

AUSTRALIAN VETERINARY EMERGENCY PLAN

AUSVETPLAN

Response strategy

Lumpy skin disease

Version 5.0

AUSVETPLAN is a series of technical response plans that describe the proposed Australian approach to an emergency animal disease incident. The documents provide guidance based on sound analysis, linking policy, strategies, implementation, coordination and emergency-management plans.

National Biosecurity Committee

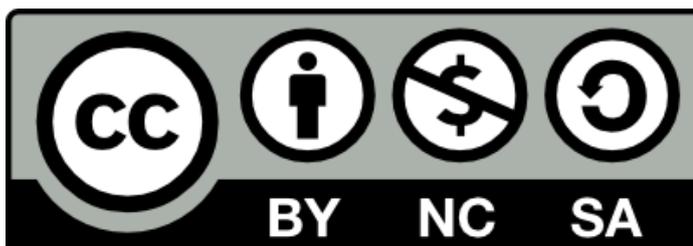
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Edition 1

1991

Edition 2

Version 2.0, 2006 (major update)

Edition 3

Version 3.0, 2009 (major update to Edition 3)

Edition 5

Version 5.0, 2022 (major update and new format)

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1 Introduction

1.1 This manual

1.1.1 Purpose

As part of AUSVETPLAN (the Australian Veterinary Emergency Plan), this response strategy contains the nationally agreed approach to the response to an incident – or suspected incident – of lumpy skin disease (LSD) in Australia. It has been developed to guide decision making to ensure that a fast, efficient and effective response can be implemented consistently across Australia with minimal delay.

1.1.2 Scope

This response strategy covers LSD caused by lumpy skin disease virus.

This response strategy provides information about:

- the disease (Section 2)
- the implications for Australia, including potential pathways of introduction; social, environmental, human health and economic effects; and the critical factors for a response to the disease (Section 3)
- the agreed policy and guidelines for agencies and organisations involved in a response to an outbreak (Section 4)
- declared areas and premises classifications (Section 5)
- biosecurity controls, including quarantine and movement controls (Section 6)
- response surveillance and establishing proof of freedom (Section 7).

The key features of LSD are described in the **Lumpy skin disease fact sheet** (Appendix 1).

1.1.3 Development

The strategies in this document for the diagnosis and management of an outbreak of LSD are based on risk assessment. They are informed by the recommendations in the World Organisation for Animal Health (WOAH) *Terrestrial animal health code* (Chapters 7.6 and 11.9) and the WOAH *Manual of diagnostic tests and vaccines for terrestrial animals* (Chapter 3.4.12). The strategies and policy guidelines are for emergency situations and are not applicable to policies for imported animals or animal products.

This manual has been produced in accordance with the procedures described in the **AUSVETPLAN Overview**, and in consultation with Australian national, state and territory governments; the relevant livestock industries; nongovernment agencies; and public health authorities, where relevant.

In this manual, text placed in square brackets [xxx] indicates that that aspect of the manual remains unresolved or is under development; such text is not part of the official manual. The issues will be worked on by experts and relevant text included at a future date.

1.2 Other documentation

This response strategy should be read and implemented in conjunction with:

- other AUSVETPLAN documents, including the operational, enterprise and management manuals; and any relevant guidance and resource documents. The complete series of manuals is available on the Animal Health Australia website¹
- relevant nationally agreed standard operating procedures (NASOPs).² These procedures complement AUSVETPLAN and describe in detail specific actions undertaken during a response to an incident. NASOPs have been developed for use by jurisdictions during responses to emergency animal disease (EAD) incidents and emergencies
- relevant jurisdictional or industry policies, response plans, standard operating procedures and work instructions
- relevant Commonwealth and jurisdictional legislation and legal agreements (such as the Emergency Animal Disease Response Agreement – EADRA³), where applicable.

1.3 Training resources

EAD preparedness and response arrangements in Australia

The EAD Foundation online course⁴ provides livestock producers, veterinarians, veterinary students, government personnel and emergency workers with foundation knowledge for further training in EAD preparedness and response in Australia.

