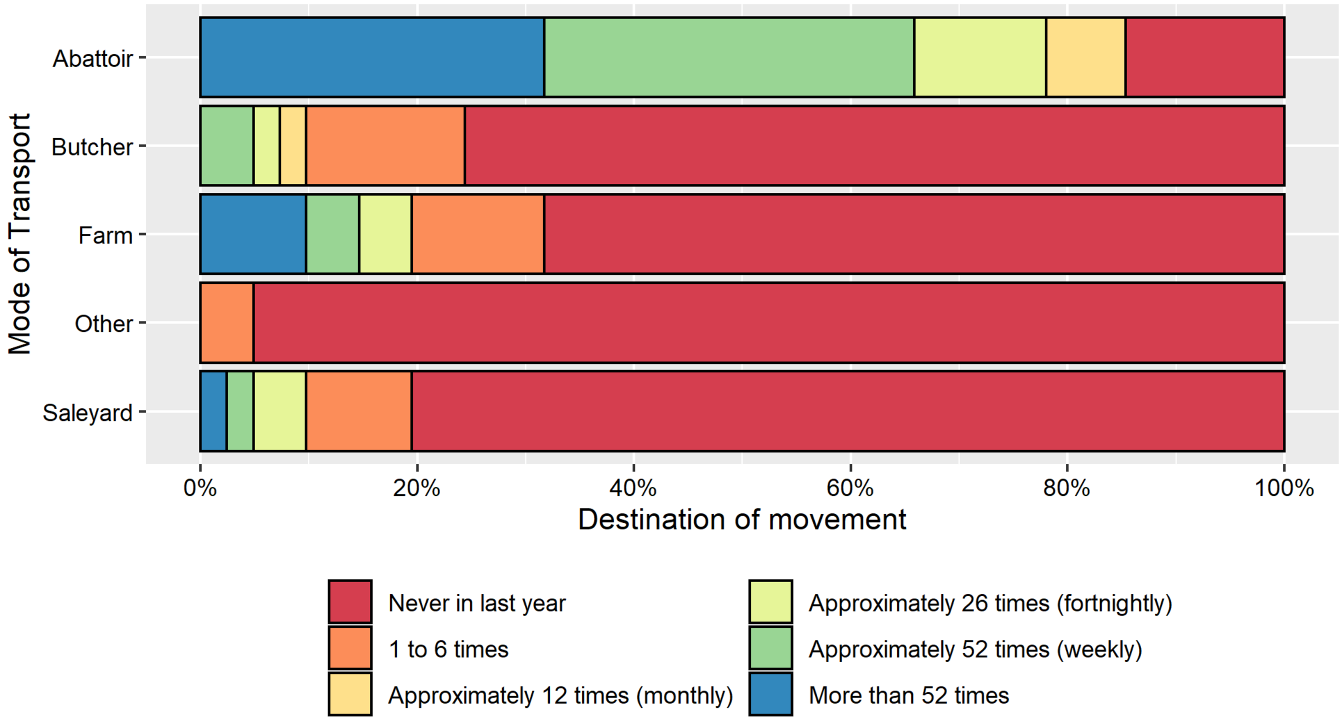


Figure 1: Type of business for each of the farms (Activities)

For questions related to movement of pigs off farm, respondents were asked to consider only activities occurring over the previous 12 months.

Among the 41 respondents, only 22 respondents indicated that they use their own truck for transporting their pigs to various destinations, 14 indicated they move their pigs with the help of contract haulers, and the remaining 5 respondents reported that they use a combination of self-hauling and contractors for moving their pigs to various destinations (Figure 2). Nineteen respondents (46.3%) indicated that they either exclusively use contract haulers or use a combination of self-haul and contract haulers for transporting their pigs to various destinations.

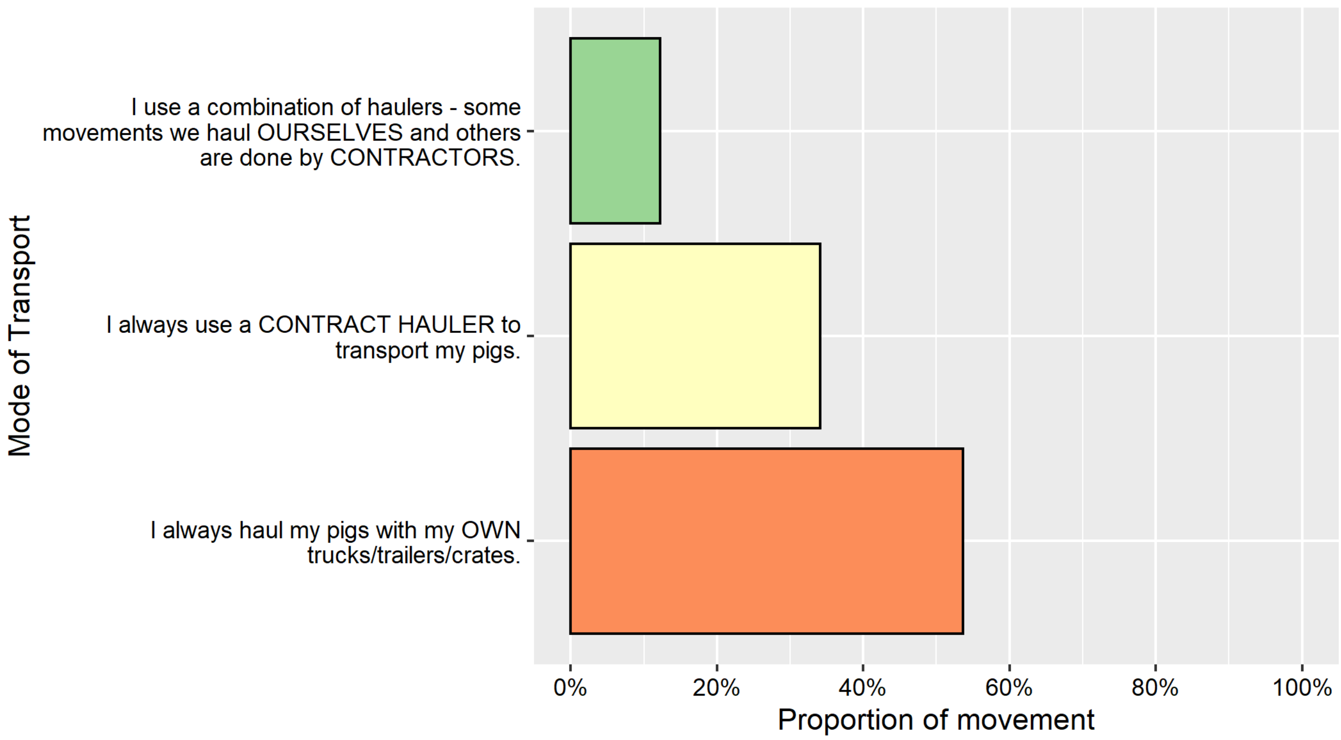


Figure 2: Mode of transportation of pigs off the farms.

3 Biosecurity behaviours related to movement of pigs off-farm

3.1 Pigs already on board prior to arrival at farm

In some instances, pigs may be on board a truck prior to a producer loading his own pigs onto that truck. Amongst all respondents, this was an infrequent occurrence with only 2 of 41 (4.9%) reporting that this occurred in the last 12 months (Table 3).

Table 3: Proportion of producers responding that other pigs were aboard a truck prior to loading their own pigs at least once in the last year.

Type of transport used	No. of respondents	No. reporting pigs on board	Proportion reporting pigs on board
I always haul my pigs with my OWN trucks/trailers/crates.	22	1	4.5%
I always use a CONTRACT HAULER to transport my pigs.	14	0	0.0%
I use a combination of haulers - some movements we haul OURSELVES and others are done by CONTRACTORS.	5	1	20.0%

3.2 Use of on-farm load-outs/lairage when moving pigs off farm

Use of a separate load-out/lairage area as compared to loading-out directly from the shed for various types of pigs are shown in Figure 3 for respondents that only used their own trucks and Figure 4 for respondents that used contract haulers at least some of the time. All respondents indicated that loading directly from the shed occurred at least one time during the last 12 months.

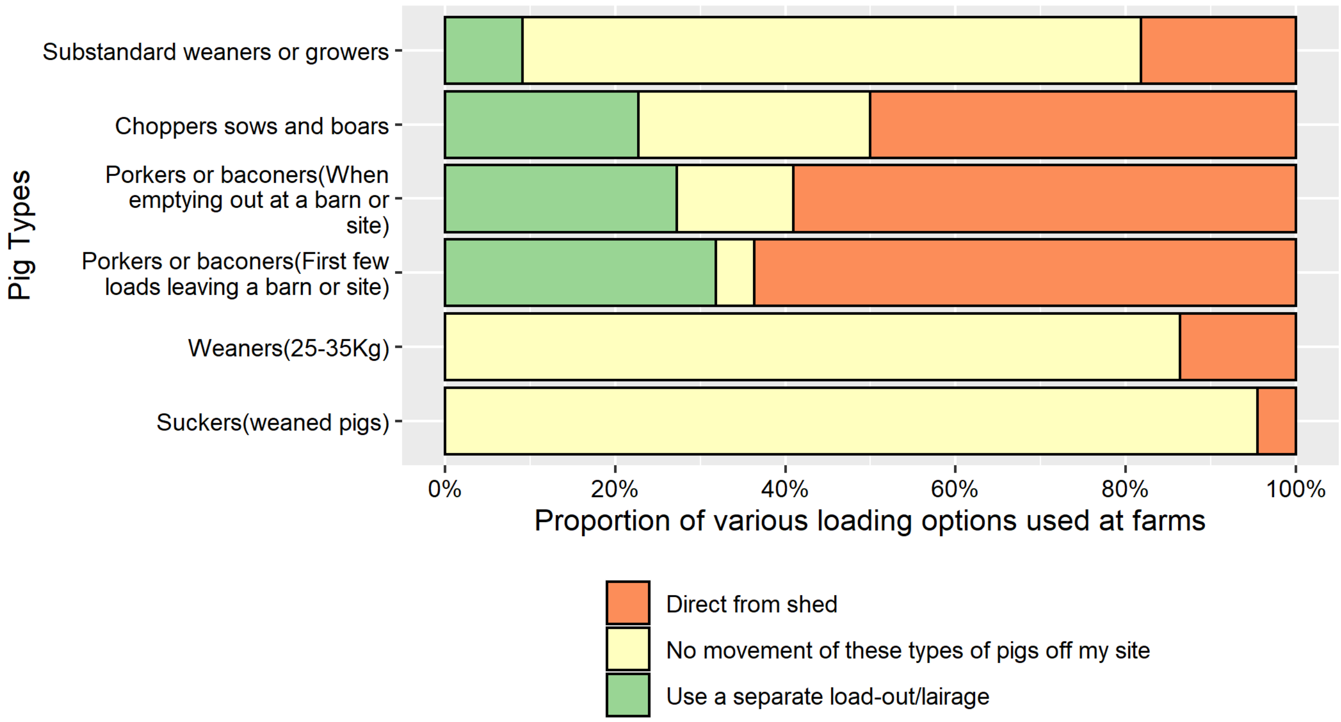


Figure 3: Various loading options when using own truck for transport.

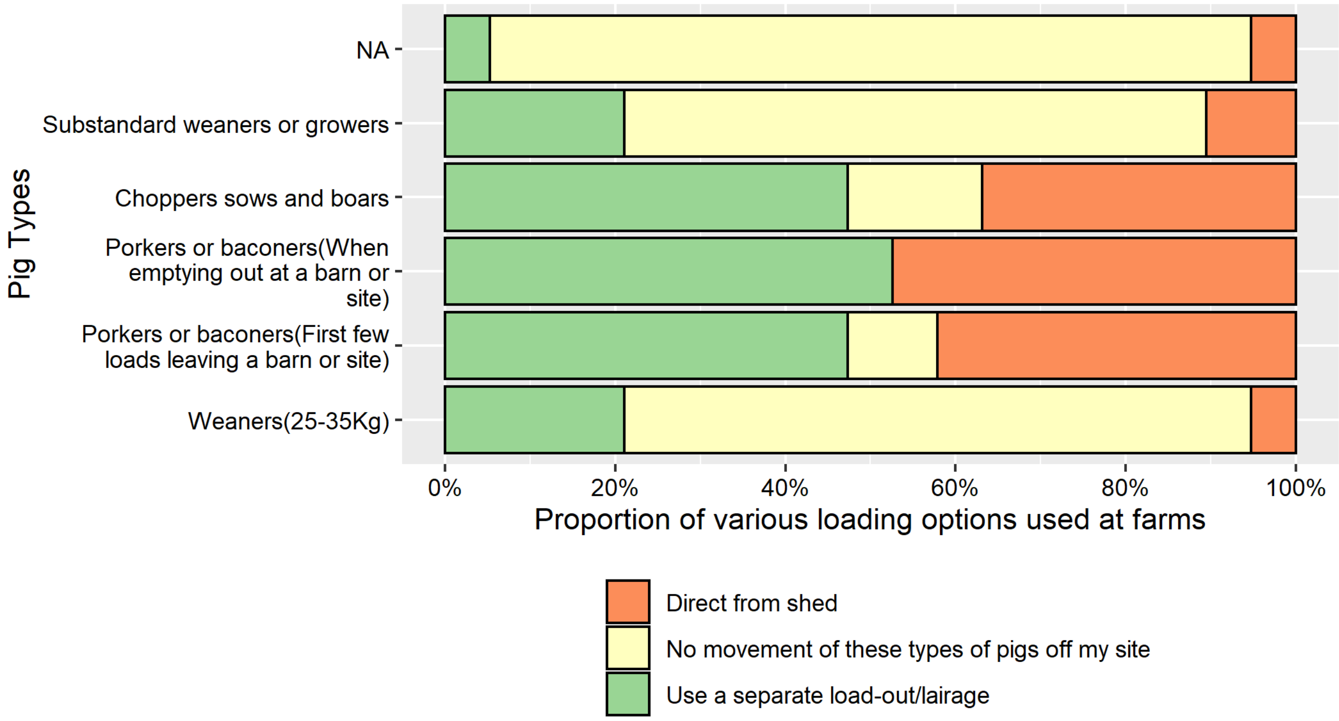


Figure 4: Various loading options when using contract haulers for some or all of their pig transport.

3.3 Driver position during load-out ('line of separation')

The driver movements that occur during loading of pigs when a farmer uses their own truck and driver to haul pigs is in Figure 5. Similar data for farms that use contract haulers some or all of the time is shown in Figure 6.

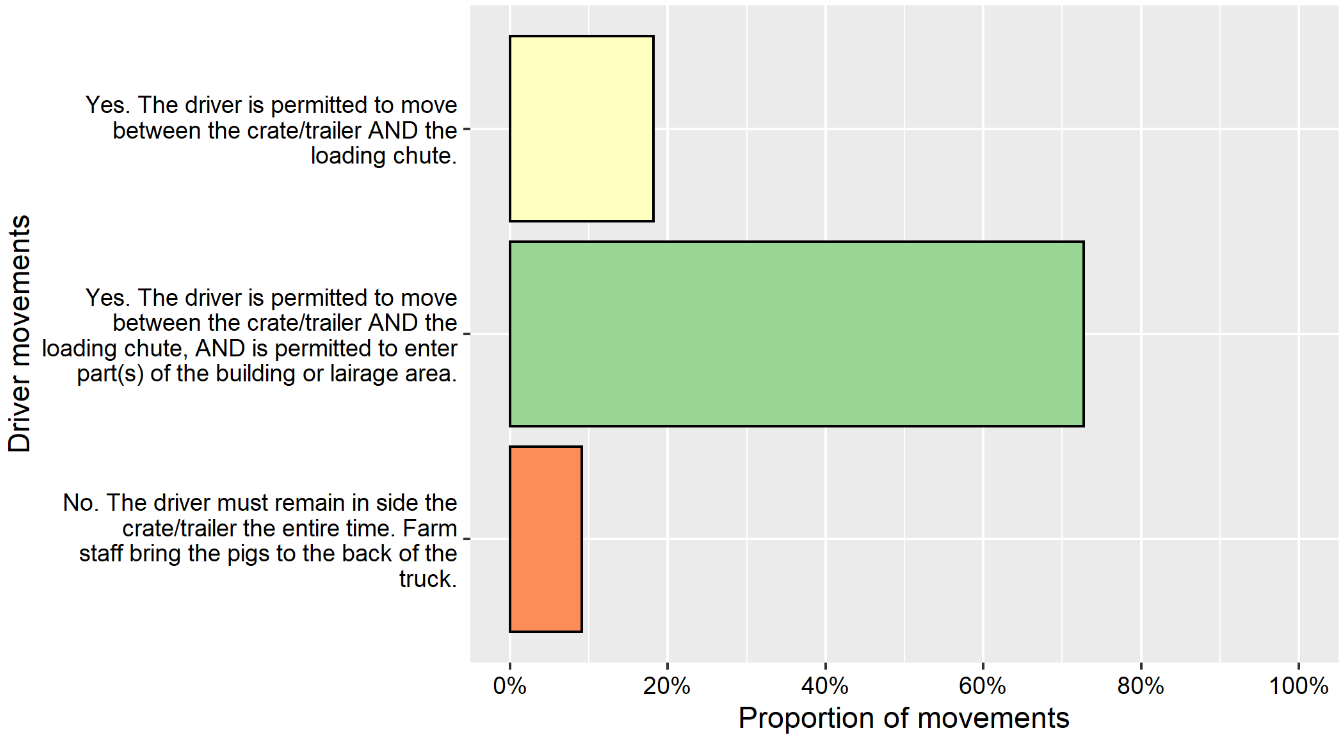


Figure 5: Movement of drivers when using own truck during loadout procedures.

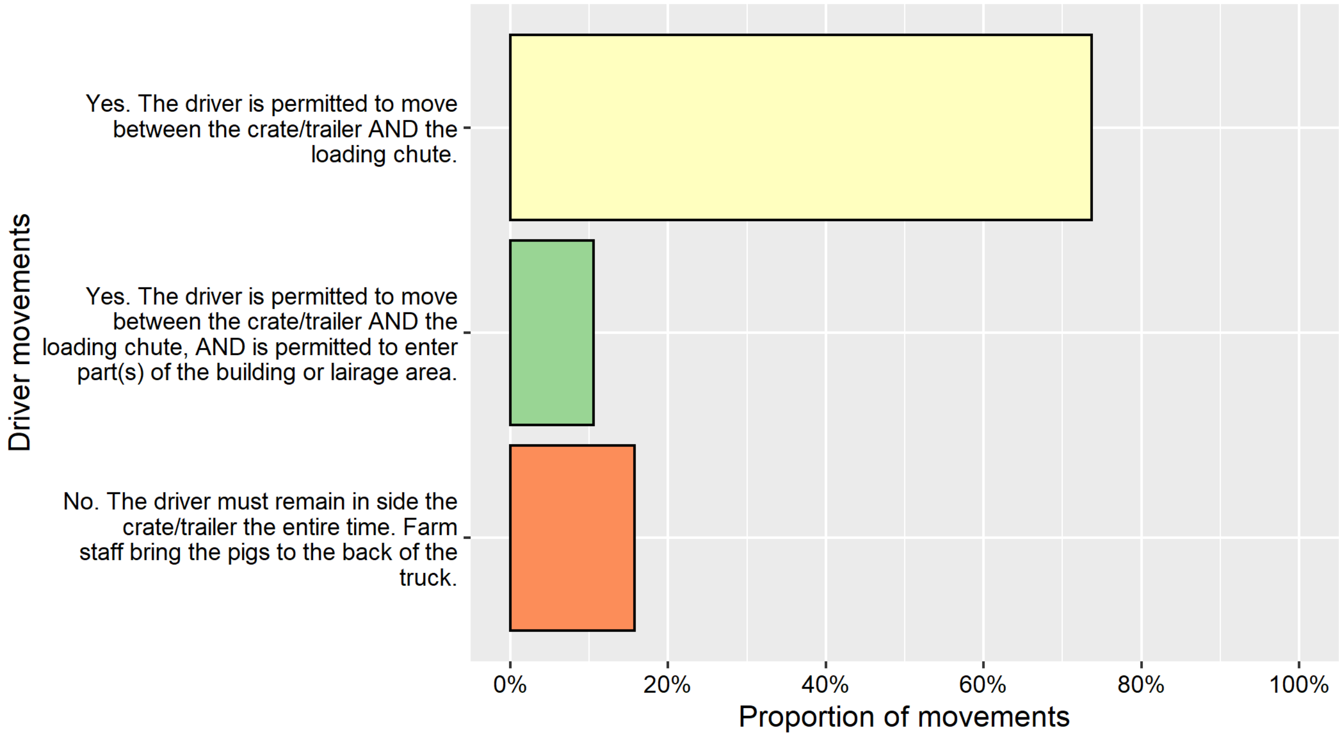


Figure 6: Movement of drivers when using contract haulers.

3.4 Frequency of cross-contamination between driver and farm staff

During any load-out procedure, there is a potential for cross-contamination to occur between the driver (who is almost always involved in the loading process) and staff, regardless of where the "line of separation" has been established ahead of time. Respondents were asked about the frequency that this kind of cross-contamination occurs (Table 4).

Table 4: Proportion of load-out events that involve cross-contamination between farm staff and driver, under three different load-out processes ('lines of separation').

Type of hauler	No. The driver must remain in side the crate/trailer the entire time. Farm staff bring the pigs to the back of the truck.	Yes. The driver is permitted to move between the crate/trailer AND the loading chute	Yes. The driver is permitted to move between the crate/trailer AND the loading chute, AND is permitted to enter part(s) of the building or lairage area
Owned truck and driver	50%	27%	6%
Contract truck and driver	100%	46%	0%

3.5 Truck washing biosecurity (farmers using their own trucks)

3.5.1 Frequency of Washing/cleaning after pig transport

Producer that exclusively used their own trucks for transporting pigs off their farms were asked about their use of truck washes. The proportion of respondents indicating truck wash frequency is shown in Figure 7.