¹ www.animalhealthaustralia.com.au/our-publications/ausvetplan-manuals-and-documents

² <https://animalhealthaustralia.com.au/nationally-agreed-standard-operating-procedures>

³ <https://animalhealthaustralia.com.au/eadra>

⁴ <https://animalhealthaustralia.com.au/online-training-courses>

2 Nature of the disease

Lumpy skin disease (LSD) is an acute to chronic, highly infectious, generalised skin disease of cattle and buffalo characterised by widespread skin nodules, production losses and mortality. The disease is caused by lumpy skin disease virus, which is similar to the viruses causing sheep pox and goat pox. Lumpy skin disease is a mechanically transmitted vector-borne disease, which can also be transmitted directly and through fomites.

2.1 Aetiology

Sheep pox, goat pox and LSD viruses belong to the genus *Capripoxvirus* of the family *Poxviridae*. These viruses are morphologically indistinguishable from each other; they are also difficult to distinguish serologically, and cross-protection does occur (Kitching 2003). However, they are phylogenetically distinct and are adapted to different host species (Tulman et al 2001, 2002). They can be differentiated using species-specific molecular diagnostic techniques (Le Goff et al 2009; Lamien et al 2011a, b).

2.2 Susceptible species

LSD mainly affects cattle. *Bos taurus* cattle are generally more susceptible than *Bos indicus* (zebu) cattle (Davies 1991a, Gari et al 2011). Jersey, Guernsey, Friesian and Ayrshire breeds are particularly susceptible. Cases have also been seen in Asian water buffalo (*Bubalis bubalis*) (Ali et al 1990, El-Nahas et al 2011, Elhaig et al 2017) and banteng (*Bos javanicus*). It has been reported that the morbidity rate in buffalo (1.6%) is significantly lower than in cattle (30.8%) (El-Nahas et al 2011).

Some strains of LSD virus may replicate in sheep and goats, although there is no epidemiological evidence of small ruminants acting as a reservoir for the virus (FAO 2017, Tuppurainen et al 2017).

LSD was reported in Arabian oryx in Saudi Arabia (Greth et al 1992); however, differentiation from sheep pox was not confirmed. Experimentally, impala and giraffe are also susceptible (Young et al 1970, Hedger & Hamblin 1983, Greth et al 1992). No wildlife reservoir species have been identified in Africa.

Antibodies to capripoxviruses have been detected in a range of African wildlife species, including Cape buffalo (*Syncerus caffer*), wildebeest, springbok, eland, impala, kudu and waterbuck (Davies 1982, 1991a; Hedger & Hamblin 1983; Barnard 1997). LSD virus nucleic acid has been detected in skin samples from springbok (Le Goff et al 2009, Lamien et al 2011a).

Australian fauna are unlikely to be susceptible to LSD.

2.2.1 Zoonotic potential

LSD does not affect humans (OIE 2017).

2.3 World distribution

For the latest information on the distribution of LSD, refer to the World Organisation for Animal Health (WOAH) World Animal Health Information System.⁵

2.3.1 Distribution outside Australia

Before 2012, the distribution of LSD was limited to Africa and Israel. However, since then, LSD has spread to many parts of the Middle East, Turkey, Cyprus, eastern Europe, the Balkans and the Russian Federation (EFSA AHAW Panel 2015).

Since 2019, LSD has spread throughout the Asian continent, including India and China, and southwards through Southeast Asia. In 2020, outbreaks were reported in a territory of Taiwan and in Nepal (possibly from the movement of flies or mosquitoes from neighbouring countries, or animal movements). In 2021, LSD spread further into Cambodia, Malaysia and Thailand. In 2022, cases were reported in Indonesia and Singapore.

2.3.2 Occurrence in Australia

LSD has never been recorded in Australia.

2.4 Epidemiology

2.4.1 Incubation period

The incubation period for LSD is 6–26 days (Sohier et al 2019, EFSA 2020).

WOAH incubation period

For the purposes of the WOAH *Terrestrial animal health code*, the incubation period⁶ for LSD is 28 days.

⁵ <https://wahis.woah.org/#/home>

⁶ In the OIE Terrestrial Code, 'incubation period' means the longest period that elapses between the introduction of the pathogenic agent into the animal and the occurrence of the first clinical signs of the disease. See www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmfile=glossaire.htm.

2.4.2 Persistence of agent and modes of transmission

General properties

General properties of LSD virus include:

- stable between pH 6.6 and 8.6 (Barnard et al 1994, Coetzer & Tuppurainen 2004)
- inactivated in 10 minutes at 60 °C, but dried virus (orthopoxviruses in general) can withstand 100 °C for 10 minutes (Andrewes et al 1978)
- persists in dark environmental conditions for many months (OIE 2017)
- persists for long periods in chilled (4 °C) and frozen (-80 °C) material (Weiss 1968)
- susceptible to heat, with inactivation at 55 °C in 2 hours and 65 °C in 30 minutes; these values are also commonly cited for sheep pox and goat pox viruses (OIE 2017)
- susceptible to sunlight and detergents containing lipid solvents
- inactivated by a wide range of disinfectants, including some detergents, ether, chloroform, formalin, phenol, sodium hypochlorite, iodine compounds and quaternary ammonium compounds (Weiss 1968, OIE 2017).

Organic material surrounding the infectious virus in the environment will affect the efficacy of disinfectants.

Note that these are general properties, and research to validate specific values is limited. Data on LSD virus stability outside the ranges given above are lacking. For example, the range of pH values that the virus can tolerate may be wider than thought, and extremes of acidity or alkalinity may be required to reliably lead to significant inactivation (Polson & Turner 1954, Herd Health 2017). A few studies demonstrate the pH resistance to inactivation of both sheep pox virus and goat pox virus, with virus survival between pH 3.0 and 11.0 (OIE 2017).

The common temperature range cited for inactivation of LSD virus is extrapolated from studies on sheep pox virus and vaccinia virus. Many studies have produced inactivation in the 50–60 °C range; however, some studies had differing findings on inactivation levels and resistance of individual strains to these treatments. Although pasteurisation is likely to inactivate some virus, the level of inactivation has not been quantified. Consideration should also be given to the protective qualities of milk fat and protein (OIE 2017). The WOAHP recommendations for importation of milk and milk products are that the products have either been derived from animals in a country or zone free from LSD or were subjected to pasteurisation or any combination of control measures with equivalent performance, as described in the Codex Alimentarius *Code of hygienic practice for milk and milk products*.⁷

⁷ www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=1&htmlfile=chapitre_lsd.htm

Environment (including windborne spread)

Capripoxviruses can remain viable for long periods outside the animal host. They may persist for many months in a suitable environment, such as that provided by shaded animal pens (OIE 2017, DoA & CSIRO 2019).

Windborne spread has not been documented, but dispersal of vectors by wind may facilitate disease spread (see 'Arthropod vectors').

Arthropod vectors

Mechanical transmission by biting insects is considered to be the main route of local transmission of LSD virus. Longer-distance spread (eg by wind dispersal of vectors) has been implicated in the introduction of LSD into new countries.

Uptake of virus by biting vectors is most efficient from clinically affected animals; asymptomatic animals in a herd are likely to have much lower virus titres and therefore play less of a role in propagation of the virus by vectors (Sanz-Bernardo et al 2021). LSD virus has been shown to persist for 2.4 days in the vector, and the vector has a 0.19 probability of transmitting LSD to cattle (Sanz-Bernardo et al 2021).

The likely insect species involved are expected to vary depending on local conditions and insect populations. Mechanical transmission of LSD virus by mosquitoes (*Aedes aegyptii*) and hard ticks (*Rhipicephalus appendiculatus*) has been demonstrated experimentally (Chihota et al 2001, Tuppurainen et al 2013a). Stable flies (*Stomoxys calcitrans*), tabanid flies, other flies, midges (*Culicoides* spp.) and other hard ticks (eg *Amblyomma hebraeum*) have also been demonstrated as mechanical vectors (Weiss 1968, Kitching & Mellor 1986, Muller et al 2011, Tuppurainen et al 2011, Lubinga et al 2015, EFSA AHAW Panel 2015).

LSD virus is not thought to remain infectious in mechanical vectors for long, although survival for at least 8 days has been reported in mosquitoes (*A. aegyptii*) and stable flies (*S. calcitrans*) (Spickler 2017, Sanz-Bernardo et al 2021). Variability in the mean duration of potential virus survival in vectors has been reported (Gubbins 2019), which should be considered along with the feeding behaviour of the likely vectors and vector life spans.

Recent experimental studies demonstrated mechanical transmission of LSD virus via *Stomoxys* species (including *S. calcitrans* – stable flies) (Sohier et al 2019, Issimov et al 2020). The ability for *Stomoxys* spp. to travel 21–28 km in 24 hours, in addition to virus survival times, means that *Stomoxys* activity can easily lead to localised spread (Gubbins 2019, Issimov et al 2020). Tabanid horseflies can transmit LSD virus (Sohier et al 2019).