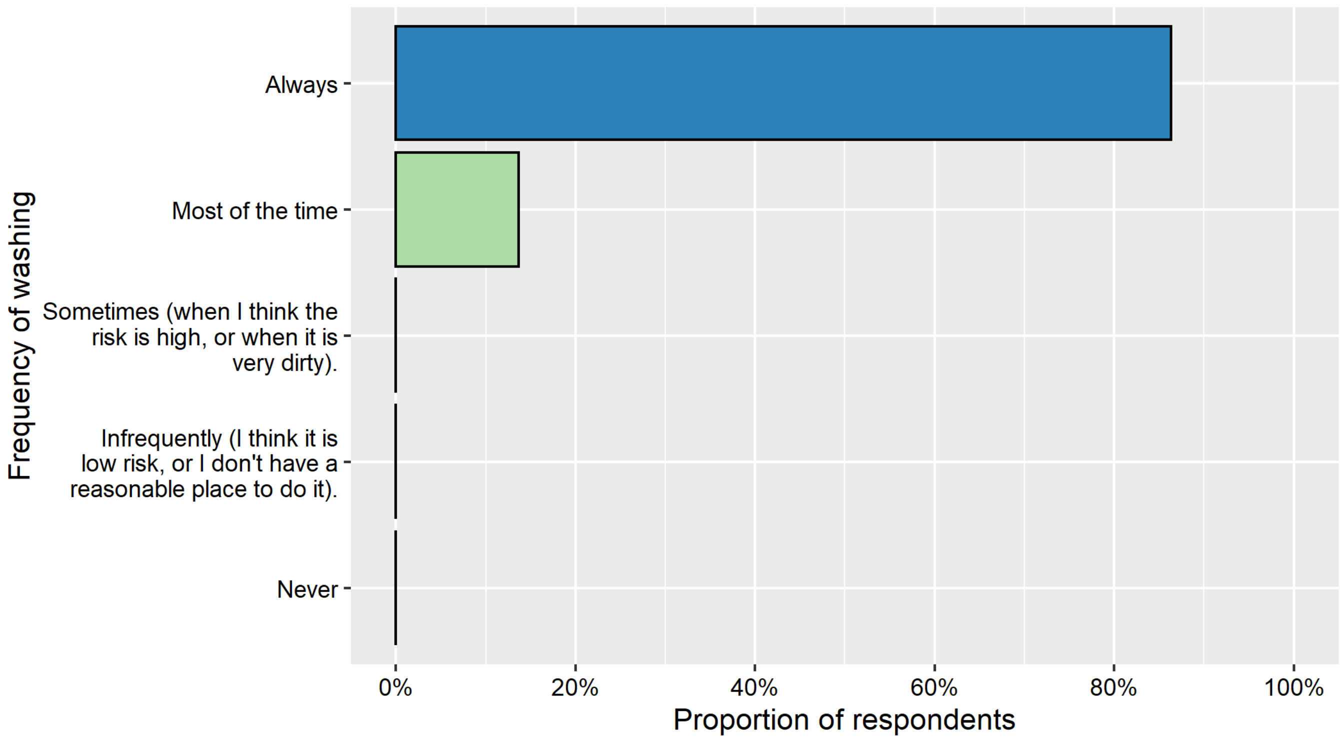


Figure 7: Frequency of Washing of own used trucks between hauls.

3.5.2 Availability of truck washing facilities

A significant constraint to frequent use of truck washing is related to the access (availability and location) of truck washes. Producers that were using only their own trucks to transport their pigs were asked about their access to different kinds of truck wash facilities and a summary of their responses is shown in Table 5.

Table 5: Availability and use of truck wash facilities by producers transporting pigs with their own trucks.

Location of truck wash	Number of farms with access	Proportion of farms with access	Number of farms with access that use it	Proportion of farms with access that use it
Abattoir	10	45%	10	100%
Saleyard	8	36%	4	50%
Commercial truck wash	7	32%	3	43%
Self-owned	12	55%	11	92%

3.5.3 On-farm truck washing facilities: Capabilities and their usage

The 12 respondents that indicated they had access to their own on-farm truck wash facility were asked about the different capabilities that were available to assist in cleaning a truck using good biosecurity procedures. Detail of their responses are shown in Figure 8.

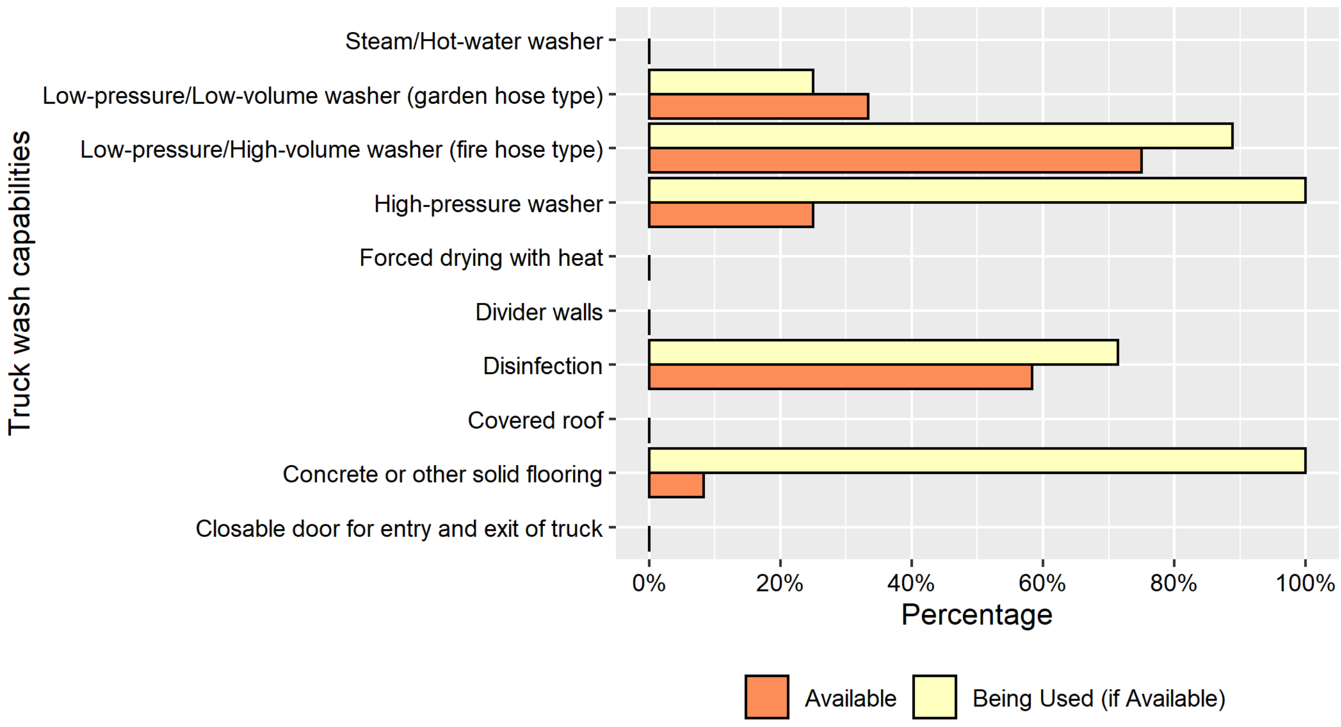


Figure 8: Truck washing capabilities (and usage) found amongst farms that had their own on-farm truck wash.

3.5.4 Disposal of waste water and effluent from on-farm truck washing facility

Of the 12 respondents that had their own on-farm truck washing facility, most (66.7%) used a system where the effluent was Uncontained (Table 6).

Table 6: Methods that respondents with on-farm truck washes used to dispose of effluent from the truck wash.

Q3.10_OwnerEffluent	Proportion of farms
Contained in a dedicated tank or pond for later disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar).	8.3%
Contained, but in the same tank or pond used for holding pig effluent, with eventual disposal on-site, onto nearby farmland, or into a municipal treatment system (or similar).	25.0%
Discharged directly into a municipal treatment system (or similar).	0.0%
Uncontained	66.7%

In most cases, respondents with on-farm truck washes did minimal treatment to effluent collected from the truck wash before disposal (Table 7).

Table 7: Methods that respondents with on-farm truck washes used to treat effluent from the truck wash.

Possible types of effluent treatment	Proportion of farms
Addition of disinfectant or other chemical disinfectant	8.3%
Addition of other chemicals for breaking down solids, but not necessarily a disinfectant	8.3%
Minimum hold time of waste before being applied to land	8.3%
Other	16.7%
Solids separator	0.0%
Water from truck washing is recycled for use back in TRUCK WASH	0.0%

Possible types of effluent treatment	Proportion of farms
Water from truck washing is recycled for use in cleaning PIG FACILITIES	0.0%

3.5.5 Third-party truck washing facilities: Capabilities and their usage

The 20 respondents that indicated they always or occasionally used truch wash facilities at abattoirs, saleyards, or commercial truck washing facilities were asked about the different capabilities that were available to assist in cleaning a truck using good biosecurity procedures. Detail of their responses are shown in Figure 9.

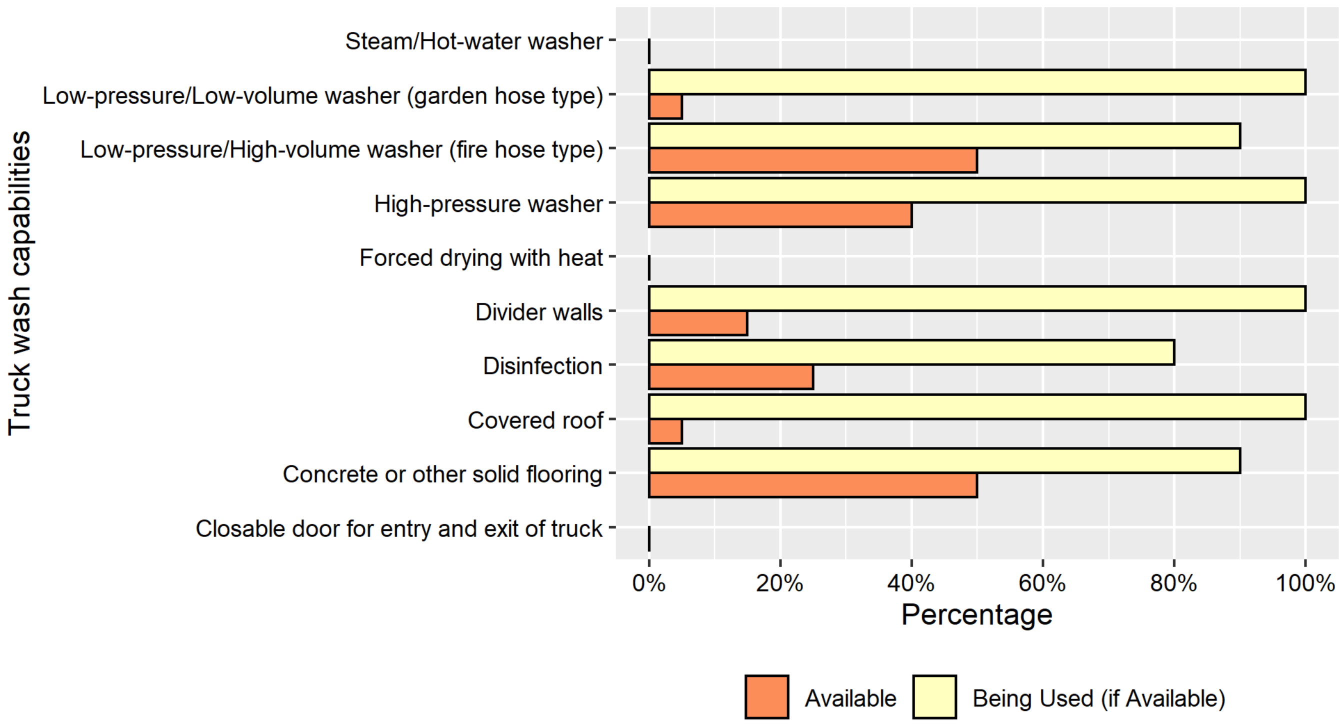


Figure 9: Truck washing capabilities (and usage) at abattoirs, saleyards, and commercial truck washing facilities.

3.6 Biosecurity around moving pigs using contract haulers

Among the 19 respondents that used contract haulers at least once for transporting pigs off their farm, 15 had specific biosecurity requests that the transporter was asked to comply with (Figure 10).

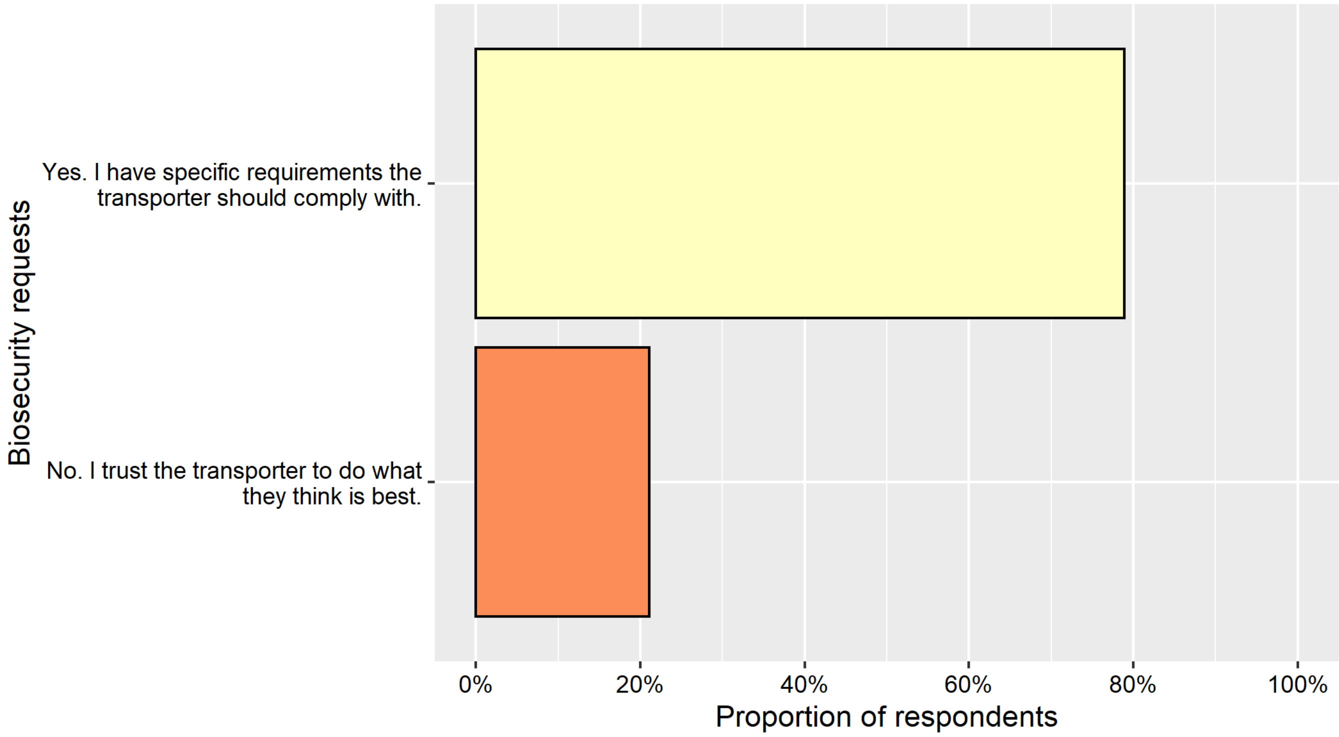


Figure 10: Proportion of respondents that requested specific biosecurity measures when using contract haulers to transport pigs off their farm.

3.6.1 Specific biosecurity requests made by respondents to contract haulers

The level of compliance to each of the specific biosecurity requests is shown in Figure 11.

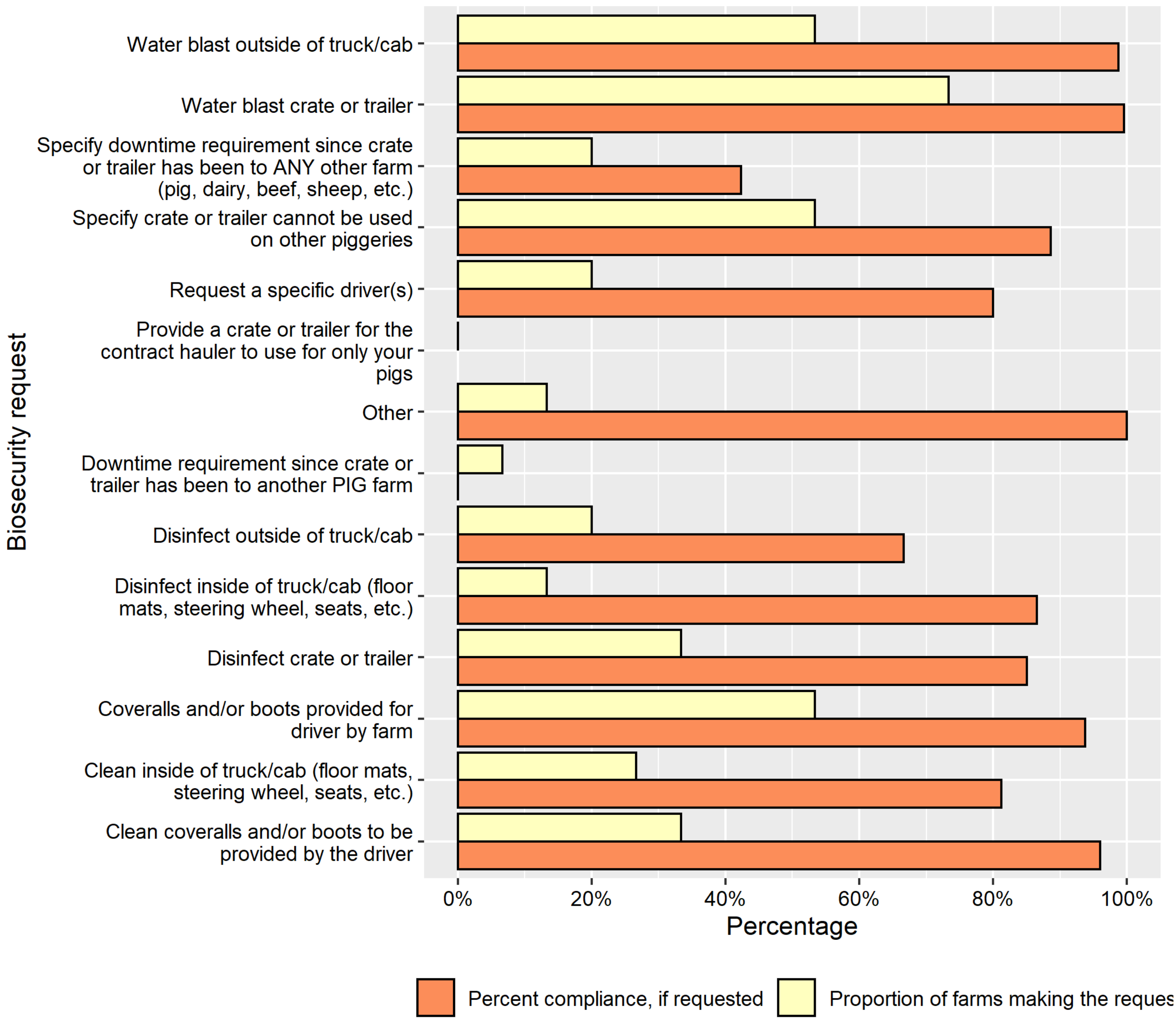


Figure 11: Types and number of request on biosecurity made to contract haulers by farmers.

Standard Operating Procedure

<Insert Company Name>
<Insert Street Address>
<Insert Town, State, Post Code>

Pig transport vehicle cleaning and disinfection

SOP number:	<Insert SOP Number>
Version number:	<Insert Version Number>
Effective date:	<Insert Effective Date>
Review date:	<Insert Review Date>
Approved by:	<Insert Approver Name>

Purpose

This Standard Operating Procedure (SOP) describes procedures for the effective cleaning and disinfection of vehicles used for the transportation of pigs.

This SOP does not specifically cover procedures that may be required when the transport vehicle is contaminated with zoonotic organisms that have a high likelihood of being transmitted to humans and are known to cause serious disease in humans. In these situations, it is likely that additional precautions may need to be taken to minimize risk to people undertaking the procedures below.

Procedure

Contaminated vehicles used to haul livestock, animal feed or products, and their drivers pose a disease dissemination risk. This is true not only for diseases that already exist in Australia but especially those disease agents that are exotic to Australia such as in the case of an Emergency Animal Disease (EAD) outbreak.

It is a priority that no vehicle enters a farm to collect pigs without having been properly cleaned and disinfected. In the situation of an EAD, it is critical that all vehicles leaving a farm known to be an Infected Premises (IP) or a Dangerous Contact Premises (DCPs) be properly decontaminated before leaving, regardless of whether it is carrying pigs or whether it is simply travelling to another location. The need to effectively clean and disinfect trucks used for transporting pigs is recognised as a critical biosecurity step.

This SOP follows the principles of Clean – Disinfect – Dry to ensure vehicles do not present an unacceptable biosecurity risk to a farm.

Materials

Essential safety equipment

- Eye protection
- Helmet
- Ear protection
- Waterproof clothing
- Waterproof gloves

- Slip-resistant boots

Water quality

- Drinking water must contain no chemical or biological contaminants.
- Hard water can reduce the effectiveness of soaps and disinfectants. Check the manufacturers' recommendations for more information.
- Test deep bores once a year for chemical or biological contaminants.
- Test surface bores four times a year for microbial load.

Employees to be trained in

- The issues and importance of washing, disinfection, and drying.
- Safety
- Equipment and product use.

Methods

STEP 1: CLEANING

Remove as much debris as possible. At the completion of this step all debris will have been removed from the exterior and interior of the vehicle.

- Begin on the highest level of the vehicle and work towards the lower areas to avoid cross-contamination.
- Vehicle exterior: Remove accumulated dirt (wheels, mud flaps, chassis).
- Vehicle interior: Scrape off as much bedding as possible with a shovel, a rake, or a brush. All solid debris, faecal matter, and bedding must be removed. All water, feedstuff, and bedding carried in the vehicle should be managed in a way that avoids contamination of the environment that creates some other biosecurity risk.
- Rinse, wash and disinfect all cleaning tools prior to storing them for the next use.
- Remove all objects from the vehicle (clothing, boots, crates, tools) and wash, disinfect, and dry them prior to replacing them in the clean vehicle.
- Lift floor panels if they are removeable to aid in their cleaning. If it is detachable, the crate structure of the vehicle should be lifted and cleaned inside, outside, and underneath. If the vehicle flooring has a double layer (e.g., re-enforcing wire mesh), it should be lifted to aid in removing faecal material that may be trapped between it and the underlying wood or metal surface. Some trailers may carry extra equipment under the body (spare tire, jack stands, etc.). If so, this equipment must be removed, cleaned, and disinfected.
- In the event of an EAD, authorities may require that outside dual wheels be removed to ensure adequate decontamination of the wheel hubs and to allow inspection of the undercarriage.

STEP 2. PRE-WASHING

At the completion of this step all debris including faeces will have been washed from the exterior and interior of the vehicle so that it is visibly clean.

- Tools must be cleaned separately.
- Pre-washing is usually done with a low-pressure, high-volume water supply such as a fire hose. Garden hoses often do not supply enough volume or pressure to do the job effectively. High-pressure water blasters (1500 to 2500 psi) while good for cutting through caked on faeces, are often inefficient at moving large amounts of bedding or faecal material off the vehicle surfaces and towards a floor drain.
- Cold or hot water may be used.
- Especially in summer, pre-soaking the surfaces for 30-60 minutes prior to washing will help to remove debris and faecal material that has dried on the vehicle surfaces.
- In winter, ensure vehicle is de-iced, if necessary, before pre-washing.

Pre-wash in this order:

- Vehicle exterior
- Top to bottom, front to back.
- Storage areas.
- Tools must be cleaned separately.

STEP 3: WASHING

At the completion of this step, the vehicle will be free of any visible or invisible organic material, and ready for disinfection.

- Use of detergents are a recommended part of the washing step. Detergents are a type of soap and sometimes include a degreaser. While not strictly necessary, using a detergent will result in superior cleaning of surfaces compared to water alone. Detergents also will significantly speed up the cleaning process. When using detergents, read the product label carefully and always use at the recommended concentration.
  Some detergents are applied separately from the washing step using a foam applicator. Other washing setups allow the detergent to be delivered through an inline injector with the wash water. Either system can be used successfully.
- Washing should be done using a high-pressure water blaster (usually 1500 to 2500 psi). Normal garden hose or fire hose pressure is not high enough to effectively clean livestock vehicles. Most truck washes are only equipped with cold-water supply however, hot-water or steam supplies are built into some high-pressure washing systems. These systems greatly speed the washing process.
- As in the pre-wash step, wash the vehicle in a top-to-bottom, and front-to-back order to minimize cross contaminating areas that have already been washed.
- After all surfaces have been washed, thoroughly rinse off any residual dirty wash water and detergent with a final top-to-bottom and front-to-back rinse with water only. Some detergents are not compatible with some disinfectants (next step) so this final rinse step should be done only with water.
- Minimize splashing onto previously rinsed areas or other vehicles. Keep the truck wash environment as clean as possible to avoid contaminating the “next truck”.
- Following rinsing let the vehicle drain before disinfecting to prevent water accumulation within the interior of the vehicle.

PRIOR TO MOVING ON TO THE NEXT STEP

Inspect the vehicle, with a torch if necessary, to ensure:

- No visible contaminated material.
- No accumulated water.

STEP 4: DISINFECTION

At the completion of this step the vehicle will be ready to be air-dried; in some situations, forced-air drying using fans and heat is recommended as an additional biosecurity step.

- Disinfectants may be highly toxic. Read the label and respect safety instructions before use.
- Disinfectants come with different specified dilution rates. Read and follow the label for the product you are using – different manufacturers of the same type of disinfectants may require different dilution rates.
- Disinfectants can be applied with either low or medium pressure. Application through high-pressure water blasters is discouraged as the disinfectant will be aerosolized and create a health hazard to the operator.

- Disinfectants don't work instantaneously. Read the label and respect the required contact time, which is usually between 10 and 60 minutes.
- The efficiency of disinfectants is decreased in temperatures below 20°C. Add 15 minutes to the minimum contact time for every 5° under 20°C.
- The entire surface needs to be thoroughly wetted with the disinfectant solution.
- If the surface is wet before you apply disinfectant solution, be aware that this extra water further dilutes the disinfectant you are using. While not usually a problem on vertical surface, this can be a problem on floors or other horizontal surfaces.
- Do not touch, walk on, or drag hoses over disinfected areas. Let the disinfected surfaces dry before treading over them.
- Wear personal safety equipment while applying disinfectants.
    - Eye protection
    - Cartridge mask
    - Waterproof gloves

Why use a disinfectant?

- Disinfectants destroy bacteria, viruses, and fungi that are invisible to the eye and that remain on surfaces even after a thorough wash.

Which disinfectant is best?

- Most commercial disinfectants are effective against a wide range of microbes (bacteria, viruses, and fungi). However consult the product label or refer to available resources online such as the excellent advice provided by the Center for Food Security and Public Health (https://www.cfsph.iastate.edu/infectioncontrol/disinfection/).
- For EADs, there will be official advice around what disinfectants are suitable for that situation. An example of approved disinfectants for African swine fever are shown in **Table 1**. Recently, APVMA has approved an additional product for disinfecting hard surfaces, equipment, and air spaces for use during an outbreak of some viral diseases including ASF (https://permits.apvma.gov.au/PER90975.PDF).
    - F10SC VETERINARY DISINFECTANT (APVMA No. 54149) containing: 54g/L benzalkonium chloride and 4g/L poly (hexamethylene biguanide hydrochloride) hydrochloride diluted at 10 ml per 1L (1:100) and allowed to contact the surface for 30 minutes.

STEP 5: DRYING

At the completion of this step, the vehicle interior will be ready to be re-assembled and put into use again.

- Why is drying important? Moisture encourages bacterial survival and multiplication. Also, waiting for the disinfectant to dry almost always ensures you have provided enough contact time for the disinfectant to do its job.
- Most vehicles can be easily dried with natural ventilation (open all doors) and with the vehicle parked on a slope so that residual water can drain from the vehicle.
- Active drying with forced heat is highly effective as a further disinfecting process. Also, don't forget sunlight. The UV rays in sunlight help to destroy pathogens and its free!

STEP 6: CLEANING THE TRUCK CAB

At the completion of this step, the vehicle will be ready to be used again.

Remove all objects including floor mats and vacuum the cab floor. Wash the floors and pedals with soapy water and a brush. Apply a disinfectant spray to the cleaned floor and other surfaces in the cab interior. Often, spray bottles of household disinfectant are convenient for this purpose.

Quality control

- Visual inspection following washing, disinfection, and drying steps.
- It is good practice to rotate your choice of disinfectants every 3-6 months.
- Think about your overall cleaning process, including vehicle and human traffic. Takes steps to avoid recontaminating or cross-contaminating areas or vehicles that have already been cleaned and disinfected.
- Clean vehicles:
    - Must not use the same route as soiled vehicles.
    - Must be parked far from soiled vehicles.
    - Must remain inaccessible to animals.

STEP 7: WASH / DISINFECT / DRY CYCLE FREQUENCY

- Ideal: After unloading at the abattoir.
- Required: At the end of each day.
- Consider the sanitation status of the loading and unloading sites. Monitor movements, organize your route, etc.
- Consider the biosecurity of your movement <u>between</u> sites, but also <u>within</u> a farm or production system. Always move from the most biosecure area (a breeding herd, for example) to the least biosecure area (a commercial finishing farm, for example).
- Don’t re-use bedding.
- The frequency of the wash / disinfect / dry cycle may be modified based on discussions with your veterinarian.

Table 1. Australian Pesticides and Veterinary Medicines Authority (APVMA) list of approved disinfectants and concentrations for treatment of ASF virus.[d]

Disinfectant	Rate	Application[a,b]
494 g/kg of potassium peroxymonosulfate triple salt, 132 g/kg of sodium dodecylbenzene sulfonate, 44 g/kg sulfamic acid, and 15 g/kg of sodium chloride (Virkon S) 497 g/kg potassium peroxymonosulfate, 49 g/kg sulfamic acid, and 15 g/kg sodium chloride (Virkon Aquatic)	20 g/L	Final dose: 2-3% solution (equivalent to 20 g/L). Soak clothes/small items and equipment for at least 10 minutes. For surface cleaning, apply at rate of 1-1.5 L/m^2. Do not use high pressure sprays. Decontaminate removed organic matter before disposal.
Sodium hypochlorite 125 g/L	40 ml/L	Final dose: 0.5% solution (equivalent to 40 ml/L). Soak clothes, footwear, and small equipment for 15-30 minutes. For surfaces, apply at a rate of 1-1.5 L/m^2 and soak for 15 minutes on non-porous surfaces and 30 minutes on porous surfaces.
Calcium hypochlorite 700 g/kg	7.2 ml/L	Final dose: 0.5% solution concentration (equivalent to 7.2 ml/L) for 10-30 minutes.
Sodium hydroxide 400 g/L	50 ml/L	Final dose: 2% solution (equivalent 50 ml/L). Soak clothes, footwear, and small equipment for at least 10 minutes. For surfaces, apply at a rate of 1-1.5 L/m^2 and soak for at least 10 minutes.
Sodium carbonate anhydrous	40 g/L	Final dose: 4% solution (equivalent to 40 g/L) for 20 minutes.
Sodium carbonate washing soda	100 g/L	Final dose: 10% solution (equivalent to 100 g/L) for 30 minutes.
Glutaraldehyde with quaternary ammonium compounds[c] Available as 150 g/L of glutaraldehyde. One part of 15% glutaraldehyde to 7.5 parts water = 2% final concentration = 133 ml/L.	133 ml/L	Final dose: 2% solution (equivalent to 133 ml/L). Clean equipment with soap or detergent first then rinse with water. Immerse for minimum of 10 minutes at 35°C and 20 minutes at 25°C. Maintain solution at pH>7. Efficacy may be increased by raising the solution temperature to 60°C.
Citric acid	30 g product/L	Final dose: 3% solution (equivalent to 30 g/L). Non-porous surfaces apply for 15 minutes; porous surfaces apply for 30 minutes.

a Efficacy of some of the products and proposed uses under this permit has not been thoroughly determined. However, efficacy is reasonably expected due to the broad-spectrum nature of the product.

b For all situations, APVMA requires that users clean with soap or detergent first and then rinse with water to remove organic matter before applying disinfectant and that users must comply with their relevant state and territory Environmental legislation.

c Glutaraldehyde and quaternary ammonium compounds are only available as a combined product. The final concentration is based off the glutaraldehyde % or ppm.

d Anonymous. 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, https://permits.apvma.gov.au/PER88135.PDF). Australia Department of Agriculture and Water Resources, Canberra, ACT, Australia, 2019:6.

Standard Operating Procedure

<Insert Company Name>
<Insert Street Address>
<Insert Town, State, Post Code>

Feed delivery biosecurity

SOP number: <Insert SOP Number>
Version number: <Insert Version Number>
Effective date: <Insert Effective Date>
Review date: <Insert Review Date>
Approved by: <Insert Approver Name>

Purpose

This Standard Operating Procedure (SOP) describes procedures for the effective cleaning and disinfection of vehicles used for the transportation of feed to a pig farm regardless of the disease status of the farm.

Procedure

Several aspects of feed delivery present a biosecurity risk to the farm. As part of this Standard Operating Procedure, the reader should also review the APL Standard Operating Procedure for "Pig transport vehicle cleaning and disinfection". Though feed transport vehicles present a lower biosecurity risk than pig transport vehicles, the principles for truck washing and disinfection are identical.

Materials

The following is essential safety equipment.

- Eye protection
- Helmet
- Ear protection
- Waterproof clothing
- Waterproof gloves
- Slip-resistant boots
- Disposable boot covers
- Spray disinfectant or disposable disinfectant wipes

Methods

DELIVERING FEED TO A KNOWN INFECTIOUS DISEASE FARM SITE

- Delivery to known infectious sites should occur at the end of the day or week, followed by a full truck wash and disinfection. If for any reason feed is being delivered to a farm known to be infected with an EAD, then additional special conditions may apply.

FEED VEHICLE CLEANING PROTOCOLS

- Feed vehicles should be washed once a week at minimum and may require additional washing when the vehicle or driver has been exposed to manure or has travelled to a farm infected with an EAD or other high consequence disease. The recommended feed vehicle cleaning protocols include:

- Washing the exterior of the truck including wheel wells, followed by disinfection and drying.
- Washing all floor mats, brake and gas pedals, and any other potentially contaminated contact surfaces inside the cab.
- Washing and/or disinfecting inside of truck used for bagged feed delivery, to control biosecurity risks introduced by the driver's boots.

DRIVER PROTOCOLS

- Drivers should arrive at work wearing clean clothes and footwear which hasn't been worn around any livestock.
- The driver should put on cleaned and disinfected coveralls and boots before leaving the cab to enter a farm site. As an alternative, drivers may put on disposable boot covers before exiting their vehicle. Upon return to vehicle, the boot covers should be removed before getting into the cab and placed in a plastic bag or 'dirty box' for later disposal.
- Drivers should stay as close to the truck as possible to minimize the areas in which they come into contact with and to maintain the Line of Separation (LOS; see Standard Operating Procedure "Line of Separation"). Whenever possible, farm staff should assist by opening and closing bin lids, thus avoiding the driver contaminating the area.
- Drivers should never need to enter the farm office or pig sheds. An area should be designated, such as a mailbox attached to the bin leg or a location outside of the farm office, for the driver to leave invoices or delivery tickets.
- Bagged feed should be delivered to the designated area, preferably at a site away from the pig sheds.
- Boots or boot covers should be removed when climbing back into the truck; any rubbish including used boot covers should be placed into a designated "dirty" box in the truck or cab for later disposal.
- Apply hand sanitizer to maintain a clean cab before touching surfaces. As an extra precaution, spray disinfectant on the floor and any other surfaces in the cab that may have become contaminated during the delivery. Disposable disinfectant wipes are another convenient means for completing this step.
- If using cloth coveralls and rubber boots, clean and launder all clothing/footwear and allow for at least 24 hours downtime after cleaning and drying before use on another farm. Once fully clean (no organic matter visible), be sure to also disinfect rubber boots.

FEED SUPPLIER OBLIGATIONS

Delivery of feed or feed ingredients to a farm exposes the truck, the driver, and the feed mill to pig diseases. If biosecurity measures are not undertaken by the feed supplier, there is risk that the feed supplier can then act as a means of spreading animal diseases to other farms across a region. Suppliers should develop systems and processes that ensure feed can be delivered in a biosecure manner, and to enable effective tracing to occur if an outbreak of disease does happen.

- Ensure batch or lot numbers are recorded. Pathogens have the potential to be moved around on feed trucks but also, some pathogens may be a direct contaminant in the feed itself.
- Ensure equipment is clean and in proper working order prior to loading. Develop good practices around cleaning and / or repairing equipment to avoid contamination or cross-contamination in the mill environment.

- Secure truck trailers, both bag and bulk, once they are loaded.
- In the case of soft-topped trailers, measures should be taken to prevent environmental contamination or unauthorized persons from accessing and adulterating the shipments. Birds, mice, cats, and their droppings can be a source of pathogens for pigs.
- Clean tarps (or covers) before using, as follows:
    - Establishing cleaning protocols to follow if covers are soiled.
    - Ensuring tarps (or covers) are in good repair, are not torn, and are sealed properly when used.
- Establish and maintain a disease status log for livestock farm where feed is delivered, as follows:
    - Establish routine and trusted communication customers. Develop a relationship that promotes prompt disclosure of disease events. Communication should happen in both directions.
    - Establish a hierarchy for feed delivery locations based on the disease status of the location; the hierarchy should consider the following: The biosecurity level of the production unit (i.e., for example a gilt multiplier may have a higher biosecurity need compared with a commercial finishing location).
    - Consult the hierarchy routinely before scheduling deliveries or entry onto a customer's premises.
    - Complete deliveries to customers according to the hierarchy.
    - Establish cleaning procedures, including down time, as appropriate, consistent with the disease risk hierarchy for feed deliveries.
- Ensure drivers understand any particular protocols for unloading feed at specific customer sites. Suggested minimum procedures are described above but each farm may have different requirements. Work across your customer base to develop common procedures whenever possible.
- Potentially contaminated rubbish such as boot covers will almost certainly be created during every delivery event. Ensure drivers are given a means to deal with this rubbish. Use of clearly marked "Clean" and "Dirty" plastic containers in the cab of each truck is a simple system that can keep gear organised and can be implemented by anyone. Make sure drivers know what to do with the rubbish once return to the mill or truck depot!
- Avoid using customer equipment to unload deliveries if this will create a biosecurity hazard.
- Prohibit drivers from entering pig sheds; even entering the farm office presents a biosecurity risk and should be avoided.
- Prohibit the return of wood pallets from farms. Plastic pallets may be returned but a process needs to be developed to ensure these are cleaned and disinfected before re-use in the mill or on another customer farm.

Standard Operating Procedure

<Insert Company Name>

<Insert Street Address>

<Insert Town, State, Post Code>

Line of Separation

SOP number:	<Insert SOP Number>
Version number:	<Insert Version Number>
Effective date:	<Insert Effective Date>
Review date:	<Insert Review Date>
Approved by:	<Insert Approver Name>

Purpose

This Standard Operating Procedure (SOP) describes procedures for the effective separation between a truck driver and a biosecure site such as a piggery.

This SOP should be read in consultation with related APL SOPs “Feed delivery biosecurity” and “Pig transport vehicle cleaning and disinfection”.

Procedure

The Line of Separation (LOS) is defined as the line between the area that is to be used by the truck and the area to be used by farm or abattoir personnel. Think of the LOS as a line dividing the area that is to be used by the farm for live animals (often referred to as the “clean” area) and the area that is outside of the live animal area (the “dirty” area).

The LOS applies at many locations but is most important for drivers to understand when loading pigs at a farm or when unloading of pigs at an abattoir or another farm site. Respecting the LOS will help to ensure that there is no cross contamination of a farm site by infective material that may be on a truck or driver that has not been properly cleaned before arriving at a farm.

At the unloading point, these procedures will prevent contamination of a truck with infected material that is present at an abattoir or another farm.

The organisms that cause disease in pigs (bacteria, viruses, and parasites) can survive in different types of materials. Organic matter (bedding, manure, etc.), feed, water, and mud can all carry diseases. Contaminated boots, clothing, tyres, undercarriages, trailers, shovels, sorting panels, and people’s clothes can infect healthy pigs. Other activities, such as walking into a contaminated barn or abattoir can increase the risk of disease spread because boots and truck or trailers can become contaminated with diseases that you are trying to keep out.

This SOP outlines the steps to be taken to effectively implement and use the LOS concept when loading and unloading pigs.

Materials

Signage that clearly indicates “go / no-go” areas for farm staff and truck drivers.

Methods

As described above, the LOS is defined as the line between the area that is to be used by the truck and the area to be used by farm or abattoir personnel. Think of the LOS as a line dividing the area that is to be used by the farm for live animals (often referred to as the “clean” area) and the area that is outside of the live animal area (the “dirty” area).

Depending on the specific farm or circumstance, this line may be defined as the cab of the truck, the back of the truck, or the loading/unloading ramp/chute at the farm or abattoir. Because the defined LOS can vary between locations, signage should be prominently placed so that drivers and farm staff know where the LOS is in every situation. A LOS should be defined at every location where an "outsider" can come into contact with a pig, farm staff, or lairage areas at an abattoir and may include:

- Load chutes
- Entry and exit doors
- Farm office
- On-farm feed mill or ingredient storage areas
- Abattoir lairage or office

The LOS concept needs to be interpreted along with the idea of "one-way flow". Obviously, people do need to cross a LOS – how else would farm staff get to work? In essence, people can generally move from an area of higher biosecurity to an area of lower biosecurity with minimal biosecurity risk and therefore, only minimal precautionary steps are required. However, it should be remembered that once a person has entered a lower biosecurity area, they must not return to the higher biosecurity area until completing the required farm-specific decontamination steps.

For example, staff can generally move around within a farm site or between sheds on the same farm with only minimal requirements (for example, change of boots or use of boot baths) because the pigs are all of a similar health status. However, once leaving the site (going home after work), a worker potentially comes into contact with higher biosecurity risks (another farm site, public areas frequented by other farmers, hunting activities, etc.) and therefore higher precautions are needed (such showering into the farm, use of a bench-entry system, or changing into farm-specific boots and coveralls before entering) in order to return safely to the farm. In other words, the staff can leave the farm with minimal requirements (high biosecurity to low biosecurity direction) but coming back into the farm (low biosecurity to high biosecurity direction) requires more biosecurity precautions.

Other examples of how LOS and one-directional movement work together include:

- Staff may enter the pig unloading area but are NOT allowed to re-enter the piggery afterwards, unless precautions are taken (overnight downtime, or other measures).
- No one is allowed enter a piggery shed through the load chute area (which should always be considered a "dirty" area). Instead, people need to enter the shed through a designated entry point where biosecurity can be managed through procedures such as showering-in, bench-entry systems, changing clothes and boots, or handwashing. The specific entry procedures will vary by farm and by situation – these should be clearly explained in a written on-farm biosecurity manual.
- Staff are not allowed to enter a pig transport. Depending on the situation, the LOS might be defined as the "back of the truck", the "bottom of the ramp", or the "piggery doorway". The location doesn't necessarily matter, as long as it is clearly understood between staff and drivers.
- LOS location should be clearly marked with signage. Even painting a line on the floor will work!
- Similar LOS principles apply when unloading the pigs at an abattoir.

Pig Transport Biosecurity

A Resource Guide for Australian Producers

FINAL: September 17, 2022

Contents

Abbreviations and definitions

C&D	Cleaning and disinfection
Cleaning	The removal of gross contamination, organic material, and debris from the premises or respective structures, via mechanical means like sweeping (dry cleaning) and/or the use of water and soap or detergent (wet cleaning). The goal is to minimize the amount of organic material so disinfection will be effective. Also, referred to as "washing".
Disinfection	Methods used on surfaces to destroy or eliminate a specific species of infectious microorganism through physical (e.g., heat) or chemical (e.g., disinfectant) means. A combination of methods may be required.
EAD	Emergency Animal Disease
Fire hose	Low pressure, high-volume washing…
Garden hose	Low-pressure, low-volume washing…
High-pressure washer	Pump attached to a low-pressure water supply to increase the pressure above 1500 psi (approx. 100 bar or 10,000 kP). Pump may be driven by mains power or a petrol/diesel motor. High-pressure water stream delivered through a high-pressure hose fitted with a metal wand (usually 500-1000mm long) and one of several tips depending on the desired performance (fan, rotary, turbo tip, etc.). Some high-pressure washers may be equipped to deliver heated water and/or steam. Also, referred to as a water blaster.
LOS	Line of Separation
PBA	Perimeter Buffer Area
PPE	Personal protective equipment
Soap	A chemical detergent used to…
Washing	See "Cleaning"
Water blaster	See High-pressure washer
	Cleaning

Introduction

Australian Pork Limited (APL) is pleased to present Pig Transport Biosecurity - A Resource Guide for Australian Producers. While the principles of biosecurity are relatively simple, the sheer volume of information available on the topic globally sometimes makes it difficult for pork producers to find information on the specific area in which they are interested.

This Manual is intended to provide some of the background material that supports three Standard Operating Procedures produced by APL that relate to pig farm biosecurity: Truck Washing, Line of Separation, and Feed Trucks. This Manual provides detailed information on disinfectants and planning for construction of an on-farm truck wash that may be difficult to find, presented in a straightforward and common-sense format, in other places.

Acknowledgements

There is an enormous amount of pig industry biosecurity information available from many countries around the world, including Australia. While research continues to optimize disease control measures, the principles upon which these measures are based are well-known, consistent, and reliable.

This Manual borrows material from sources in North America. From decades of experience managing significant endemic and exotic diseases such as Aujeszky's, porcine reproductive and respiratory syndrome, and swine enteric coronavirus diseases, a comprehensive library of materials is freely available for use. We take this opportunity to acknowledge contributions from these sources in this Manual.