Ticks are unlikely to play a role in rapid spread of LSD virus in outbreaks because of their slow mobility. However, prolonged survival of the virus in hard ticks may be possible, and ticks may therefore act as an environmental reservoir and facilitate overwintering of the virus in endemic areas (EFSA AHAW Panel 2015). Transstadial transmission has been demonstrated in hard ticks (*R. appendiculatus* and *A. hebraeum*) (Lubinga et al 2013). Transovarial transmission has been demonstrated in *R. decoloratus*; LSD virus was detected in the eggs (Tuppurainen et al 2011) and larvae (Lubinga et al 2014) of female *R. decoloratus* ticks fed on LSD virus–infected animals – this tick is closely related to the Australian cattle tick, *R. australis* (previously known as *R. microplus*). Transmission of LSD virus back to susceptible cattle was subsequently demonstrated (Tuppurainen et al 2013b). Larvae from *A. hebraeum* female ticks fed on LSD virus–infected cattle were positive for LSD virus on PCR testing, but cattle exposed to these ticks did not develop clinical signs or seroconvert (Lubinga et al 2014).

Although there is no evidence of multiplication of LSD virus in these vectors, it cannot be excluded (Tuppurainen et al 2017). Recent studies did not find evidence of viral replication in the vectors studied; thus this is unlikely to be epidemiologically important in transmission (Sanz-Bernardo et al 2021, Paslaru et al 2022). Viral retention has been shown as feasible under experimental conditions – for one species (*Culex pipiens*), for up to 10 days. However, it is unknown how this relates to field situations.

Live animals

Transmission of LSD virus is incompletely understood; however, transmission through direct contact between infected animals is believed to be inefficient and plays only a minor role in the epidemiology of the disease (OIE 2017).

LSD virus is present in nasal, lachrymal and pharyngeal secretions of infected animals, and in their semen, milk and blood (Thomas & Mare 1945, cited in Davies 1991b; Weiss 1968). Infectious LSD virus has been detected in saliva and nasal discharges for up to 18 days post-infection (Babiuk et al 2008) and in blood for up to 16–28 days post-infection (Tuppurainen et al 2005, 2011; Sanz-Bernardo et al 2021). Direct transmission between animals is likely to be more significant in animals managed under intensive scenarios (ie feedlot and dairy), and non-bloodsucking insects may play a role in transmission via secretions between animals in these contexts.

LSD virus is found at higher concentrations in skin lesions than in blood in animals with clinical disease (Sanz-Bernardo et al 2021).

LSD virus present in bull semen can be a source of infection for females (Tuppurainen et al 2017; see ‘Semen and embryos from live susceptible animals’).

LSD virus may be spread from cows to their progeny. There are reports of calves from infected cows being born with skin lesions; the virus is also thought to be rarely spread to suckling calves through infected milk, or from skin lesions on the teats (Tuppurainen et al 2017).

It is assumed that LSD virus is also excreted in vaginal secretions. The resistant nature of the virus would make venereal transmission very likely (Committee on Managing Global Genetic Resources 1993).

There is no carrier status for LSD virus (OIE 2017).

Carcasses

LSD virus is very resistant to inactivation, surviving in necrotic skin nodules for 33 days or longer, desiccated crusts for up to 35 days, and at least 18 days in air-dried hides (OIE 2017) – these may pose a risk of transmission if they are accessible to arthropod mechanical vectors. Although some arthropod vectors may feed on body exudates other than blood, the pathways that enable insects to mechanically transmit infection are uncertain. Nevertheless, application of insecticides containing repellents to carcasses before transport or burial is recommended (EFSA AHAW Panel 2015). Long-distance spread of LSD in Israel was associated with movement of infected carcasses to a disposal site (near where the new outbreak occurred), although a causal association was not proven (EFSA AHAW Panel 2015).

Most vectors of LSD virus are unlikely to feed on carcasses, and larvae under the skin that retain the virus throughout metamorphosis into the adult stage are very unlikely to transmit the virus. However, consideration should be given to the risk that feral pigs, wild dogs and carrion birds feeding on infected carcasses may potentially spread the virus. This slight risk means that there are benefits in

destroying carcasses of animals that exhibited clinical signs, preferably by burial on-site. Additional guidance on disposal options and methods can be found in the **AUSVETPLAN operational manual Disposal**.