Official animal disease control authorities rely on slightly different terminology when describing some aspects of biosecurity measures, particularly as they pertain to official response activities during an exotic disease outbreak or investigation. Whenever possible, we have tried to be consistent with terminology common in the Australian pig industry or that used in the national AUSVETPLAN manuals. However, remember this Manual is a principle-based approach to biosecurity. Regardless of differences in terminology between countries, the overall message should be clear to the reader.

Reference materials used, but not specifically cited, in creating this Manual:

US National Pork Board

- Establish a Line of Separation: Help Control the Spread of PEDV and Other Swine Diseases
- Create a Clean Crossing: Help Control the Spread of PEDV
- General Biosecurity Practices for Non-farm Personnel
- Feed Delivery Biosecurity
- General Biosecurity Practices for Non-farm Personnel,

United States Department of Agriculture

- Foreign Animal Disease Preparedness and Response Plan (FADPReP) Swine Industry Manual
- FADPReP Standard Operating Procedures: Cleaning and Disinfection

US Secure Pork Supply

- U.S. Pork Industry Guide to the Secure Pork Supply Plan

AUSVETPLAN

- Operational Procedures Manual Decontamination Version 3.2, 2008

Australian Pork Limited

- Standard Operating Procedure: Truck Washing
- Standard Operating Procedure: Line of Separation
- Standard Operating Procedure: Feed Trucks

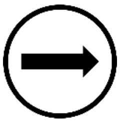
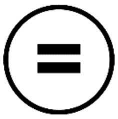
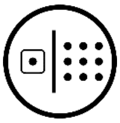
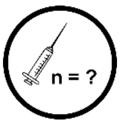
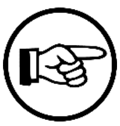
Other

- Canadian Swine Health Board “Live Hog Transport Vehicle Wash/Dry/Disinfect/Dry Protocols”
- American Feed Industry Association “Developing Biosecurity Practices for Feed & Ingredient Manufacturing”
- Stock Feed Manufacturers Council of Australia “National Biosecurity Manual for Feed Mills, Version 1”
- Center for Food Security and Public Health “Disinfection 101”

Principles of evidence-based biosecurity

All the features of size, production flow, commercial imperative, geographical location, local industry density, connectedness to other farms, and physical building characteristics that describe a farm are the same features that make it impossible to develop a "one-size fits all" biosecurity plan suitable for use across the pig industry.

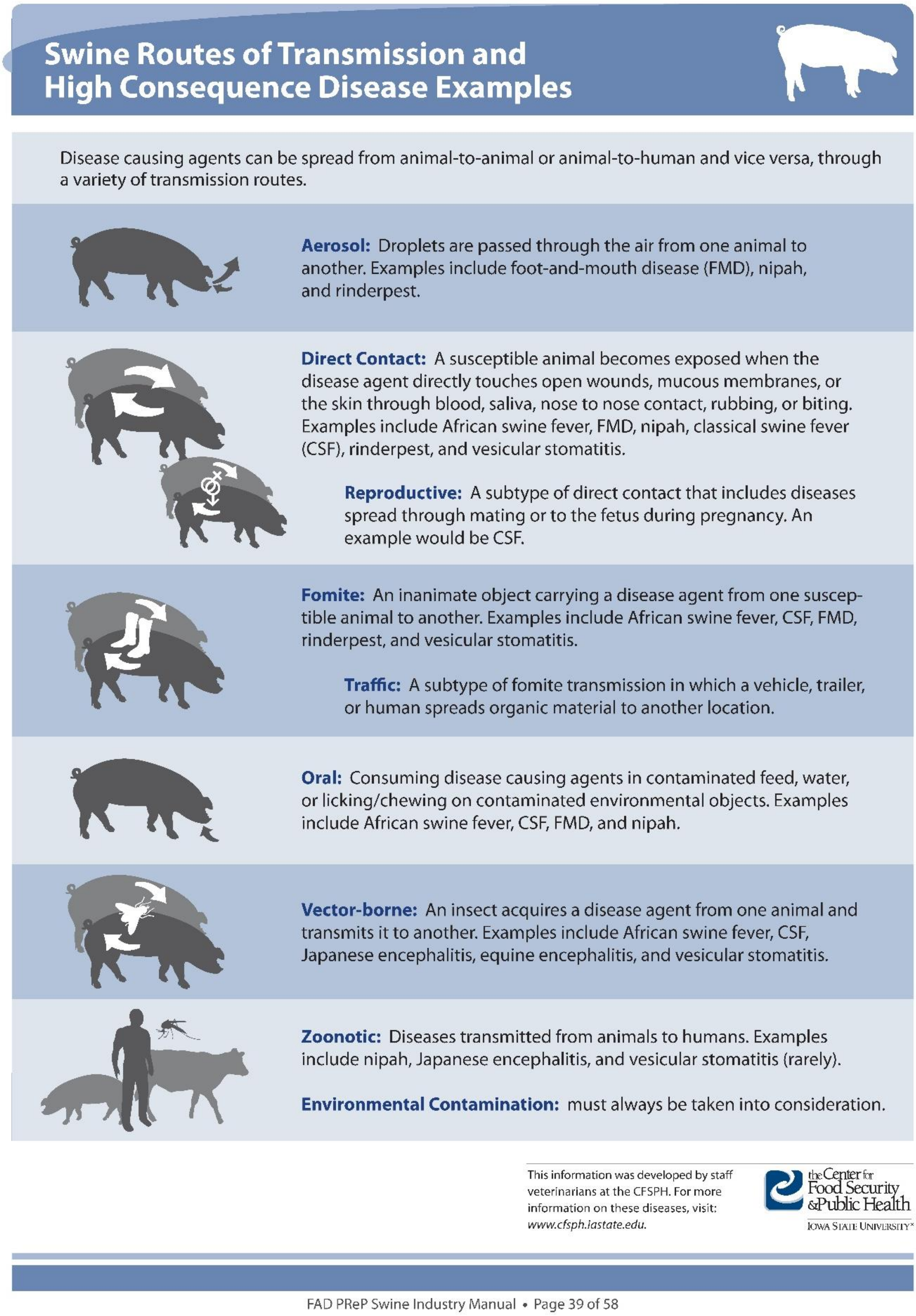
As an alternative, the following ten principles are proposed as fundamental criteria that must be fulfilled when developing biosecurity plans for pig farms. Scientific evidence is available to support application of each principle that is appropriate for most farm and disease settings that will be encountered. Readers are encouraged to develop their own studies that can further our knowledge of these topics for use by an even broader cross-section of the international industry. The principles are not complicated, though they can be difficult to institute effectively and with adequate levels of compliance.

	A distinct boundary must exist between 'clean' and 'dirty' areas of the farm. These boundaries may exist virtually or physically, and they must be readily identifiable.
	Cleaning must precede disinfection. The effectiveness of all disinfectants is reduced considerably in the presence of organic matter.
	Sterility is a myth; the objective of biosecurity is to reduce the pig's level of exposure to a pathogen. Reducing the pig's exposure is a function of both exposure time and pathogen density.
	Unidirectional flow of both people and pigs is imperative. The direction of flow should be away from the customer, away from the population least easy to recover from a disease introduction, and away from the most disease-susceptible population, in that priority order.
	Categorical descriptors of the health status of a farm (e.g. 'high-health', 'conventional health', etc.) are meaningless. Considering farms to be of 'comparable' or 'compatible' health status is only marginally more useful. Ad hoc and routine submission of samples to a veterinary diagnostic laboratory are a required part of a biosecurity plan.
	Isolation and acclimatization procedures are mandatory prior to introduction of genetic stock into farms.
	A herd's health status is only as good as the last time it was tested. Imperfect diagnostic test sensitivity and specificity need considered when determining required sample sizes for establishing the disease status of a population.
	Purchased pigs never come with a guarantee of their health status. Health status is not static nor is it a deterministic variable. Disease risk needs to be managed, not contractually obligated.
	Health status of all farms will decline over time. Biosecurity planning should consider pay-off schedules that inform one of the 'cost to benefit ratio' of biosecurity processes and procedures.
	Procedures that are established as part of a biosecurity plan are meant to be followed by everyone, especially veterinarians.

** Neumann, E. J., & Hall, W. F. (2019). Disease Control, Prevention, and Elimination. In J. J. Zimmerman, L. A. Karriker, A. Ramirez, K. J. Schwartz, G. W. Stevenson, & J. Zhang (Eds.), Diseases of Swine (11th ed., pp. 123-157). Hoboken, NJ, USA: John Wiley & Sons.*

Routes of Disease Transmission

Understanding how diseases are transmitted between sites and between animals is fundamental to establishing good biosecurity measures that will protect your herd from introduction of diseases. Figure 1 below summarizes the most common routes of disease transmission in pigs.



Swine Routes of Transmission and High Consequence Disease Examples

Disease causing agents can be spread from animal-to-animal or animal-to-human and vice versa, through a variety of transmission routes.

Aerosol: Droplets are passed through the air from one animal to another. Examples include foot-and-mouth disease (FMD), nipah, and rinderpest.

Direct Contact: A susceptible animal becomes exposed when the disease agent directly touches open wounds, mucous membranes, or the skin through blood, saliva, nose to nose contact, rubbing, or biting. Examples include African swine fever, FMD, nipah, classical swine fever (CSF), rinderpest, and vesicular stomatitis.

Reproductive: A subtype of direct contact that includes diseases spread through mating or to the fetus during pregnancy. An example would be CSF.

Fomite: An inanimate object carrying a disease agent from one susceptible animal to another. Examples include African swine fever, CSF, FMD, rinderpest, and vesicular stomatitis.

Traffic: A subtype of fomite transmission in which a vehicle, trailer, or human spreads organic material to another location.

Oral: Consuming disease causing agents in contaminated feed, water, or licking/chewing on contaminated environmental objects. Examples include African swine fever, CSF, FMD, and nipah.

Vector-borne: An insect acquires a disease agent from one animal and transmits it to another. Examples include African swine fever, CSF, Japanese encephalitis, equine encephalitis, and vesicular stomatitis.

Zoonotic: Diseases transmitted from animals to humans. Examples include nipah, Japanese encephalitis, and vesicular stomatitis (rarely).

Environmental Contamination: must always be taken into consideration.

This information was developed by staff veterinarians at the CFSPH. For more information on these diseases, visit: *www.cfsph.iastate.edu.*

the Center for Food Security & Public Health
Iowa State University

FAD PReP Swine Industry Manual • Page 39 of 58

Figure 1. Common routes of disease transmission between farms and pigs (Anonymous, 2011).

The Clean-Dirty Zone

Perimeter Buffer Area

A perimeter buffer area (PBA) is an outer control boundary around the sheds meant to limit opportunities for movement of the disease agents near your pigs. The PBA should be set up so that caretakers can perform all their normal duties within it during the course of the day. This means that routine farm deliveries (feed, supplies, etc.) and visitors or tradesmen should remain outside of the PBA until appropriate measures are undertaken to permit their safe introduction into the biosecure area of the farm. The PBA needs to be clearly defined in the farm's written biosecurity plan and clearly marked around animal buildings, most easily accomplished by installing a perimeter fence. A physical fence is especially important in areas with a known feral pig population. Entry into the PBA should be restricted and only allowed through specific, controlled access points. Vehicles that need to move through a PBA access point should be cleaned to remove visible contamination and then disinfected. Similar measures should be established for introduction of people, equipment, and supplies through PBA access points.

Importantly, the PBA provides a "buffer" between the farm inner sanctum where the pigs are, and "the rest of the world". No pigs exist in the PBA.

Line of Separation

The Line of Separation (LOS) is a real or virtual boundary designed to prevent direct movement of disease agents into areas of a farm where susceptible animals can be exposed. A LOS separates people, equipment, and supplies that are in the PBA, from the inner sanctum where pigs are being reared.

For pigs raised indoors, the walls of the shed form the LOS. The LOS needs to be defined in a farm's biosecurity plan and clearly marked on the premises. Animals, people, or items may only cross the LOS through clearly marked and controlled LOS access point(s), following appropriate biosecurity measures. Each LOS access point should be clearly marked with a sign using language that can be understood by anyone that needs to enter.

It should be noted that defining the LOS can be complicated in situations when flying insects are one of the risks that are trying to be managed (such as for Japanese encephalitis). LOS is a "concept" that needs to be applied creatively when faced with these kinds of unusual challenges.

Most farms will have more than one LOS access point. For example, an office or shower-in/shower-out facility may act as an LOS access point for people and supplies. The load-out area is another LOS access point, and it should not serve as an entry point for personnel. Ideally, all movement (animals, equipment, people) across an LOS access point should be recorded daily.

Where is your LOS?

Almost every farmer has some idea about "a clean-dirty" line around their farm but may not have taken measures to ensure that staff and visitors (including truck drivers) understand exactly where this line is located, and what rules are in place to manage access across the LOS. The LOS at access points may be a real (e.g. a gate) or virtual (e.g. the "bottom of the load chute") barrier, but whenever possible the LOS should be visibly marked (perhaps a painted line across the floor and penning).

Due to concerns about ASF, the recent emergence of yet another highly virulent and transmissible PRRS virus variant in North America and coming off a significant national incursion/epidemic of porcine epidemic diarrhoea (PED) in 2013-14, an enormous amount of work has gone into investigation of the contribution of biosecurity failures that occur around load-in and load-out procedures to disease outbreaks. Repeatedly, findings from these investigations have shown that despite the best intentions of farm staff and the existence of written biosecurity procedures, it appears that the LOS gets routinely violated during load-out of pigs at many farms.

It is unlikely that any biosecurity procedure will be 100% effective nor that it will be followed by 100% of farm staff 100% of the time. However, an individual biosecurity process does not need to be 100% effective to work. By creating "layers" of protection (e.g. defining a clearly understood LOS between farm staff and a driver **PLUS** using a lairage/load-out space **PLUS** requiring the driver to use boots and coveralls provided by the farm **PLUS** cleaning and disinfecting the load-out area after use), reliance on any single process to be 100% perfect can be reduced. Each step in this type of layered approach can act as a backup or mitigation for the other steps in the process – therefore the overall "process" is much more likely to provide the biosecurity protection one hopes for.

Clean – Disinfect – Dry

Cleaning and disinfection (C&D) involves the use of physical, chemical, or biological processes to remove, inactivate, reduce, or destroy pathogenic microorganisms. Selected C&D methods should account for the physical characteristics of the premises and other factors, such as environmental conditions, which may influence the effectiveness of virus elimination. Proper C&D is essential to contain the spread of a disease agent and is an integral part of the eradication plan. Care must be taken to reduce the generation and dispersal of infective dust and aerosols. If items cannot be adequately cleaned and disinfected, they must be disposed of by other appropriate means.

Pre-cleaning assessment

In the assessment phase, information is gathered to assist with the planning of the C&D activities and includes the following:

1. Identifying the key pathogens that need to be controlled or eliminated.
2. Conducting a situation assessment.
    - Conduct a property assessment (location of electricity poles and lines, underground cables, phone lines, fuse box, and meter).
    - Identify areas and items requiring specific C&D procedures.
    - Identify any potentially hazardous situations.
    - Identify the location of drainages and run off destinations.
3. Estimating the time frame needed to address the situations.
4. Identifying areas requiring specific decontamination action.
5. Identifying any potential hazardous situation.

In some instances, it may be determined that a particular surface, facility, truck, or piece of equipment is constructed in such a way that effective C&D is not feasible. In these situations, replacement or repair should be considered as part of a longer-term solution.

Cleaning and disinfection plan

Information gathered during the assessment phase helps one to effectively plan activities. In consultation with the farm owner, veterinarian, and other relevant experts, a site-specific plan for C&D should be prepared. This plan should also address the details on proper disposal of materials (e.g., gross debris, chemical solutions) in a manner that minimizes the further spread of microorganisms.

A detailed written C&D/virus elimination plan should include the following:

- A review, design, and setup of the premises.
- Definition of the area to be cleaned and disinfected.
- Identification of appropriate locations for the C&D setup and process, and holding areas for:
    - vehicles and heavy equipment,
    - personnel, and
    - small equipment.
- Selection of approved C&D products to be used.
- Description of proper C&D methods and processes to include:
    - cleaning,
    - disinfecting, and
    - downtime.
- Personnel requirements and assignments.
- Materials, supplies, and equipment.
- Regulatory permits and approvals.

- Plans for proper disposal of disinfectants and materials.
- Quality assurance and quality control.

Cleaning and disinfection procedures

Proper Cleaning Procedures

Wear the appropriate personal protective equipment (PPE): Gloves, coveralls, rubber boots (or disposable boots) and possibly a mask if you are cleaning an area that will generate dust.

1. Dry clean: Remove all visible material by brushing, scraping and/or sweeping. This is the most important step as organic matter prevents many disinfectants from working effectively. Disposal of waste material should be handled in such a way as to prevent contamination of other areas such as feed, water, or other animals.
2. Soak: Soak the area with hot water and a detergent or cleaning agent. Be sure to wash and soap down all equipment in the area: Waterers, feed troughs, pails, etc.
3. Wash: Wipe, spray or scrub the area, starting with the dirtiest or highest area (ceiling), after it has soaked for a period of time. This step can be enhanced using pressure washers when cleaning wood, cement, or other porous surfaces. Never use high-pressure washers in rooms with pigs as these washers can aerosolize disease organisms and spread them to healthy pigs.
4. Rinse: Remove all detergent residue by applying a low-pressure water rinse on all surfaces, starting with the highest area, and working your way to the floor. This is especially important as certain disinfectants are inactivated by detergents and soaps.
5. Dry: Allow the area to dry completely before applying a disinfectant so that it can work effectively.

Proper Disinfecting Procedures

1. Read the product label: This is important to make sure the solution is handled correctly. PPE (gloves, mask, safety glasses) should be used when preparing solutions. Other considerations to review before applying solutions to fomites include specific dilutions, water temperature, environmental temperature, the need for ventilation and the disease organisms killed by the disinfectant.
2. Disinfect: Apply the product at the correct dilution and let it "sit and work" for the recommended amount of time. Contact time of the disinfectant is important for the product to inactivate or kill the microorganism present. Add 10 minutes to the recommended contact time for every 5°C of ambient temperature below 20°C.
3. Final rinse: Remove all disinfectant by applying a low-pressure water rinse on all surfaces, starting with the highest area, and working your way to the floor.
4. Dry: Allow the area to completely dry before allowing animals to contact the area or item that was just cleaned and disinfected.

Proper Boot Bath Procedures

1. Mix solution to the proper concentration according to the label instructions.
2. Clean all dirt, manure, and debris from boots BEFORE stepping into the disinfectant solution. The presence of organic material (dirt, manure, etc.) will prevent most disinfectants from working.
3. Allow the disinfectant solution to have ample contact time with the boot surface. This will vary with the disinfectant selected. Consult the product label.
4. Change solutions at least daily or when visibly dirty.

For general cleaning and disinfection, the following steps must be taken:

1. Wear appropriate PPE for the task.
2. Select an appropriate disinfection station for small equipment and personnel.
3. Remove sensitive equipment.
4. Remove dead insects and rodents; eliminate openings where wild animals, birds, and rodents can enter the building.
5. Disconnect utility supplies if necessary
6. Control ventilation to maintain human comfort and prevent pathogen dispersion.
7. Seal and disinfect all drains and run offs.
8. Empty all watering and feeding apparatuses, disassembling if appropriate, to facilitate C&D.
9. Conduct the dry cleaning; wet cleaning (washing, rinsing, and drying); disinfecting (mixing protocol; wet disinfection; and heat treatment); and downtime protocols as indicated in the C&D Plan.

10. Use a systematic procedure for C&D:
    - Always start at the back of the facility and proceed to the front.
    - Always begin application on the ceilings and move down the walls to the floor, then across to the drain.
11. Gather the cleaning and disinfecting equipment (for example, rakes, shovels, scrapers, brushes, spray/disinfection devices) and clean and disinfect these items. Reapply disinfectant as needed to keep the surfaces wet for the required contact time.
12. If the facility is to be fumigated, make the facility airtight after the cleaning and washing steps.

Cleaning Methods

Cleaning is one of the most important steps in the C&D process. The cleaning process can be executed as **dry cleaning and/or wet cleaning**. When done appropriately, cleaning alone can remove over 90 percent of microorganisms.

Dry Cleaning

Dry cleaning involves the removal of any gross contamination and organic material (for example, dust, soil, manure, bedding, and feed) from production areas or equipment. Consideration must be taken in selecting the best time and performing this particular systematic way of cleaning to not aerosolize viruses. Shovels, manure forks, brooms, and brushes should be used to sweep, scrape, and remove organic material and debris from surfaces. Heavy equipment may also be required to clear away and discard large amounts of bedding and manure.

The following steps for cleaning are recommended:

1. Minimize remaining organic material; in most cases the original surface should be visible on floors, walls, and fans (e.g., wood or metal).
2. Priority is to ensure all wet organic material is dry or removed. This is likely to be the most recent deposits to the site and thus, the most likely to have infectious material.
3. Ensure all remaining organic material dries, i.e., if weather has made material damp or wet, allow to dry naturally or remove. Drying is an effective way to destroy/eliminate the virus.
4. Dispose of removed material appropriately.

Wet Cleaning

Wet cleaning involves the use of water and soap or detergent.

Washing

Following the removal of gross contamination (dry cleaning), areas or items should be washed with detergent. The washing process helps to further reduce the number of microorganisms and to remove any oil, grease, or exudates that may inhibit the action of disinfection. Washing prior to disinfection is one of the most overlooked steps in the C&D process.

The following steps for washing are recommended:

1. Obtain alternate power supplies if all electrical power will be shut off for washing.
2. Turn off, unplug, and remove or tightly cover any electrical equipment with plastic sheeting. Contact an electrician if necessary.
3. If necessary, use brushes to scrub all contaminated surfaces with water and detergent in accordance with the site-specific plan, ensuring that cleaned areas are free of dirt and debris. Warm water can aid in removing organic debris. Caked-on materials may require prolonged soaking time.
4. Use warm to hot water (32–54°C, or higher).
5. If surfaces and ambient temperature are below freezing, either heat the surfaces to prevent freezing, use heat blankets around liquid containers, or add up to 40% propylene glycol in water when mixing solutions.
6. Flush, sanitize, and drain all components of the watering and feeding systems. If possible, remove and disassemble these devices to remove organic debris and permit proper cleaning. Flush, sanitize, and drain reservoirs.
7. For ventilation components, individually clean fans, casings, motors, belts, curtains, ventilation pads, and louvers, ensuring they are free of manure, debris, dust, and dirt before disinfection. Individually wipe, clean, and sanitize equipment such as thermostats, scales, time clocks, electrical panels, switches, and light bulbs and protect them as needed from recontamination during the cleaning process.
8. Dispose of all C&D solutions in accordance with the site-specific disposal plan.

Rinsing and Drying

After washing, all surfaces should be thoroughly rinsed, as residues from soaps and detergent can inactivate certain chemical disinfectants.

The following steps for rinsing and drying are recommended:

1. Use clean, cold water that is under low pressure to rinse all contaminated surfaces to remove any remaining dirt, debris, and residue. This is necessary to remove any soap or detergent residue, which if present may inactivate several chemical disinfectants.
2. If surfaces and ambient temperature are below freezing, either heat the surfaces to prevent freezing, use heat blankets around liquid containers, or add up to 40% propylene glycol in water when mixing solutions.
3. Visually inspect the surface for cleanliness; there should be no “beading”. Instead, the water should spread evenly over the surface. All surfaces should be free of all foreign matter.
4. Dispose of the rinse water in accordance with the site-specific plan.
5. Allow sufficient drying time (overnight) so no free liquids remain on the washed surfaces. Use of an external heat source may be necessary in cold weather.

Evaluation of the Premises after Cleaning Procedures

An inspection is conducted after the cleaning of a premises is completed to ensure:

- Gross debris (for example, manure, unused feed, or bedding) have been removed.
- All grossly contaminated surfaces have been identified are sufficiently cleaned prior to disinfection procedures.
- Any contaminated wood or items difficult to clean have been appraised, removed, and disposed of in a manner that minimizes spread of pathogens (for example, burned, composted, or buried).
- All fixtures and fittings have been dismantled and cleaned.
- All infected or suspected areas have been properly washed, rinsed, and dried; visual inspection should be conducted to ensure surfaces are clean and no organic material has been left behind.
- Effluent from the cleaning procedures has been handled in a manner to minimize or to avoid environmental impact.

Disinfection Methods

1. Calculate the total surface area of the floor, ceiling, and walls. Approximately 3-4 square metres of surface area can typically be covered by one litre of disinfectant solution.
2. Select the appropriate chemical disinfectant (see section on disinfectants later in this Manual).

General Disinfectant Mixing Protocol

The correct mixing of the chosen disinfectant is critical to achieving the right concentration for effective disinfection and the health and safety of C&D personnel. This section describes a general disinfectant mixing protocol:

1. Wear appropriate PPE when opening and mixing disinfectants. At minimum, wear disposable outerwear (for example, long-sleeved coveralls, boots, hat, safety glasses, face mask, and gloves).
2. Calculate the required amount of disinfectant. For liquid chemical disinfectant solution, calculate the total surface area of the floor, walls, ceiling, and fixed equipment requiring treatment.
3. Ensure that the correct volume of disinfectant concentrate is added to the correct volume of water.
4. If ambient temperature is below freezing, either heat the surfaces to be treated to prevent freezing or add up to 40% propylene glycol in water when mixing solutions.
5. Mix the required amount of disinfectant solution in accordance with label instructions. Always add concentrate to water, not water to concentrate.
6. In cold temperatures, the building may require heating to ensure that the disinfectant is effective. Follow label instructions regarding the minimum contact time required for the disinfectant to be effective. As a rule, add 10 minutes to the minimum contact time for every 5°C below 20°C ambient temperature.
7. Once a solution has been prepared, it must be used on the same day, or it may become inactive.

It may be necessary to maintain a log of the prepared solution; it is critical in minimizing excess solution preparation and maintaining the efficacy of the disinfectant.

Apply disinfectant in a pre-cleaned facility from top to bottom and from back to front. The time a disinfectant is in contact with the surface is important and varies with the type of disinfectant.

Carefully follow the specific instructions on the disinfectant label. Reapplication of disinfectant may be necessary to achieve the product label-indicated contact time.

An Introduction to Disinfectants

Selection of Proper Disinfectants

The requirements of the incident, specifically, the microorganism of concern, disinfection methods, and environmental factors all contribute to disinfectant selection. Disinfection protocols may vary depending on the need of the farm . No single disinfectant is adequate for all situations. Disinfection protocols used daily will differ from those needed to control an infectious disease outbreak. However, both have one component in common; thorough cleaning and washing prior to the application of any disinfectant is essential.

Biocide or germicide refers to chemical agents that kill microorganisms. These general terms include disinfectants, antiseptics, and antibiotics. When a killing action is implied, the suffix -cide (e.g. biocide, bactericide, virucide, sporicide) is used, while -static (e.g. bacteriostatic, virostatic, sporostatic) is added when an organism's growth is merely inhibited, or it is prevented from multiplying.

Sanitizers do not destroy or eliminate all bacteria or microorganisms but reduce the number of microbial contaminants on inanimate surfaces to levels that are considered safe from a public health standpoint. Many sanitizers are a formulation of a detergent and disinfectant.

Disinfectant describes a product applied directly to an inanimate object. It destroys or irreversibly inactivates most pathogenic microorganisms, some viruses, but not usually fungal spores. In comparison, antiseptics are applied to the surface of living organisms or tissues to prevent or stop the growth of microorganisms by inhibiting the organism or by destroying them.

Sterilization refers to the process, either physical (i.e., extreme heat) or chemical (i.e., ethylene oxide), that destroys or eliminates all forms of life, especially microorganisms.

Detergents serve to disperse and remove soil and organic material from surfaces allowing a disinfectant to reach and destroy microbes within or beneath the dirt. These products also reduce surface tension and increase the penetrating ability of water, thereby allowing more organic matter to be removed from surfaces. Some disinfectants have detergent properties (i.e., chlorine compounds, iodophors, QACs).

Disinfectant Labels

Product labels contain important information on the proper use and hazards of a chemical. This information may often be overlooked however **it is a violation of the law to use a product in a manner inconsistent with its labelling**. Therefore, strict attention must be given to the proper use of a product regarding its application, effectiveness, and associated hazards (human, animal, and environment). This information will assist in decisions for infection control efforts.

Label Claims

Ultimately, regulatory agencies such as APVMA have the responsibility of ensuring that any claims made by an applicant (manufacturer or distributor) for a product that hopes to be registered for use in Australia are accurate and acceptable. Depending on the claims, the assessment can vary.

Disinfectants may have a range of uses and label claims, such as cleaner, deodorizer, sanitizer, disinfectant, fungicide, virucide or 'for hospital, institutional and industrial use'. Label claims may made for efficacy against standardized test microorganisms such as *Staphylococcus aureus*, *Salmonella enterica var choleraesuis*, and *Pseudomonas aeruginosa* or the applicant may wish for a claim against a specific microorganism such as African swine fever virus.

Other Important Information on a Product Label

- Effectiveness of Product Under Certain Conditions: Product testing often requires testing under "hard" water conditions of up to 400 ppm hardness (CaCo3) and in the presence of 5% serum contamination to simulate the product's effectiveness under field conditions.
- Active Ingredients. The active ingredients of the product are listed as percentages and are the chemicals responsible for the control of the microorganisms.
- Inert Ingredients. Inactive ingredients are often lumped into one statement and include items such as soaps or detergents, dyes or colouring agents, perfumes, and water.
- A precautionary statement describing the potential hazards of the product (to people or animals) and actions to take to reduce those hazards (i.e., wearing gloves or goggles). Specific "signal words" are used to indicate the degree of hazard. Descriptors used (from least harmful to most harmful) are: "Caution", "Warning", "Danger" and "Danger-Poison". Additional precautionary statements contained on the label may include additional safety and precautionary information such as environmental hazards, physical or chemical hazards, (i.e., corrosiveness or flammability), and storage and disposal information.
- The First Aid section lists the actions to take in the event of accidental swallowing, inhalation or contact with the product.
- The Directions for Use section tells what the product controls, as well as where, how, and when to use it. Some products may have multiple uses (i.e., cleaning versus disinfection), require different dilutions and/or contact times for such specific actions (i.e., -cidal versus -static). The best application method to use with the product (i.e., spray directly or wipe on surfaces) will usually be listed.

Considerations and assessment for a disinfection action plan

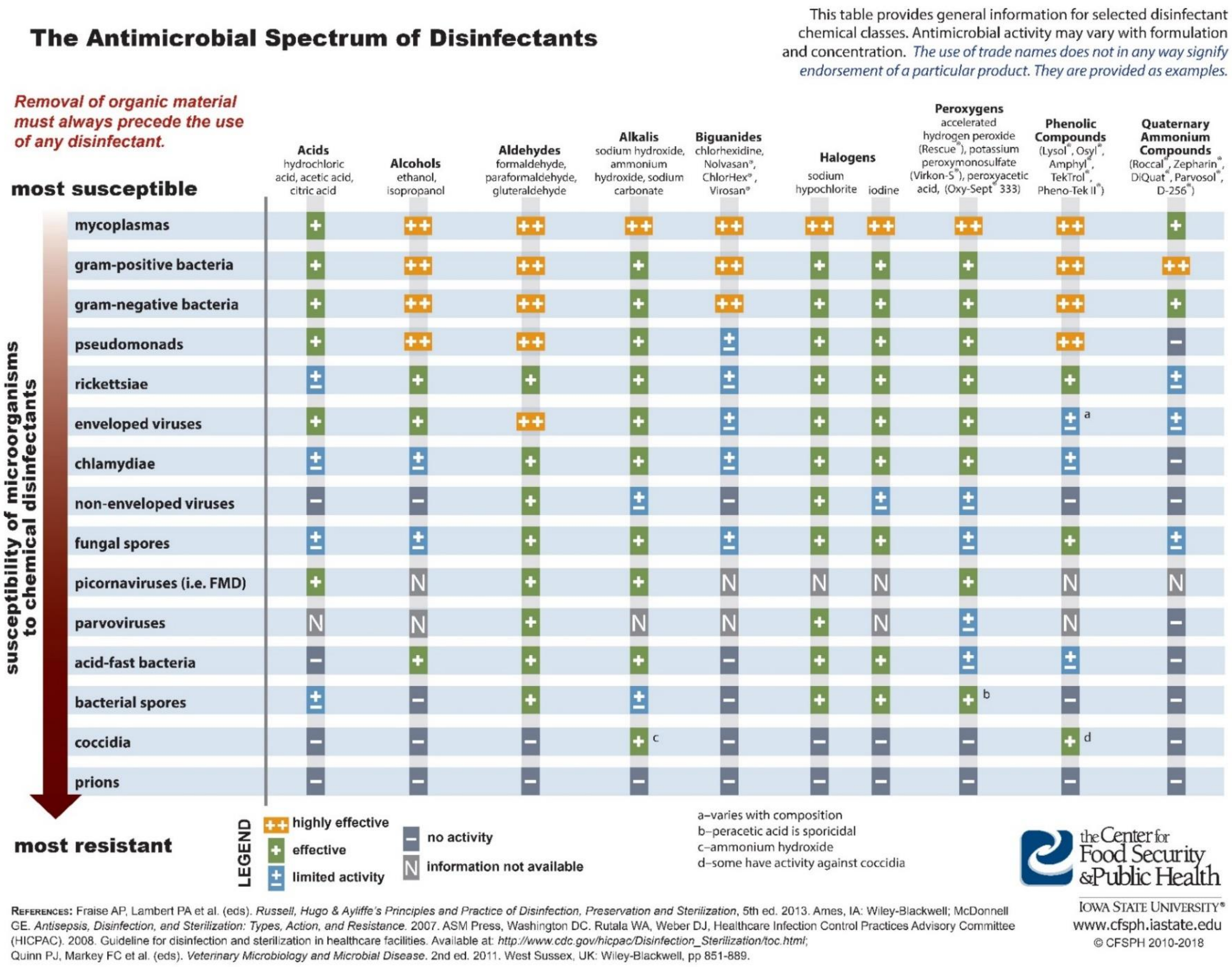
Before selecting a disinfectant to use, there are several factors that must be considered. Some disinfectants are effective for routine disinfection protocols at the farm while others are necessary for outbreak situations.

For an effective disinfection protocol, consideration should be given to the microorganism being targeted, the characteristics of a specific disinfectant, and environmental issues. Additionally, the health and safety of personnel and animals is always important.

Microorganism considerations

Microorganisms vary in their degree of susceptibility to disinfectants. In general, Gram-positive bacteria are more susceptible to chemical disinfectants while Mycobacteria or bacterial endospores are more resistant. The hydrophilic, non-enveloped viruses (adenoviruses, picornaviruses, reoviruses, rotaviruses) are more resistant to disinfection than lipophilic, enveloped viruses (coronaviruses, herpesviruses, orthomyxoviruses, paramyxoviruses, retroviruses).

For a comparison of microorganisms and their susceptibility to various disinfectant chemical classes, see Figure 2 on the next page.



The Antimicrobial Spectrum of Disinfectants

This table provides general information for selected disinfectant chemical classes. Antimicrobial activity may vary with formulation and concentration. *The use of trade names does not in any way signify endorsement of a particular product. They are provided as examples.*

Removal of organic material must always precede the use of any disinfectant.

Susceptibility of microorganisms to chemical disinfectants: **most susceptible** (top) to **most resistant** (bottom)

	Acids (hydrochloric acid, acetic acid, citric acid)	Alcohols (ethanol, isopropanol)	Aldehydes (formaldehyde, paraformaldehyde, gluteraldehyde)	Alkalis (sodium hydroxide, ammonium hydroxide, sodium carbonate)	Biguanides (chlorhexidine, Nolvasan®, ChlorHex®, Virosan®)	Halogens: sodium hypochlorite	Halogens: iodine	Peroxygens (accelerated hydrogen peroxide (Rescue®), potassium peroxymonosulfate (Virkon-S®), peroxyacetic acid, (Oxy-Sept® 333))	Phenolic Compounds (Lysol®, Osyl®, Amphyl®, TekTrol®, Pheno-Tek II®)	Quaternary Ammonium Compounds (Roccal®, Zepharin®, DiQuat®, Parvosol®, D-256®)
mycoplasmas	+	++	++	++	++	++	++	++	++	+
gram-positive bacteria	+	++	++	+	++	+	+	+	++	++
gram-negative bacteria	+	++	++	+	++	+	+	+	++	+
pseudomonads	+	++	++	+	±	+	+	+	++	−
rickettsiae	±	+	+	+	±	+	+	+	+	±
enveloped viruses	+	+	++	+	±	+	+	+	± a	±
chlamydiae	±	±	+	+	±	+	+	+	±	−
non-enveloped viruses	−	−	+	±	−	+	±	±	−	−
fungal spores	±	±	+	+	±	+	+	±	+	±
picornaviruses (i.e. FMD)	+	N	+	+	N	N	N	+	N	N
parvoviruses	N	N	+	N	N	+	N	±	N	−
acid-fast bacteria	−	+	+	+	−	+	+	±	±	−
bacterial spores	±	−	+	±	−	+	+	+ b	−	−
coccidia	−	−	−	+ c	−	−	−	−	+ d	−
prions	−	−	−	−	−	−	−	−	−	−

LEGEND: ++ highly effective; + effective; ± limited activity; − no activity; N information not available

a–varies with composition
b–peracetic acid is sporicidal
c–ammonium hydroxide
d–some have activity against coccidia

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Quinn PJ, Markey FC et al. (eds). *Veterinary Microbiology and Microbial Disease.* 2nd ed. 2011. West Sussex, UK: Wiley-Blackwell, pp 851-889.

Figure 2. The antimicrobial spectrum of disinfectants (Anonymous, 2018).

Pathogenic microorganisms also vary in their ability to survive or persist in the environment (i.e., bedding, debris, feed), and in their potential routes of transmission. Additionally, some microorganisms are also effective at creating a biofilm that enhances their ability to persist in the environment and avoid the action of disinfectants. These also are important considerations when selecting a disinfectant and protocol to use. Whenever possible, identification of the target microorganism should be done, however if the organism has not been identified, a broad-spectrum approach should be utilized until identification can be made.

Disinfectant considerations

An ideal disinfectant is one that is broad spectrum, works in any environment and is non-toxic, non-irritating, non-corrosive and relatively inexpensive. Unfortunately, no disinfectant is ideal. Therefore, careful consideration of the characteristics of a disinfectant are essential to select the most useful, effective and cost-efficient product.

Disinfectant concentration: Use of the proper concentration of a disinfectant is important to achieve the best results for each situation. Some products will have different dilutions depending on the desired use of the product (i.e., -*static* versus –*cidal* action). Although some disinfectants may be more efficacious at higher concentrations, these levels may be limited by the degree of risk to personnel, surfaces, or equipment, as well as the cost of the chemical.

However, any dilution of a product may render the disinfectant ineffective against the target microorganism. The product label will list the best concentration to use for each situation. Be sure to consider any standing water or other water sources (i.e., rainfall) in the area as a potential dilution source for a disinfectant.

Application method: There are a variety of ways to apply disinfectants. Object surfaces or walls of a building may be treated with a disinfectant solution by wiping, brushing, spraying or misting. Portable items should be soaked in a container of disinfectant. Fumigation may be used in some situations but is inefficient in buildings with ill-fitting doors and windows, or damaged roofs; fumigation typically requires skilled personnel to avoid impacts on human health.

Contact time: Appropriate contact times are essential. Disinfectants may vary in the contact time needed to kill versus inactivate microorganisms. For example, 70% isopropyl alcohol can destroy *Mycobacterium tuberculosis* in 5 minutes, whereas 3% phenol requires 2-3 hours. The minimum contact time needed is normally stated on the product label. Areas being disinfected should be well soaked with the disinfectant selected to avoid drying before the end of the optimum contact time. Some chemicals may have residual activity while others may evaporate quickly.

Stability and storage: Some disinfectants (i.e., sodium hypochlorite) lose stability quickly after being prepared for use or when stored over long periods, especially in the presence of heat or light. Disinfectant product labels will list the shelf life of the concentrated product. To maximize stability and shelf life, products should be stored in a dark, cool location and preferably in stock concentrations. Use of an outdated or inactivated product may result in the use of a non-efficacious product and will lead to a false sense of security.

Instructions for use: Mis-use of a product is a violation of the law. The label of a disinfectant may include limitations of the product and must be followed carefully. This will ensure maximum effectiveness, as well as protect personnel, the treated items and the environment.

Safety precautions: Most disinfectants can cause irritation to eyes, skin and/or the respiratory tract, therefore, the safety of all personnel should be considered. Training on proper storage, mixing and application procedures is essential. Personal protective equipment, such as gloves, masks, and eye protection, should be worn during the mixing or application of disinfectants. All chemical disinfectants have a Material Safety Data Sheets (MSDS) that lists the stability, hazards, and personal protection needed, as well as first aid information. This information should be available to all personnel. A ring binder containing this information in one easily accessible location may be useful.

Expense: Economic considerations are always important when selecting a disinfectant. Since disinfectants vary in cost, contact time and dilution, **costs should always be calculated on a per litre of use/dilution rather than the cost of concentrate**. However, disinfection protocols are generally a cost-effective means of reducing pathogenic organisms. For example, a disinfectant that costs $15.00 per litre of concentrate will cost $0.15 per diluted litre (1%

final solution). Considering a litre of diluted disinfectant covers approximately 4 m^2, the cost for disinfecting a 50 m^2 room is $1.88.

Environmental considerations: To disinfect a contaminated item or area, environmental factors can greatly impact the effectiveness of a disinfection plan. Organic load, surface topography, temperature, relative humidity, pH, water hardness or the presence of other chemicals are all important environmental factors to consider. Additionally, the value of an item and the health and safety of humans, animals and the environment are also important considerations.

Purpose of disinfection protocol: Initial assessment of the farm or clinic and the needs for disinfection will be important in the development of an effective protocol as well as disinfectant selection. What are the goals for the disinfection protocol? Are they to prevent an infectious disease, minimize disease spread, or control an outbreak? Answers should be addressed to develop an effective disinfection plan. Ineffective disinfection methods can lead to a false sense of security, which can inevitably lead to further spread of a disease.

Organic load: Removal of all organic material prior to application of a disinfectant is essential. The level of organic material (i.e., soil, bedding, litter, feed, manure) on an item or in areas to be disinfected can greatly impact the efficacy of a product or protocol. Organic matter provides a physical barrier that protects microorganisms from contact with the disinfectant. Debris and organic material can also neutralize many disinfectants especially chlorine and iodine containing compounds.[2,9] Items or equipment removed from the area, including those used for cleaning (i.e., brooms, shovels, buckets, hoses), must also be decontaminated before reuse or disposal.

Some disinfectants may have some efficacy or residual activity in the presence of organic material (i.e., phenols) and should be considered in circumstances where complete removal of organic debris is difficult. However, application of these products to a heavy organic load (i.e., non-cleaned surfaces) is not implied.

Surface topography: The type of surface to be disinfected can have a great impact on effectiveness of a disinfection plan. Porous, uneven, cracked, or pitted surfaces, especially wooden surfaces, and earthen floors, can hide microorganisms and are difficult to disinfect. An ideal surface to be disinfected is smooth.

Temperature: In general, most disinfectants work best at temperatures above 20°C. However, elevated temperatures may accelerate evaporation of a disinfectant, which can reduce contact time and decrease efficacy. Colder temperatures may also reduce the efficacy of some products. Consideration of the exposure temperature will be important if you will be disinfecting outdoors. Additionally, some items or areas being treated will be heat sensitive.

Relative humidity: Relative humidity can also influence the activity of some disinfectants. For example, formaldehyde fumigation requires a relative humidity in excess of 70% for effectiveness.

Water hardness: The water source used when cleaning and diluting disinfectants is also important. Water "hardness" can inactivate or reduce the effectiveness of certain disinfectants (i.e., QAC, phenols). "Hard" water contains calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions (leached from limestone and other minerals as groundwater passes over it). These ions can complex with cleaning compounds, leading to residue build-up, which may reduce their cleaning action.
However, many detergents have chelating agents, such as EDTA, to help bind these ions.

pH: The activity of some disinfectants is also affected by pH. For example, the efficacy of glutaraldehyde is dependent on pH, working best at a pH greater than 7. In contrast, quaternary ammonia compounds have the greatest efficacy at pH of 9-10. The pH can also affect the activity of phenolics, hypochlorite and iodine compounds.

Presence of other chemicals: Other chemicals can affect the efficacy of some disinfectants. For example, iodine agents are inactivated by QACs, while phenols are commonly formulated with soaps to increase their penetrative ability.

Value of the item to be decontaminated: Equipment will have varying degrees of value and disposability. Items that are reusable will need to be handled differently than those that will be discarded.

Health, safety, and the environment: The health and safety of humans and/or animals should always be a primary consideration when selecting a disinfectant. Most disinfectants have some level of hazard associated with their use. Some pose a serious threat to human and animal health (i.e., aldehydes, phenols, sodium hydroxide). Some cannot be used when animals are present or must be thoroughly rinsed away with potable water prior to restocking. Personnel training, personal protective measures and safety precautions should always be taken.

Environmental factors, such as runoff into creeks or ponds, must also be considered when selecting a disinfectant. Many agents are known ecological hazards for plants and aquatic life (i.e., sodium carbonate, hypochlorites, phenolics), therefore drainage, runoff, and biodegradability of disinfectants should be considered. Health and safety information of a disinfectant is required to be printed on the product's label.

Physical Disinfection

In addition to chemical disinfectants, heat, light, and radiation may also be appropriately used to reduce or eliminate microorganisms in the environment.

The use of **heat** is a one of the oldest physical controls against microorganisms and is reliable method of sterilization. Although both moist heat (autoclave, steam) and dry heat (flame, baking) can be used for inactivating microorganisms, moist heat is more effective and requires less time than dry heat.

Sunlight and ultraviolet (UV) light can have a detrimental effect on a number of microorganisms and may be a practical method for inactivating viruses, mycoplasma, bacteria, and fungi, particularly those that are airborne. UV light sterilizing capabilities are limited on surfaces because of its lack of penetrating power.

Other forms of **radiation** are less frequently used but may include the use of microwaves or gamma radiation. Freezing is not a reliable method of sterilization but may help to reduce heavy numbers of bacteria; some microorganisms are resistant to freezing.

Classification of Chemical Disinfectants

Disinfectants are classified by their chemical nature and each class has its unique characteristics, hazards, toxicities, and efficacy against various microorganisms. Environmental conditions, such as the presence of organic matter, pH or water hardness can also impact the action of a disinfectant. Therefore, before using any chemical disinfectant, **thoroughly read and follow the label instructions**.

Acids

Examples: acetic acid, citric acid

Acidic disinfectants function by destroying the bonds of nucleic acids and precipitating proteins. Acids also change the pH of the environment making it detrimental to many microorganisms.[13] Concentrated solutions of acids can be caustic, cause chemical burns, and can be toxic at high concentrations in the air. These characteristics limit their use. The antimicrobial activity of acids is highly pH dependent. Acids have a defined but limited use as disinfectants. Strong acids may damage concrete surfaces.

Acetic acid is usually sold as glacial acetic acid (95% acetic acid) which is then diluted with water to make a working solution concentration of 5%. The concentrated form is corrosive to the skin and lungs, but the typical dilution (5%) is considered non-toxic and non-irritating.

Acetic acid is typically applied by spraying, misting or immersing an item in a diluted solution. Household vinegar is a 4-5% solution of acetic acid (by volume). Acetic acid has poor activity in organic material.

Alcohols

Examples: ethanol, isopropanol

Alcohols are broad spectrum antimicrobial agents that damage microorganisms by denaturing proteins, causing membrane damage and cell lysis. Alcohols are used for surface disinfection, topical antiseptic and hand sanitizing lotions. Alcohols are considered fast-acting capable of killing most bacteria within five minutes of exposure but are limited in virucidal activity and are ineffective against spores. [Ethanol is considered virucidal; isopropanol is not effective against non-enveloped viruses.] An important consideration with alcohols is the concentration used, with 70-90% being optimum. Higher concentrations (95%) are less effective because some degree of water is required for efficacy (to denature proteins).[2,5] Alcohols evaporate quickly but leave behind no residue. The activity of alcohols is limited in the presence of organic matter. Alcohols are highly flammable, can cause damage to rubber and plastic, and can be very irritating to injured skin.

Aldehydes

Examples: formaldehyde, glutaraldehyde

Aldehydes are highly effective, broad-spectrum disinfectants, which typically achieve sterilization by denaturing proteins and disrupting nucleic acids. The most used agents are formaldehyde and glutaraldehyde. Aldehydes are effective against bacteria, fungi, viruses, mycobacteria and spores. Aldehydes are non-corrosive to metals, rubber, plastic and cement. These chemicals are highly irritating, toxic to humans or animals with contact or inhalation, and are potentially carcinogenic; therefore, their use is limited. Personal protective equipment (i.e., nitrile gloves, fluid resistant gowns, eye protection) should be worn if using these chemicals.

Formaldehyde is used as a surface disinfectant and a fumigant and has been used to decontaminate wooden surfaces, bricks and crevices of electronic and mechanical equipment. Its use must occur in an airtight building, which must remain closed for at least 24 hours after treatment. The efficacy of formaldehyde is dependent on relative humidity and temperature; optimum being humidity close to 70% and a temperature close to 14˚C. [Formalin is 37% solution of formaldehyde in water].

Glutaraldehyde is primarily used as a disinfectant for medical equipment (e.g. endoscopes) but can provide sterilization at prolonged contact times. A 2% concentration is used for high- level disinfection. Its efficacy is highly dependent on pH and temperature, working best at a pH greater than 7 and high temperatures. It is considered more efficacious in the presence of organic matter, soaps and hard water than formaldehyde.

Alkalis

Examples: sodium or ammonium hydroxide, sodium carbonate, calcium oxide

Alkaline agents work by saponifying lipids within the envelopes of microorganisms. The activity of alkali compounds is slow but can be increased by raising the temperature. Alkalis have good microbicidal properties but are very corrosive agents and personal protection precautions should be observed.

Sodium hydroxide (lye, caustic soda, soda ash) is a strong alkali used to disinfect buildings but is highly caustic. Protective clothing, rubber gloves, and safety glasses should be worn when mixing and applying the chemical. Lye should always be carefully added to water. **Never pour water into lye**; a very violent reaction will occur as well as the production of high heat that can melt plastic containers. Sodium hydroxide is corrosive for metals. It is considered an effective FMD disinfectant.

Ammonium hydroxide is an effective disinfectant against coccidial oocysts however strong solutions emit intense and pungent fumes. This substance is not considered effective against most bacteria. General disinfection should follow the use of this compound.

Sodium carbonate (soda ash, washing soda) has been used in a hot solution (82˚C) for disinfecting buildings, which have housed animals with FMD. It is more effective as a cleanser than a disinfectant since it lacks efficacy against some bacteria and most viruses. A 4% solution has been listed as an approved chemical for the FMD virus. It has poor activity in the presence of organic material and can be deactivated by hard water. It can be irritating and requires protective clothing and is harmful to aquatic life.

Calcium oxide (quicklime) becomes lime wash when mixed with water. This has biocidal effects on some bacteria and viruses and is sometimes spread on the ground following depopulation of infected premises and has also been used to retard putrefaction of buried carcasses after depopulation. It is not very effective against the FMD virus.

Biguanides

Example: chlorhexidine

Biguanides are detrimental to microorganisms by reacting with the negatively charged groups on cell membranes which alters the permeability. Biguanides have a broad antibacterial spectrum, however they are limited in their effectiveness against viruses and are not sporicidal, mycobactericidal, or fungicidal. Biguanides can only function in a limited pH range (5-7) and are easily inactivated by soaps and detergents. These products are toxic to fish and should not be discharged into the environment.

Halogens

Examples: chlorine or iodine compounds

Halogen compounds are broad spectrum compounds that are considered low toxicity, low cost and easy to use. They do lose potency over time and are not active at temperatures above 43°C or at high pH (>9). Since these compounds lose activity quickly in the presence of organic debris, sunlight and some metals, they must be applied to thoroughly cleaned surfaces for disinfection.

Chlorine compounds function through their electronegative nature to denature proteins and are considered broad spectrum, being effective against bacteria, enveloped and non-enveloped viruses, mycobacteria and fungi. At elevated concentrations, chlorine compounds can be sporicidal.

Sodium hypochlorite ($NaOCl$) is one of the most widely used chlorine containing disinfectants. [Commercial chlorine bleach contains 5.25% sodium hypochlorite in aqueous solution and 50,000 ppm available chlorine]. Biocidal activity is determined by the amount of the available chlorine of the solution. Low concentrations (2 to 500 ppm) are active against vegetative bacteria, fungi and most viruses. Rapid sporicidal action can be obtained around 2500 ppm; however, this concentration is very corrosive so should be limited in its use. High concentrations are also irritating to the mucous membranes, eyes and skin. Chlorine compounds are rapidly inactivated by light and some metals so fresh solutions should always be used. Hypochlorites should **never** be **mixed** with acids or ammonia as this will result in the release of toxic chlorine gas. See Table 1 below for details regarding different bleach dilutions.

Table 1. Commonly used applications of sodium hypochlorite as a disinfectant.

Sodium hypochlorite %	Bleach Solution Ratio	Bleach Dilution	ppm (available chlorine)	Comments
0.025%	1:200	1.5 Tbsp (0.6 oz) bleach to 1 gallon water	250 ppm	Common household use
0.1%	1:50	1/8 C (1 oz.) bleach to 1 gallon water	1000 ppm	Commonly used
0.16%	1:32	1/2 cup (4 oz.) bleach to 1 gallon water	1562.5 ppm	Commonly used
0.5%	1:10	1.5 cups (12 oz.) bleach to 1 gallon water	5000 ppm	This is a very strong solution and should be used on a limited basis.

Iodine Compounds are broad spectrum and considered effective for a variety of bacteria, mycobacteria, fungi and viruses. Iodides function by denaturing proteins to interfere with the enzymatic systems of microorganisms. Iodides are often formulated with soaps and considered relatively safe. Concentrated iodine compounds can be irritating to the skin, can stain clothes or damage rubber and some metals. Iodine agents are inactivated by QACs and organic debris.

Iodophors are iodine complexes that have increased solubility and sustained release of iodine. One of the more commonly used iodophors if povidone-iodine. They are good for general use and are less readily inactivated by organic matter than elemental iodine compounds. The dilution of iodophors increases the free iodine concentration and antimicrobial activity.

Oxidizing Agents

Oxidizing agents are broad spectrum, peroxide-based compounds that function by denaturing the proteins and lipids of microorganisms. Peroxygen compounds vary in their microbiocidal range but are considered effective on hard surfaces and equipment. In their diluted form, these agents are relatively safe but may be irritating and damage clothing when concentrated.

Hydrogen peroxide in the home is in diluted form (3-10%) whereas industrial use involves concentrated solutions (30% or greater). Hydrogen peroxide (at a 5-20% concentration) is considered bactericidal, virucidal (non-enveloped viruses may be resistant), fungicidal and at high concentrations sporicidal. Its activity against mycobacteria is limited.

Peracetic acid is a strong oxidizing agent and is a formulation of hydrogen peroxide and acetic acid. It is considered bactericidal, fungicidal, sporicidal and virucidal. It is also effective against mycobacteria and algae and has some activity in the presence of organic material.

Virkon-S (potassium peroxymonosulfate and sodium chloride) is a peroxygen molecule, organic acid, and surfactant combination, with a wide microbial spectrum of activity and some efficacy in the presence of organic material.

Phenols

Phenols are broad spectrum disinfectants that function by denaturing proteins and inactivating membrane-bound enzymes to alter the cell wall permeability of microorganisms. Phenols can be coal-tar derivatives or synthetic formulations and usually have a milky or cloudy appearance when added to water, as well as a strong pine odour.

Pine-Sol is an example of a phenol found in the home. Phenols are typically formulated in soap solutions to increase their penetrative powers and at 5% concentrations are considered bactericidal, tuberculocidal, fungicidal and virucidal for enveloped viruses. Phenols are not effective against non-enveloped viruses and spores. Phenols do maintain activity in hard water and in the presence of organic matter and have some residual activity after drying. Phenolic disinfectants are generally safe for humans but prolonged exposure to the skin may cause irritation. Concentrations over 2% are highly toxic to all animals, especially cats.

Quaternary Ammonium Compounds

Also known as “quats” or QACs, these compounds are cationic detergents that are attracted to the negatively charged surfaces of microorganisms, where they irreversibly bind phospholipids in the cell membrane and denature proteins impairing permeability. QACs can be from different “generations” depending on their chemistry, with later generations being more germicidal, less foaming and more tolerate to organic loads. QACs are highly effective against Gram positive bacteria, and have good efficacy against Gram-negative bacteria, fungi and enveloped viruses. They are not effective against non-enveloped viruses or mycobacteria and are considered sporostatic but not sporicidal. QACs have some residual effect, keeping surfaces bacteriostatic for a brief time. They are more active at neutral to slightly alkaline pH but lose their activity at pH less than 3.5. QACs are considered stable in storage but are, in general, easily inactivated by organic matter, detergents, soaps and hard water (this may vary with the “generation”). QACs are toxic to fish and should not be discharged into water sources (i.e., streams, ponds, lakes).

Special Considerations

Boot baths

To avoid mechanical transfer of microorganisms by personnel, boot baths may be included as a biosecurity measure. However, protocols and maintenance of boot baths are commonly neglected and are overlooked, so deserve special mention.

Common problems with boot baths include inadequate removal of organic debris prior to stepping into the disinfectant solution, inappropriate contact time allowed for the disinfectant, and infrequent change of disinfection solution. Incorrect use of boot baths will be a waste of resources and can lead to a false sense of security. The most overlooked and important step is removal of gross debris from boots **prior** to stepping into a boot bath disinfectant. Studies have shown that removing visible manure from boots prior to stepping into a disinfectant, greatly significantly reduces the number of bacteria present. This may either be accomplished by a hose, water and a scrub brush or by cleaning boots in a preliminary bath filled with dilute detergent. This process not only reduces the number of microorganisms present but will also minimize the amount of debris accumulating in the boot bath solution. Therefore, boots should be scrubbed and cleaned of all grossly visible debris prior to a timed soak in the disinfectant boot wash.

Allowing the proper contact time for a disinfectant is just as important for boot baths as it is when cleaning premises and equipment. Additionally, use of a fresh, efficacious solution is also essential. Boot baths should be refilled at least every 2-3 days. For best results, it should be replaced daily. Replacement of the disinfectant solution will also depend on the degree of traffic flow; more frequent replacement will be needed in large or busy areas or when organic debris accumulates in the boot bath.

Phenolic compounds are most commonly used for boot baths, due to their efficacy in the presence of organic matter. However, this should not prevent proper boot washing techniques from being implemented. In fact, cleaning away gross material will help to minimize organic debris accumulation in the boot bath.

Boot bath solutions should also be kept from freezing and protected from rain to avoid over- dilution. The use of rubber boots may better allow compliance with the necessary contact and soak times.

Disinfectant use approved by Australian Pesticides and Veterinary Medicines Authority

Australian animal health officials will provide guidance to farmers regarding which disinfectants are approved for specific applications in the event of an EAD. Table 2 below shows some of the current APVMA approved list of disinfectants effective against African swine fever virus.

Table 2. Australian Pesticides and Veterinary Medicine Authority list of approved disinfectants and concentrations for treatment of ASF virus (Neumann, Hall, Dahl, Hamilton, & Kurian, 2021).

Table 1. Australian Pesticides and Veterinary Medicines Authority (APVMA) list of approved disinfectants and concentrations for treatment of ASF virus

Disinfectant	Rate	Application[a,b]
494 g/kg of potassium peroxymonosulfate triple salt, 132 g/kg of sodium dodecylbenzene sulfonate, 44 g/kg sulfamic acid and 15 g/kg of sodium chloride (Virkon S) 497 g/kg potassium peroxymonosulfate, 49 g/kg sulfamic acid and 15 g/kg sodium chloride (Virkon Aquatic)	20 g/L	Final dose: 2–3% solution (equivalent to 20 g/L). Soak clothes/small items and equipment for at least 10 min. For surface cleaning, apply at the rate of 1–1.5 L/m^2. Do not use high-pressure sprays. Decontaminate removed organic matter before disposal.
Sodium hypochlorite 125 g/L	40 mL/L	Final dose: 0.5% solution (equivalent to 40 mL/L). Soak clothes, footwear and small equipment for 15–30 min. For surfaces, apply at a rate of 1–1.5 L/m^2 and soak for 15 min on nonporous surfaces and 30 min on porous surfaces.
Calcium hypochlorite 700 g/kg	7.2 mL/L	Final dose: 0.5% solution concentration (equivalent to 7.2 mL/L) for 10–30 min.
Sodium hydroxide 400 g/L	50 mL/L	Final dose: 2% solution (equivalent 50 mL/L). Soak clothes, footwear and small equipment for at least 10 min. For surfaces, apply at a rate of 1–1.5 L/m^2 and soak for at least 10 min.
Sodium carbonate anhydrous	40 g/L	Final dose: 4% solution (equivalent to 40 g/L) for 20 min.
Sodium carbonate washing soda	100 g/L	Final dose: 10% solution (equivalent to 100 g/L) for 30 min.
Glutaraldehyde with quaternary ammonium compounds[c] Available as 150 g/L of glutaraldehyde. One part of 15% glutaraldehyde to 7.5 parts water = 2% final concentration = 133 mL/L.	133 mL/L	Final dose: 2% solution (equivalent to 133 mL/L). Clean equipment with soap or detergent first and then rinse with water. Immerse for minimum of 10 min at 35°C and 20 min at 25°C. Maintain solution at pH > 7. Efficacy may be increased by raising the solution temperature to 60°C.
Citric acid	30 g product/L	Final dose: 3% solution (equivalent to 30 g/L). Nonporous surfaces apply for 15 min; porous surfaces apply for 30 min.

[a] Efficacy of some of the products and proposed uses under this permit has not been thoroughly determined. However, efficacy is reasonably expected due to the broad-spectrum nature of the product.
[b] For all situations, APVMA requires that users clean with soap or detergent first and then rinse with water to remove organic matter before applying disinfectant and that users must comply with their relevant state and territory environmental legislation.
[c] Glutaraldehyde and quaternary ammonium compounds are only available as a combined product. The final concentration is based on the glutaraldehyde% or its ppm.

Guidelines for planning construction of an on-farm truckwash

Size and surfaces

- Cement flooring is a must, regardless of whether you choose to build a covered or open truck wash. The are several reasons for this:
  - You need to have a clean place to stand when cleaning the outside of the trailer. You need to be able move between the inside and outside of the trailer, move to/from the area where cleaning equipment is stored, move back into the cab of the truck, etc. without cross-contaminating surfaces.
  - Cement flooring will facilitate capture of wash-water, effluent, and organic material for safe disposal or treatment. This is particularly critical during outbreaks of high-consequence diseases.
- The length and width of the wash area should be a minimum of 2m and preferably 3m, greater (on each side) than the width and length of the trailer. This allows room for the operator to manipulate the high-pressure washer wand (usually 1 to 1.5m) to clean the outside of the trailer, cab, and areas underneath the truck/trailer.
- There is debate as to the necessity of washing the top of a livestock trailer. While it is an unlikely area to become contaminated with livestock effluent and pathogens, it remains good practice to clean the area.
- Cleaning the outsides (and top) of the truck and trailer is facilitated by having some kind of catwalk on each side of the wash bay.
- Lighting in the wash bay is more than a luxury, it is very necessary. There is often pressure to keep trucks and trailers "on-the-road" meaning some washing may need to get done in the evening or early morning hours. Having good lighting in the wash bay allows one to do a much better job with cleaning, regardless of the time of day. In addition, having a well-lit wash bay will also improve the ambient light inside the trailer, where most of one's time will be spent during the wash process.
- Making the investment in having an enclosed wash bay facilitates meeting nearly all the guidelines described above. Concrete flooring, control of cross-contamination, effluent management, good lighting, installation of catwalks, all-weather use, day/night use, etc. are all much easier to accomplish in a purpose-built enclosure than in an ad hoc outdoor space. Walls and ceilings should be constructed from white material or painted white, to improve lighting in the space.

Cleaning equipment

- You need to have a way to remove bedding material from the trailer. While it is possible to do this with a shovel or broom, the easiest and fastest way is with a low pressure, high volume firehose.
- Bedding may be washed out in an area separate from the wash bay, but run-off from this material needs to be managed to avoid spread of disease to grazing stock, wildlife, or birds.
- Some professional haulers have found it useful to install water sprinklers inside pig transport crates to keep pigs cool in hot weather conditions. These systems make it very easy to pre-soak a trailer for 30-60 minutes prior to the actual washing process.

Water flow and pressure

- Low pressure washing is inadequate to clean livestock trailers, even if unlimited time was available to do the washing. High-pressure is more effective and quicker at removing organic matter than low pressure.
- 2500-3000 PSI washers are recommended, with 20 to 25 L per minute of flow. Given a choice, pressure is more important than flow. Invest in a good cleaning tip for your pressure washer; the free fan-tip that it comes with is not very effective. Splurge on a good rotary tip – you will thank yourself later.
- Budget on 3 person-hours to clean the inside and outside of a semi-trailer. While most of this can be done by a single person, a second person can speed some of the tasks such as breaking down internal gating/ramps/flooring, dealing with bedding removal, etc.
- How much water will you use? Run your fire hose into a barrel for 1-minute to measure the flow rate. Do the same for your high-pressure washer (the flow rate never matches the manufacturer specification, and the tip design will have a big impact). It takes about 15 minutes to wash out bedding (fire hose) and about 1.5 hours of run time to do the cleaning (pressure washer). A bit of simple math will then allow you to estimate your total water usage.

Disinfection

- This manual includes a lot of detailed information about disinfectants – familiarize yourself with the relevant parts.
- Surfaces must be clean for disinfectants to work. No shortcuts.
- For much of Australia, sunlight and drying are great add-ons to a disinfection programme but should not be counted on to replace a disinfectant programme.
- The outside of the truck/cab should be cleaned every time the trailer is cleaned. While the level of contamination with pathogens should be minimal, it remains a risk. Fortunately, the low level of contamination also means the cleaning (and disinfection) process should add only minimal time and expense to the overall truck washing process.

Effluent management

- Effluent and wash water from a pig transport truck is regulated in a manner identical to effluent from a piggery. Therefore, effluent from a livestock truck wash should be captured and treated in a manner to control the relevant public or animal health risks.
- Having a dedicated, covered truck wash bay with a concrete floor will greatly facilitate your ability to comply with effluent management regulations and minimise any opportunity for the effluent to act as a transmission pathway during an outbreak of a high-consequence disease.
- Plan the sloping of the wash bay floor so that wash water can be easily captured, and to make it easy to clean the floor after a truck has left the wash bay. Consider adding berms to the front/back/sides of the floor to eliminate any chance of uncontrolled run-off of wash water.

Staffing and biosecurity

- Create a written basic site plan for the truck wash.
- Clearly identify clean and dirty areas on the site plan. Make a large wall poster of the plan that shows the clean and dirty areas and directs foot traffic in/out of the site to minimize cross-contaminating the farm or other farm staff.
- Consider painting lines on the floor that identify clean and dirty areas.
- Plan space for storing washing equipment.
- Create a tidy area for staff to change into protective gear for use during washing. Put in a basin and tap for drivers to clean up after washing a truck.
- Install laundry equipment for use by drivers and staff involved in truck washing.
- Boots and coveralls used during truck washing should not be used when entering the piggery until after they have been laundered.
- Locate a closable rubbish bin in the truck wash to help drivers dispose of plastic over-boots, disposable coveralls, etc in a biosecure manner.
- All trucks that return from an abattoir should be considered contaminated.

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Biosecurity and the transport of pigs

Training manual

MINTRAC

Disclaimer

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Table of Contents

Note to users

Please help to keep these materials current

MINTRAC intends to regularly update these materials to ensure that they continue to reflect current practices and regulatory requirements in the industry.

Please assist in this process by taking the time to notify MINTRAC of any errors, changed requirements, incorrect information, additional materials, or any other ways in which these materials might be improved, by emailing mintrac@mintrac.com.au.

Using these materials

How can they be used?

These materials can be used by company and RTO trainers when delivering training to operators and supervisors who are involved with livestock transport washing.

These materials **MUST BE CUSTOMISED** before they are used in training sessions. They must be customised to make them aligned with practices in a particular workplace and the requirements of the relevant State/Territory jurisdiction.

The materials must include the work instructions and standard operating procedures relevant to truck washing, disposing of solid and liquid waste as well as Personal Protective Equipment (PPE) and personal hygiene in the truck wash.

The support materials can be used by **trainers** to:

- plan and deliver training
- give additional information to trainees
- keep a record of the training they have delivered.

The support materials can be used by **assessors** to:

- plan assessment – after training and for recognition of current competence/prior learning
- show trainees the areas they need to work on to be competent
- keep a record of the evidence used in assessment.

Some parts of these training materials can be used by **trainees**:

- as a resource during training

- to review knowledge, understanding and learning
- to prepare for assessment.

The **Assessment Materials** are sample materials which may be customised and used to assess the requirements of this task. Assessors can also develop their own Assessment Materials to suit the trainees.

The **Resources** section has a list of other resources the trainer can use in the training.

The **Bibliography** lists the books and other sources of information that were used to write the training materials.

How should training and assessment materials be customised?

Every pig farm is different. The training and assessment should match the operations of the company and the requirements of the workplace. ***The material in this booklet MUST BE CUSTOMISED to the company's and trainee's needs*** by including the:

WI Company **work instructions** for the tasks in the material.

SOPs Company **standard operating procedures** for the tasks in the material.

E Company **equipment** used for the tasks in the material.

D Any company **documents** or forms used for the tasks in the material. This includes safety signs, Material Safety Data Sheets (MSDSs), Quality Assurance checklists and company memos.

The icons in the question-and-answer section show:

- where to put the company information in the materials
- when the training and assessment must be applied to company operations.

These training materials must be updated for any changes in relevant legislation, and regulations, guidelines and codes of practice / Standards.

Biosecurity and the transport of pigs

Introduction

The pig industry faces a significant threat to its viability if there is an outbreak of African swine fever (ASF) or any other Emergency Animal Disease (EAD) here in Australia. One of the tools that the industry will have to help restrict the spread of a disease is effective truck washing. Truck washing will help prevent trucks and drivers spreading a disease from one pig farm to another.

In addition to being a measure to prevent the spread of any outbreak of diseases like ASF, truck washing should also be part of the everyday biosecurity arrangements of pig producers. Truck washing assists in restricting the spread of local or endemic diseases between properties, saleyards and abattoirs.

Section 1 Emergency Animal Diseases

What is an Emergency Animal Disease (EAD)?

Emergency Animal Diseases

Emergency Animal Diseases (EADs) are called emergency diseases because of their potential to spread rapidly and cause major economic impact to livestock industries and the economy. Some of these diseases can also be spread from animals to humans (zoonoses).

Emergency Animal Diseases are usually either:

- a disease that does not normally occur in Australia (exotic), and it is in the national interest for the country to be free from that disease e.g. African swine fever, Foot and Mouth disease (FMD) and Rabies

  or

- a disease that does occur in Australia (endemic) but is occurring in such a severe outbreak form that an emergency response is required to ensure that there is neither a large-scale epidemic of national significance, nor serious loss of market access e.g. Anthrax.

The horrendous toll and devastation that an EAD outbreak can cause can be seen when looking at the 2001 outbreak of FMD in the UK. The disease was discovered at an abattoir and by the time it was confirmed FMD had spread like wildfire throughout the country. It took nine months to bring FMD under control, with estimated losses of $14 billion and over six million farm animals were culled. Exclusion zones made travel and tourism in some areas almost impossible. This FMD outbreak took the livestock industries and rural communities decades to recover from.

Notifiable Diseases

A notifiable disease is any disease that is required by law to be reported to government authorities. It is your legal obligation to notify the Emergency Animal Disease Hotline 1800 675 888 or state/territory authorities if you know or suspect that an animal has a notifiable disease.

The full list of state and territory notifiable animal diseases can be found on the Department of Agriculture website (https://www.awe.gov.au/biosecurity-trade/pests-diseases-weeds/animal/notifiable). Note, state and territory lists often have additional diseases that are not included in the national list.

All Emergency Animal Diseases (EADs) are notifiable diseases.

What is African swine fever?

African swine fever (ASF) is a serious, highly contagious viral disease of domestic and wild pigs. It does not affect any other species of animals.

ASF can spread very rapidly and affects all age groups of pigs. The disease is usually fatal for infected pigs. ASF is not a zoonotic disease as it does not affect humans.

ASF was first detected in Africa in domestic pigs and wart hogs where it remains endemic today. The latest round of ASF outbreaks outside Africa began in 2007 when the disease was detected in Georgia. The disease has since spread into eastern Europe and was detected in China in 2018. ASF decimated the pig industry in China. By 2020 ASF had spread throughout South East Asia.

Currently the disease is not in Australia but is now endemic in neighbouring countries such as Papua New Guinea and Timor Leste.

In Europe, the disease has been spread by wild boar, which is a major concern for Australia given there is an estimated population of between 15 and 25 million feral pigs which can spread the disease in every State and Territory. The disease has also been spread amongst backyard farms through swill feeding.

How is ASF spread?

African swine fever is a highly lethal disease of pigs that can be spread by:

- Direct contact between pigs
- People, clothing, and livestock trucks and trailers contaminated with the virus
- Pigs consuming contaminated waste food (e.g. swill feeding) or more typical feed ingredients found in commercial pig diets that have somehow become contaminated with the virus during transport, storage, or manufacture
- Wild boar or feral pigs coming into contact with infected pigs or carcases of pigs that have died from the disease
- Ticks and biting flies
- The environment (e.g. water, soil, yards, etc.) contaminated by the virus
- Aerosols which are droplets that spread the disease from animal to animal (short distances only, less than 30 metres)

ASF and other viruses can survive for long periods of time in dirt, faeces, urine and blood coated onto trucks, trailers, clothing, boots, and equipment.

How long can ASF viruses survive?

There has been a great deal of research into how long the ASF virus can remain infectious in various situations. If a virus can still infect an animal, it is said to be still **viable**.

A problem for researchers is that pH, temperature, and exposure to sunlight can greatly affect how long the virus will remain viable. This means the experts cannot provide a single rule-of-thumb as to how long ASF virus will remain viable in the environment but as you will read below, we do know that the virus can remain infectious for long periods of time.

In the environment

The virus can, depending on temperature and soil type, remain viable in the soil for days, weeks, or even months.

In pens

Experiments have shown that pens which have had infected pigs in them retain viable virus for up to three days after the pigs are removed, even after modest cleaning. Dirty pens can remain contaminated with the virus for many weeks.

In faeces and blood

In faeces, the virus remains infectious for between 10 and 100 days while in blood it can remain viable up to 100 days.

In virus contaminated food

The research indicates that the ASF virus can remain viable for weeks, months, and even years in frozen, cured, and dried pork products depending on the storage conditions. This illustrates the danger of illegally imported pork products and the risk that some of this illegally imported pork ends up in pig swill.

In wastewater

It is possible that ASF virus can survive for some time in wastewater, but research is not clear on how long the virus remains viable. For this reason, wastewater from truck washes must be managed and treated to avoid spreading viable virus into water ways and pasture.

How can the spread of exotic and endemic pig diseases be prevented?

Biosecurity at our borders

Preventing exotic diseases from getting into Australia is dependent on preventing potentially contaminated pork and pork products entering Australia illegally. Imported stockfeed can also represent a threat to Australian livestock unless the required biosecurity measures are followed.

Biosecurity on farm

Pig farms need to have a biosecurity plan that enables pigs to be raised in a quarantined environment. This will involve ensuring that diseases are not introduced to the herd by:

- People
- Feed
- Machinery
- Livestock trucks and other vehicles
- Other pigs, livestock or pests.

Biosecurity for livestock transport

Livestock trucks have been implicated in the spread of ASF in Asia and the introduction of other diseases into pig herds. Making sure livestock trucks and trailers are cleaned and disinfected before being used to pick up pigs is one of the important biosecurity measures that pig farms and livestock transporters can implement to ensure pig loadouts do not introduce diseases to pig farms.

Likewise, truck drivers must implement personal hygiene and safe load out procedures to ensure they do not introduce diseases into pig farms.

Section 2 Livestock truck driver hygiene and biosecurity practices

How could truck drivers spread EADs?

Truck drivers can carry diseases between properties or between an abattoir and pig farms on:

- their boots and clothing
- their skin or hair
- their personal items, including food or food containers

- in blood, faeces, mud and vegetable matter in the cabin and stock crate or trailer.

They can spread these diseases by:

- carrying the disease into the pig farms by moving into and around pens on the farm
- carrying the diseases into an abattoir or saleyard which then spreads from these sites
- coming into contact with pig farm staff or other drivers through contaminated clothing or boots.

What personal and clothing hygiene practices need to be followed by drivers?

Drivers should keep clothing and footwear site-specific. If they go to a pig farm or abattoir, they should use overalls and boots (or boot covers) provided by that site. They should not wear those overalls and boots (or boot covers) in the truck cabin and should observe the boot washing and laundry procedures for each site.

Hand washing and personal hygiene is important because EADs can travel on the driver as well as on their clothing and the truck.

Why is cabin cleaning and hygiene important?

Drivers can contaminate their truck cabin by taking mud, urine, faeces and vegetable matter into the cabin (on their boots and clothing) and spreading viruses onto pedals, seats, the steering wheel and other contact surfaces.

There should be no reason to take any personal items (including food) out of the truck cab and onto a farm.

Section 3 Biosecurity during pig loadout at a farm

The loading of pigs onto trucks at a pig farm can represent a real biosecurity hazard if the movements of the driver and stockmen are not controlled.

To avoid drivers introducing a disease to a pig farm, there must be a clear separation of clean and dirty zones as well as the contact between the driver and pig farm's facilities and personnel.

What are the clean and dirty zones?

A pig farm can be divided into clean and dirty zones.

Clean Zones

Clean zones are the areas where pigs live or are handled, including sheds, shelters, lane ways and paddocks. A pig farm's workers maintain hygiene procedures to avoid introducing diseases from the outside environment.

Dirty Zones

A dirty zone is the area where equipment, trucks and people enter or can have access to the property. These potential sources of disease should stay in the dirty zone and not enter the piggery. They must stay in that zone and make no contact with pigs, equipment or the personnel that work with the livestock. This precaution is to prevent diseases infecting the pigs on the farm.

A physical fence or gate is usually the best way to establish the line between clean and dirty zones with a limited number of entry points.

These areas should be set up so livestock workers can perform their duties during the day without coming into contact with the 'outside world'.

If people or vehicles need to move from the dirty zone to the clean zone, there must be strict biosecurity measures taken. These movements only take place through designated transition zones, described below.

What is a Line of Separation?

The line between dirty and clean zones is called the Line of Separation (LOS). This separates people, equipment and supplies that are in the dirty area from the clean area where pigs are being reared. The locations where people and equipment can be moved between the clean and dirty zones is called the transition zone. There may be several transition zones within a single farm.

The transition zone can only be entered through a designated entry point where biosecurity can be managed through procedures such as:

- showering-in
- bench-entry systems
- changing clothes and boots
- cleaning stations or UV light pass-through chambers (for gear and equipment)
- handwashing.

The load-out area should **not** serve as a designated entry point for personnel and is **not** a place for drivers to enter the farm or for piggery staff to exit the farm. Drivers must not be able to come into contact with the pigs or stock handlers, on the farm side of the LOS. The biosecurity requirements will be set out in the piggery's biosecurity management plan and SOPs.

A one-directional LOS should be clearly identified in the load-out area. The LOS (a door to the shed, a gate at the bottom of the load chute, etc.) may vary between farms and should be communicated to everyone involved in the load-out process. At the LOS in the loud-out area:

- piggery staff may enter the pig loading area to assist the driver load the truck, but these staff are **not** allowed to re-enter the piggery during the load-out process or afterwards, unless precautions are taken (returning to the piggery via a designated entry point, which may include showering, overnight downtime, change of clothing and boots, or other measures).

- no one is allowed to enter a piggery shed through the loading chute area (which should always be considered a dirty area). The load-out is **not** a designated entry point for the piggery.

- in most circumstances, piggery staff should have no reason to enter the truck's livestock crate or cab.

All movement of pigs out of the pig farm should be done according to the piggery's strict biosecurity procedures as detailed in their biosecurity plan.

Why does the loadout of pigs represent a biosecurity hazard to a pig farm?

The load-out of pigs represents a distinct biosecurity threat because a truck and its driver (and their clothing) could be contaminated by an animal disease. To avoid introducing this disease, the truck driver and the pig farm's personnel must observe the LOS.

Truck drivers and stock handlers must understand exactly where this LOS is located, and what rules are in place to manage the load out of pigs. The LOS may be a physical barrier like a fence or a gate or door or the bottom of the chute. In some pig farms, the LOS is marked by painted lines in alleyways or pens.

The load out Standard Operating Procedure (SOP) will cover the following elements:

- defining the LOS for drivers and stockmen
- separation of driver and pig farm staff using a lairage/loadout space
- clothing and hygiene requirements for the driver
- cleaning and disinfecting of load out after use.

Managing clean and dirty footwear and clothing is a challenge for drivers during the loading and unloading processes. Drivers should be encouraged to maintain a stock of clean overalls (either disposable or non-disposable), disposable over-boots, disposable vinyl or latex gloves, and disinfectant-spray or wipes in their truck at all times. These can be stored in a plastic bin clearly labelled as "CLEAN". Similarly, a second "DIRTY" bin should be kept in the truck for storage of used or soiled gear. Once a driver returns to their depot, the CLEAN bin can be restocked as required, and the contents of the DIRTY bin either laundered or disposed of into a biosecure rubbish bin.

Section 4 Driver biosecurity for unloading pigs at an abattoir

The unloading of pigs at an abattoir can represent a real biosecurity hazard for pig farms visited by the driver and truck in the future.

To avoid drivers and trucks introducing a disease to a pig farm, there must be clear protocols for drivers to reduce the chance of drivers carrying diseases back to a farm from an abattoir.

For drivers, an important hazard is that they will contaminate the cab of the truck after unloading pigs. While it is true the cab can be cleaned after unloading, the aim of abattoir unloading protocols for drivers is that they minimise the amount of contamination the truck driver carries back into the cab of the truck.

Unloading requirements and procedures will vary from abattoir to abattoir but the driver's aim should always be to reduce the possibility of carrying contamination back into the cab and to another pig farm.

What are the clean, transition and dirty zones in an abattoir?

In export abattoirs, the areas around the plant are divided into clean, transition and dirty zones depending on the arrangements at the abattoir. Attachment 4 shows the layout of an abattoir lairage area with these three zones. This will restrict the areas that can be accessed by the driver (e.g. pig transporters are not able to go beyond the load-out ramp).

Clean zone:	The inside of the cab and a designated walkway to the transition zone.
Transition zone:	An area between the clean and dirty zones where a driver can take steps to minimize contamination (boots, overalls, handwashing, showering, and other cleaning steps)
Dirty zone:	All areas in contact with pigs including the back of the truck, inside the truck, the unloading area, lairage, and scales.

IMPORTANT: The clean and dirty zones at the abattoir described above are OPPOSITE from what was described for a piggery.

How do these zones work during the unloading process?

Below are listed some of the various arrangements that a driver may encounter while unloading pigs at an abattoir.

Arrangement 1

The best arrangement is for the **driver to remain in the truck** during unloading and to communicate with the abattoir staff by mobile phone just before they arrive at the abattoir.

After arrival, abattoir staff will unload the pigs. This ensures the driver's boots or clothes are not contaminated by any diseases at the abattoir and then carried into the cab of the truck once unloading is complete.

Any paperwork that needs to be completed during the delivery process can be done by having abattoir staff bring it to the cab of the window of the truck.

Arrangement 2

At some abattoirs, drivers are required to use a type of transition zone called **a bench entry facility** to move safely between clean and dirty zones. At these abattoirs, walkways restrict the driver movements to only a single path between the vehicle and the bench entry facility. In the facility, drivers hygienically change out of their own clothes and into clean overalls and boots provided by the abattoir for unloading.

After the unloading is finished, the driver returns to the bench entry facility and changes back into their own clothing and wash/sanitise hands.

This process is explained in detail in Attachment 2 to these training materials.

Arrangement 3

This arrangement involves use of a type of transition zone called **a staged entry** to enable the drive to move between clean and dirty zones at the abattoir. In this arrangement, the driver relies on the use of plastic over-boots and clean overalls to minimize cross-contamination between the abattoir and cab of the truck**.**

The staged entry type of transition zone involves the truck driver changing into abattoir-specific over boots and overalls before unloading pigs. It is preferable that these are provided by the abattoir, so they do not have to be taken away from the site by the driver.

Having changed, the driver then unloads the pigs. After unloading the pigs, the driver re-enters the transition zone, changes out of the overalls and boots and returns to the cab. If the overalls are not provided by the plant, then the truck driver should store them away from any other clothing and wash the overalls with detergent and hot water (60°C) for both the washing and rinsing cycles, as soon as is practicable and before wearing them into another pig premises. Similarly, if the boots worn are not provided by the abattoir, then they should be stored separately, cleaned, and disinfected before having contact with other pig establishments. A more detailed description of this arrangement is available in Attachment 2 to these training materials.

Arrangement 4

This is the least desirable option. In this arrangement, the driver moves through a transition zone with **no or minimal biosecurity procedures** before unloading. The driver then directly returns to the cab causing substantial contamination of the cab when they climb back in and drive away. Under this arrangement, the driver is 100% reliant on later procedures to clean the cab and prevent spreading potential diseases to the next pig farm they visit.

The more contaminated the cab is, the less likely that cleaning processes will remove all the contamination in the cab. Cleaning the inside of a cab can be a tedious process and taking steps to minimise the level of contamination ahead of time will substantially ease the cleaning process. Arrangement 4 is the least safe of all the arrangements.

Section 5 Truck washing biosecurity

Why is truck washing important?

While effective truck washing is vital in an outbreak of an Emergency Animal Disease such as ASF, it is also good practice to prevent the spread of more common endemic pig diseases such as salmonellosis, pneumonia, worms, as well as pathogens that have potential to cause human foodborne disease outbreaks.

Ensuring livestock trucks are not contaminated with faeces, urine, and mud will help to limit the opportunity for viruses and bacteria to hitch-hike back to pig farms. This is especially crucial when transporting pigs between farms and on return from abattoirs. Livestock transport vehicles should be viewed as being potentially infectious every time they set out to load pigs unless they comply with these truck washing procedures. This includes livestock transport between loads on the same farm, and between species in a mixed farming operation. Many pathogens can move between different livestock species so simply saying “my truck is only used for hauling pigs from one piggery” does not provide very good biosecurity.

The aim of truck washing is to ensure that livestock trucks:

- are clean when pigs are loaded, and that no contamination occurs during travel
- do not spread diseases from one pig farm to another
- do not spread diseases from abattoirs or saleyards to pig farms, and to the general environment around abattoirs and saleyards.

Abattoirs and saleyards should always be considered as potentially infectious; contact with one of these facilities should always be followed by cleaning and disinfection procedures.

Best practice truck washing ensures that during the washing process waste solids and water are contained, disposed of, and treated in such a way that the general area around the wash facility does not become contaminated.

Why is livestock truck construction important?

The construction of livestock trucks can reduce the effectiveness of the cleaning process.

In the cab, for instance, it is recommended that only trucks equipped with waterproof seating (plastic or vinyl seat covers) and fully rubberized flooring (rubber mats over the top of carpeting is not acceptable) are used for transporting livestock. This will ensure that surfaces in the cab can be easily cleaned and sanitised.

Similarly, the livestock crate should be constructed so that it is easy to dry clean waste and hose out. Well-designed stock crates ensure waste does not become trapped in corners. For instance, wooden deck floors with mesh that cannot be removed are almost impossible to clean effectively.

What water quality should be used for truck washing?

Hard bore water can reduce the effectiveness of detergents and the water may need to be treated before use.

If non-municipal water supplies are used, then routine micro testing will need to be performed to make sure it is fit for purpose.

What type of waste is found on the livestock truck after a delivery?

Wastes may include solid and liquid materials, such as:

- Urine
- Faeces

- Blood
- Soil/mud
- Plant matter (including bedding).

These wastes must be removed because they are a potential source of disease that can be passed onto the next load of pigs or contaminate the next property the truck visits. Such organic material will also severely reduce the effectiveness of disinfectants.

Trucks used for carting this material off site may be subject to a range of controls including the need for truck washing requirements.

What are the procedures for entering and leaving an abattoir livestock truck washing facility?

These procedures will be site-specific and will vary depending on if the truck wash is an on-site abattoir facility or is an off-site truck wash facility such as those found at saleyards. Regardless of location, the biosecurity objective when entering, using, and leaving a truck wash will be for both the inside and outside of the truck and trailer not to be contaminated when the truck driver climbs in and drives away (this includes the inside and outside of the cab).

Two general arrangements may be in place for cleaning the inside of the cab at a truck wash, though there may be any number of different specific procedures depending on the individual facility.

Arrangement 1

Under this arrangement the **DRIVER** cleans inside of cab, while **TRUCK WASH STAFF** cleans the inside/outside of trailer and outside of cab.

Under this arrangement the abattoir provides a designated transition area where drivers can change clothes and shoes when moving between the clean and dirty zones. The transition zone is most likely to be either be a bench entry system or a shower-through facility. A detailed explanation of entry and leaving requirements for such a facility (or transition zone) is included in Attachments 2 and 3 to these materials.

The driver is provided with the appropriate gear and supplies to clean the inside of the cab and then when the cab is cleaned the driver changes into a set of their own clean clothes before re-entering the cab.

Arrangement 2

Under this arrangement the **DRIVER** cleans the inside of the cab, AND the **DRIVER** also cleans the inside/outside of the trailer, and outside of the cab.

As with Arrangement 1. the abattoir will provide a designated transition area where drivers can change clothes and shoes when moving between the clean and dirty zones. The transition zone is most likely to be either be a bench entry system or a shower-through facility. A detailed explanation of entry and leaving requirements for such a facility (or transition zone) is included in Attachments 2 and 3 to these materials.

The driver in this arrangement is provided with the appropriate gear and supplies to clean the inside and outside of the cab and the livestock trailer.

The cleaning process will begin with cleaning and disinfecting the inside of the cab before washing the outside of the cab and the livestock trailer.

Under this arrangement a driver should remain on the dirty side of the transition zone until all cleaning and disinfection (inside/outside of cab and inside/outside of trailer) is completed.

Then following the correct procedure (see Attachments 2 and 3) the driver should dispose of the dirty clothing used in the truck washing and change into clean clothes and wash/sanitise hands before re-entering the cab.

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What are the procedures for washing livestock crates and trucks?

What are the steps in the cleaning and disinfection of the interior of the cab?

Cleaning and disinfecting the inside of the cab is a mandatory part of truck washing and should be completed regardless of what arrangement the driver has used to unload the pigs.

A detailed explanation of entry and leaving requirements for such a facility (i.e. the transition zone) is included in Attachments 2 and 3 to these materials. The following steps should be followed when cleaning the inside of a livestock truck cab:

1. Driver to enter the cab. Identify and clean with soap and water any surfaces (steering wheel, shifter, dash and controls, seat, side and front windows, upper part of door and door handles, etc.) that are heavily contaminated with dust or organic material. Next, wipe down all these surfaces with disinfectant saturated towels or alternatively, spray all surfaces with a disinfectant spray (e.g., 70% alcohol spray) followed by wiping. Driver to exit the cab.

2. While remaining outside of the cab, the flooring, pedals, inside of door panels, and door moulding should be cleaned using water, soap, and a stiff brush. The steps of the cab can be climbed if necessary to complete this, but the driver should not re-enter the cab.

    - If the floor is exceptionally dirty, it may be necessary to sweep out the material before wet cleaning.

    - After wet cleaning, rinse all these surfaces with a bucket of clean water and a clean brush. This may be aided by one or more dumps of clean water onto the floor, followed by sweeping with a brush (if the surfaces do not drain well) or wiping/absorbing with multiple paper towels. Alternatively, a low-pressure water supply (garden hose) can be used to do this rinsing. Take care to avoid splashing or overspray onto surfaces in the cab that have already been disinfected.

   - Without entering the cab, coat all these surfaces with disinfectant solution and leave to dry; do not rinse out the disinfectant.

3. Use hot water, soap and a stiff brush to clean the steps leading into the cab.

4. Rinse, then spray disinfectant onto the steps on the outside of the cab.

5. Return to the dirty side of the transition zone or changing area, remove and dispose of coveralls and boots (see Attachments 2 and 3 for details). <u>Put on disposable plastic overshoes</u>.

6. Driver should return to the cab. Steps leading into the cab should be checked to ensure they are still clean. If not, driver should carefully rinse and re-sanitize them without contaminating themselves.

7. Remove disposable over-boots, being careful to minimize contamination of footwear by debris or dirty water on the ground. This can be done by placing a rubbish bag on to the ground, stepping into the rubbish bag, removing over-boots while standing in the bag, and then climbing the steps. Dirty boots in the rubbish bag can then be disposed of by the truck wash staff.

8. Upon re-entering the cab, driver should use disinfectant spray/wipes (supply should be always available in the cab) to disinfect (again) hands, and all surfaces that may come into with the driver’s hands. Dispose of used wipes (if necessary) in a labelled rubbish container in the cab or toss into the rubbish bag outside of the cab that already contains the used over-boots (do not leave the cab to do this).

9. When outside of cab/trailer and inside of trailer are cleaned and disinfected, depart the site.

What are the steps in the cleaning and disinfection the outside of the cab and the inside/outside of the crate?

The order of the cleaning of stock crates or livestock trucks will be detailed in the relevant work instruction and or Standard Operating Procedure. Effective truck washing programs will include all the following steps:

Step 1 Put on Personal Protective Equipment (PPE)

Before starting truck washing operators need to put on the appropriate Personal Protective Equipment including

- rubber gloves
- eye protection
- rubber boots
- mask

- overalls.

Step 2 Dismantle crate

Cleaning operations on some vehicles or trailers may require dismantling of parts of the stock crate or trailer before cleaning commences.

Where possible operators should lift the floor panels to aid in their cleaning. If it is detachable, the crate structure of the vehicle should be lifted and cleaned inside, outside, and underneath.

If the vehicle flooring has a double layer (e.g., re-enforcing wire mesh), it should be lifted to aid in removing faecal material that may be trapped between it and the underlying wood or metal surface. Some trailers may carry extra equipment under the body (spare tire, jack stands, etc.). If so, this equipment must be removed, cleaned and disinfected.

Step 3 Dry Cleaning and pre-wash hosing

First the operator should remove any deposits of mud and vegetable matter from the wheel rims, wheel arches, tyres, mudguards, and the exposed chassis of the vehicle using brushes and a low-pressure high volume, cold or hot water hose.

The operator should pre-soak items where soil or manure is difficult to remove with simple washing in detergent and warm water.

Secondly, the operators should use shovels, brooms, and a low-pressure hose to remove all visible dirt, faeces and vegetable material from the interior of the stock crate or trailer.

This step should be performed from top to bottom and from front to back.

After this step all the debris including faeces will have been shoveled or brushed or washed from the exterior and interior of the vehicle so that it is visibly clean.

Step 4 Washing

This step involves washing the interior of the stock crate or trailer usually using detergent and a high-pressure hose. Detergents are a type of soap and sometimes applied as a foam or with an in-line injector into the wash water. Detergents reduce the time required to wash surfaces and improve the end results.

The operator should start by washing the roof of the crate then the walls and floors working from the front to the back. Again, the rule should always be to clean from top to bottom and from the clean area to the dirty area. Operators should take care using high pressure hoses to avoid spraying water and solids outside the wash bay area.

Detergents must be used and stored according to workplace requirements, manufacturer’s instructions, and the Safety Data Sheets.

After washing, the truck should be rinsed and allowed to drain before the next step. This rinse is important if the disinfection and detergents are not compatible.

Step 5 Disinfection (Sanitizing)

Before this step operators should check that all the mud, vegetable matter and faeces have been removed because the disinfectant or sanitizer will not work on surfaces that are not clean.

Operators should select the appropriate non-corrosive disinfectant or sanitizer from the chemical store and mix it according to the manufacturer's instructions. The disinfectant should be applied to all the trucks exterior surfaces, undercarriage and inside the stock crate.

Disinfectant or sanitizer should be allowed the recommended contact time then rinsed off and the truck allowed to dry. A holding area can be used for vehicles to stay during the required disinfectant contact time.

Step 6 Store Cleaning equipment and chemicals

After the truck and cabin washing is completed, chemicals should be returned and stored according to the facility's procedures.

The cleaning equipment such as rakes, shovels, scrapers, brushes etc. should be cleaned. Then the cleaning equipment should be stored in a secure location and hoses should be rolled and stored.

Step 7 Quality check

The driver or truck wash operator should perform a systematic check to ensure the truck has been cleaned correctly. This will involve a check list and the checker confirming each section of the truck is free of dirt, faeces, vegetable matter, blood etc. and that the truck has been disinfected.

Section 6 Managing the wastewater from a truck wash

Why does wastewater from a truck wash need to be managed and treated?

Live virus in the wastewater

It is possible for pathogens such as ASF, FMD, and other viruses to remain viable in water for an extended period of time and it is because of this that the wastewater from a truck wash must be contained in ponds until the virus is no longer viable. Wastewater that is discharged direct to a sewer system is treated at the municipal sewerage treatment works.

Irrigation using wastewater and the feral pig threat

Many properties, abattoirs and saleyards use wastewater to irrigate fodder crops such as lucerne. The worry is that if water is sprayed onto irrigation paddocks while viruses are still viable then feral pigs and other susceptible species could contract the disease if they graze these paddocks. If storm water is also directed into the pondage system, it can significantly reduce the average holding time during rainy periods, thus potentially increasing the risk of viable virus exposure.

Similarly, waste solids can contaminate the environment if the solids are not composted. The heat from composting kills the virus. If solid wastes are washed into creeks and rivers this is another way an EAD disease may spread to feral pigs or other susceptible species.

Attachment 1: Assessment materials for the training of workers in the biosecurity requirements for pig transport

Written or oral quiz or test

Trainee:

Assessor:

Company/workplace:

Registered Training Organisation:

Truck washing at a pig farm		
Questions	**Answers**	**Comments:**
What is an Emergency Animal Disease (EAD)?		
What is African swine fever (ASF)?		
How is ASF spread?		
What is an endemic disease?		
What is the sequence for washing a livestock truck?		
Can disease/virus survive in wastewater?		
Why can waste water spread diseases and how?		

What is the line of separation (LOS) in a pig farm?		
What are the “dirty” and the “clean” areas in a pig farm?		
How could livestock truck drivers spread pig diseases?		
What needs to be checked after a truck is washed?		
What is a disinfectant?		
Why is it important to clean the cab of a livestock truck?		

Attachment 2: Recommended driver biosecurity procedures for moving through a transition area to unload pigs

The options presented below describe basic principles for how a truck driver can enter and leave the unloading area at an abattoir in a biosecure manner. Each abattoir will vary in its configuration and layout and the basic principles described below should be customized to fit the particular situation.

In some situations, it may be possible for the driver to remain in the truck while abattoir staff take responsibility for unloading pigs.

Use of shower-through facilities (ideal)

The objective of a transition zone using a shower-through facility is to allow a driver to move from a contaminated environment to a clean and disinfected environment, without cross-contamination.

REQUIREMENTS for a transition zone using a shower-through system

- Construction of a dedicated, shower-through facility.
- Handwashing stations, secure lockers, and rubbish bins conveniently located in the shower-through facility.
- Stock of clean boots, overalls, and over-boots provided by the abattoir.

Procedure for ENTERING the shower-through facility

1. Climb out of the cab and following the dedicated path, walk to the shower-through facility. Boots should be washed and brushed before entering the facility if they are excessively dirty.
2. Open the door leading into the facility, step through disinfectant boot bath, and wash hands in the basin provided; follow handwashing with hand sanitizer. This area is considered the clean side of the shower-through facility.
3. No equipment such as sorting boards, prods, noisemakers, cell phones, etc. should be brought through the shower-through facility. All equipment that is required to unload pigs from the truck will be provided by the abattoir on the dirty side of the bench entry facility.
4. Enter the clean side of the shower-through facility. Remove shoes, outer, and inner clothing and place in locker.
5. Step through the shower into the dirty side of the facility. Showering is optional during this entry procedure but is mandatory when exiting the facility. Do not return to the clean side of the shower.
6. If driver does “shower-in”, dry off using towels provided. Otherwise, simply put on clean under clothing, overalls, and boots (all provided by abattoir).
7. Move to unloading area, enter truck and begin unloading pigs.

Procedure for LEAVING the shower-through facility

- Before entering the shower-through facility, use the provided hose and scrub brush to thoroughly clean boots.
- Open the door to the facility, and step into the disinfectant boot bath. Step out of the boot bath, remove boots, and place them in the designated storage area.
- Remove coveralls and under clothing and place in the designated laundry area.
- Step into the shower and wash completely with soap and shampoo (provided by abattoir).
- When finished showering, step through shower and dry off using towels provided. Collect your personal effects and put on any outer clothing that you had removed previously.
- Put on clean plastic over-boots (these will be provided by the abattoir) and return to your vehicle, stepping through the disinfectant boot bath as you walk through the door. Before climbing into your vehicle cab, remove the plastic over-boots and place them into a labelled dirty rubbish bin in your vehicle for biosecure disposal when you return to your point of origin.

Use of a bench entry facility (acceptable)

The objective of a transition zone using a bench entry facility is to allow a driver to move from a contaminated environment to a clean and disinfected environment, without cross-contamination.

Bench entries are a common biosecurity feature on pig farms around the world. While not as biosecure as a shower-in shower-out system whereby visitors to a farm are asked to remove all street clothes followed by a complete shower and change into farm clothes, bench entries provide a very high level of biosecurity with much less investment in time and effort. The principles upon which bench entry systems are implemented on pig farms can be easily modified for implementation at an abattoir to ensure drivers are able to leave the cab of their truck, unload pigs, and return to the cab of their truck in a biosecure manner.

REQUIREMENTS for a transition zone using a bench entry facility

- Construction of a bench entry facility.
- Construction of walls or walkways that constrain driver movements to only a single path between the vehicle and the bench entry facility.
- Handwashing stations, secure lockers, and rubbish bins conveniently located in the bench entry facility for use by drivers.
- Labelled clean and dirty containers in each truck for biosecurity gear and rubbish storage.
- Clean boots and over-boots provided by the abattoir. Over-boots provided by the driver.

Procedure for ENTERING the bench entry facility

- Climb out of the cab and following the dedicated path, walk to the bench entry facility.

- Open the door leading into the bench entry facility, step through disinfectant boot bath, and wash hands in the basin provided; follow handwashing with hand sanitizer. This area is considered the clean side of the bench entry facility. Boots should be washed and brushed before entering the facility if they are excessively dirty.

- No equipment such as sorting boards, prods, noisemakers, cell phones, etc. should be brought through the bench entry facility. All equipment that is required to unload pigs from the truck will be provided by the abattoir on the dirty side of the bench entry facility.

- Remove any extra top clothes and place them in the designated area on the clean side of the room.

- Remove one boot and in the same motion, rotate your body on the bench so your stocking foot can now be placed on the floor on the dirty side of the facility. Repeat the procedure with your other foot. You should now be sitting on the bench and facing the dirty side of the facility.

- Put on boots and coveralls that have been provided for your use by the abattoir. Wash your hands in the basin located on the dirty side of the facility, again followed by hand sanitizer. Dry hands with a clean towel.

- Leave the bench entry facility through the designated door, stepping through the disinfectant boot bath as you go. Move to the back of your transport trailer and begin unloading pigs. Do **not** enter the lairage area under any circumstances; limit your movement to only the truck and the loading chute area.

- When unloading is complete, return to the dirty side of the bench entry facility.

Procedure for LEAVING the bench entry facility

- Before entering the bench entry facility, use the provided hose and scrub brush to thoroughly clean boots.

- Open the door to the facility, and step into the disinfectant boot bath. Step out of the boot bath, remove boots, and place them in the designated storage area.

- Remove coveralls and return to the designated storage or laundry area. If they are disposable, place them in the rubbish bin provided.

- Wash your hands in the basin located on the dirty side of the facility, again followed by hand sanitizer. Dry hands with a clean towel.

- Sit on the bench, raise one leg, rotate your body, and in the same motion place your stocking foot into your personal footwear on the clean side of the bench entry facility. Repeat this motion with your second foot. You should now be sitting on the bench but facing the clean side of the facility.

- Collect your personal effects and put on any outer clothing that you had removed previously.

- Put on clean plastic over-boots (these will be provided by the abattoir) and return to your vehicle, stepping through the disinfectant boot bath as you walk through the door. Before climbing into your vehicle cab, remove the plastic over-boots and place them into a labelled dirty rubbish bin in your vehicle for biosecure disposal when you return to your point of origin.

Use of a staged-entry procedure (less secure)

The objective of a transition zone using a staged-entry procedure is to allow a driver to move from a contaminated environment to a clean and disinfected environment, without cross-contamination.

The abattoir may establish a type of transition zone called a staged-entry to clearly separate clean (cab of the truck) and dirty (abattoir) areas during the unloading process. Staged entries rely on use of plastic over-boots and clean coveralls to minimize cross-contamination between the abattoir and cab of the truck.

REQUIREMENTS for a transition zone using a staged-entry procedure

- Construction of walls or walkways that constrain driver movements to only a single path between the vehicle and a designated staged-entry area. This area should be protected from the weather, readily cleanable, and comfortable for drivers to change into abattoir-specific boots and coveralls.

- Handwashing station and containers for biosecure rubbish disposal at the staged-entry entry point.

- Labelled clean and dirty containers in each truck for biosecure gear and rubbish storage.

- Clean boots and over-boots provided by the abattoir. Clean coveralls and over-boots provided by the driver

Procedure for ENTERING the staged-entry area

- Climb out of the cab and following the dedicated path, walk to the designated staged-entry area.

- Upon reaching the staged-entry area, step through the "stage one" disinfectant boot bath and place in rubbish bin. Wash hands in the basin located at the designated entry point, followed by hand sanitizer. Dry hands with a clean towel. Boots should be washed and brushed before entering the staged-entry area if they are excessively dirty.

- No equipment such as sorting boards, prods, noisemakers, cell phones, etc. should pass <u>through</u> the staged-entry area. All equipment that is required to unload pigs from the truck will be provided by the abattoir on the "dirty side" of the staged-entry area.

- Put on the clean coveralls (provided by the driver) and gumboots (provided by the abattoir).

- Leave the staged-entry area by stepping through the "stage two" disinfectant boot bath provided and move to the back of the transport trailer and begin unloading pigs. When unloading is complete, return to the staged-entry area.

Procedure for LEAVING the staged-entry area

- When reaching the staged-entry area, use the provided hose and scrub brush to thoroughly clean boots; step into the stage two disinfectant boot bath. Step out of the boot bath, remove gum boots, and place them in the designated storage area.

- Remove your overalls. If they are disposable, place them in the rubbish bin provided. If they are non-disposable, turn them inside out during the removal process so that you can carry them back to your truck without contaminating your street clothing.

- Wash your hands in the basin located at the staged-entry area, again followed by hand sanitizer. Dry hands with a clean towel.

- Put on clean plastic over-boots (these will be provided by the abattoir) and return to your vehicle, stepping through the stage one disinfectant boot bath as you leave the area. Before climbing into your vehicle cab, remove the plastic over-boots and place them into a labelled “dirty” rubbish bin in your vehicle (along with your non-disposable coveralls, if they were used) for biosecure disposal when you return to your point of origin

Attachment 3: Recommended driver biosecurity procedures for moving through a transition area at an abattoir truck wash

The options presented below describe basic principles for how a truck driver can enter and leave the truck washing area at an abattoir in a biosecure manner. Each abattoir will vary in its configuration and layout and the basic principles described below should be customized to fit the particular situation.

In some situations, it may be possible for the driver to remain in the truck while abattoir staff take responsibility for washing the inside and outside of the crate, and the outside of the cab but in most instances, the driver will have the responsibility for cleaning the inside of the cab.

Driver has left the pig unloading area through a shower-through, bench entry, or staged-entry transition zone prior to arriving at the truck wash

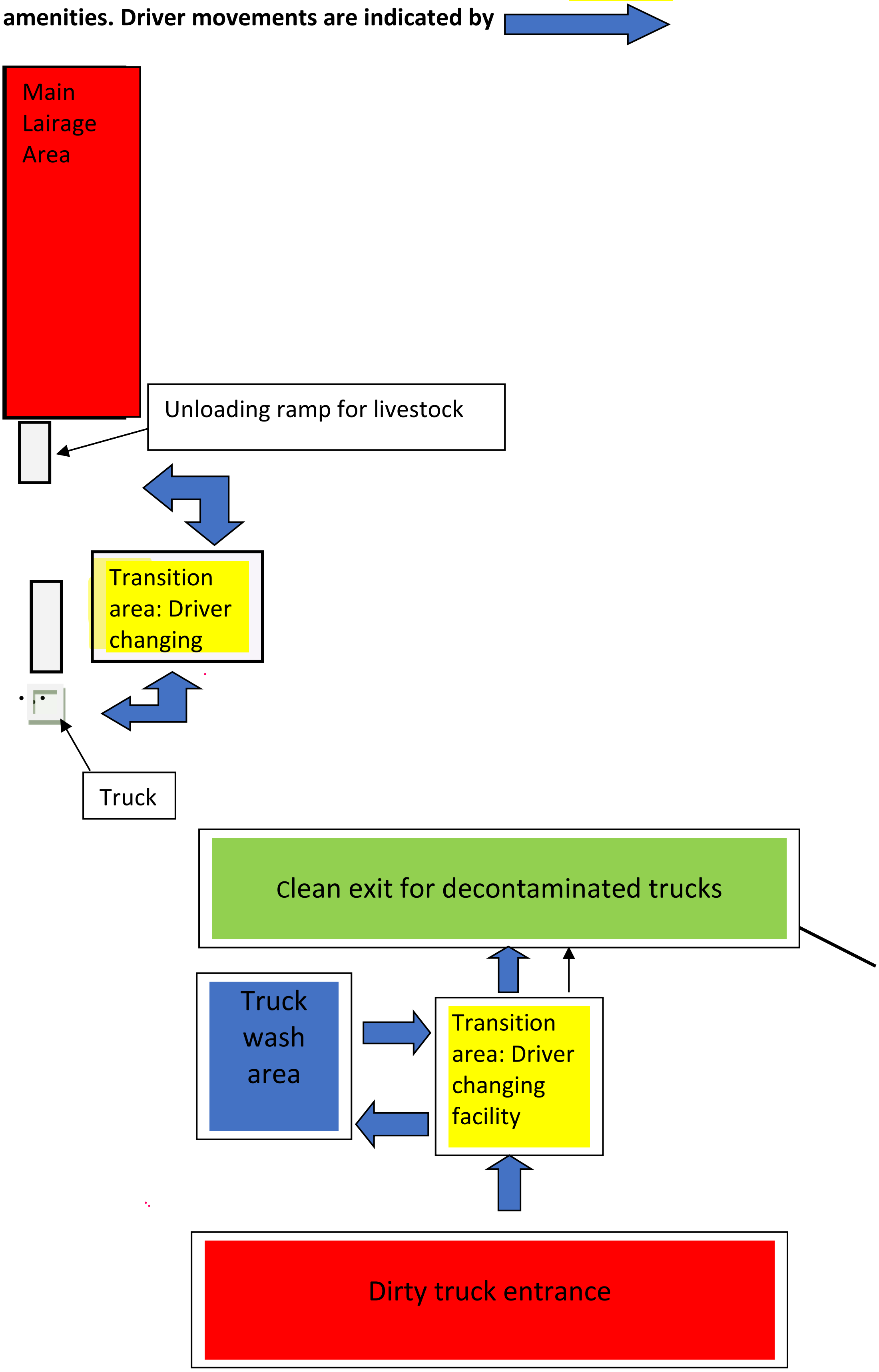
- If driver is ONLY responsible for cleaning the inside of the cab, no movement through the transition zone is required.
- In all other situations, the driver is required to move through the transition zone available at the truck wash.
    - Use of shower-through facilities (ideal), bench entry facilities (acceptable), or a staged-entry procedure (less secure) is completed as described above in Attachment 2.

Driver has left the pig unloading area without passing through a transition zone

- The driver is required to move through the transition zone available at the truck wash.
    - Use of shower-through facilities (ideal), bench entry facilities (acceptable), or a staged-entry procedure (less secure) is completed as described above in Attachment 2.

Attachment 4: Example of clean, dirty and transition zones at an abattoir

A Site Map Showing installation location and dirty to transition to clean truck flows and driver amenities. Driver movements are indicated by



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