Animal products

Meat, meat products and casings, including use as animal feed

Although LSD virus may persist in the meat of infected animals (Weiss 1968), trade in meat for human consumption is not a significant risk for transmission of the virus. LSD virus has been found in meat and offal after experimental infection, although virus was not found in deep skeletal meat, and the risk of transmission through deep skeletal meat has been assessed as minimal (Kononov et al 2019).

WOAH recommends that the following commodities should not require any LSD-related conditions regardless of the status of the animal population of the exporting country: skeletal muscle meat, casings, gelatine and collagen, tallow, and hooves and horns.

Heat treatment of meatmeal from affected animals to a minimum internal temperature of 65 °C for at least 30 minutes will reduce the risk of LSD virus transmission (OIE 2017).

Australia has well-developed national guidelines and state legislation that ban feeding to all ruminants of all meals derived from all vertebrates, including fish and birds.

Milk and dairy products, including use as animal feed

High-temperature/short-time pasteurisation may reduce the infectivity of LSD virus in milk (OIE 2017). There is some evidence that conditions equivalent to the low-temperature/long-time method of pasteurisation (62 °C for 30 minutes) will inactivate capripoxviruses, but the presence of fat, protein and other solids in the milk may protect the virus (Wolff et al 2020). The low pH of cheese may also be insufficient to inactivate the virus. The thermal inactivation parameters are extrapolated from a single study on sheep pox virus and vaccinia virus, which did not include dairy media.

The risk of LSD virus transmission by milk not intended for animal consumption can be mitigated by pasteurisation and transport in closed containers (Tuppurainen et al 2017). As noted above, the WOAH recommendations for importation of milk and milk products include pasteurisation (OIE 2017).

Animal byproducts

Hides, skin, wool and other fibres

Spread of LSD into new regions via contaminated hides is possible (Spickler 2017). LSD virus may remain infectious for up to 18 days in air-dried hides (Weiss 1968).

The WOAH Terrestrial Code recommends the following treatments:

- dry-salting or wet-salting for at least 14 days
- 7 days in salt (NaCl) with the addition of 2% sodium carbonate (Na₂CO₃)
- drying for at least 42 days at a temperature of at least 20 °C.

However, noting that hides with clinical LSD lesions are unlikely to be used because of damage and that clinical lesions are more significant for transmission than unaffected skin and tissue, partially

tanned hides and skins may still present a risk – that is, hides and skins that have undergone only liming, acid pickling or salting with 2% sodium carbonate at 50% pelt weight for 28 days (T Ingle, Australian Government Department of Agriculture, Water and the Environment, pers comm, 2021). Fully tanned hides and skins (eg ‘finished’ leather products such as shoes) are unlikely to present a risk of virus transmission.

Semen and embryos from live susceptible animals

Experimental transmission of LSD virus via semen from infected (but asymptomatic) bulls to both embryos and heifers has been proven (Annandale et al 2014). Shedding of LSD virus in the semen of infected bulls may be prolonged; virus has been isolated from semen for up to 42 days post-inoculation in an experimentally infected bull (Irons et al 2005). Viral DNA has been detected in all fractions of semen (Annandale et al 2010). Common semen processing methods are inadequate to wash semen free of LSD virus contamination (Annandale et al 2018).

Live LSD virus has been isolated from apparently healthy-looking testicular tissue in both clinical and subclinical animals (Kononov et al 2019).

There is one report of placental transmission of LSD virus (OIE 2017), and infected pregnant cows are known to deliver calves with skin lesions (Tuppurainen et al 2017). However, because of insufficient information, the International Embryo Technology Society has not classified LSD virus regarding the likelihood of its transmission via embryos.

Viral replication was observed in blastocysts following successful fertilisation of embryos with semen containing LSD virus during artificial insemination. LSD virus was also shown to affect the success of fertilisation during the experiments (Annandale et al 2019).

Specimens

LSD virus is not zoonotic, and transmission of disease via laboratory specimens is not considered a risk.

Waste products and effluent

There are no reports of isolation of LSD virus from faeces or urine.

Biological products

The use of live, attenuated vaccines for LSD has been associated with disease in some countries (Brenner et al 2009, Ben-Gera et al 2015). Transmission of LSD virus through other biological products is theoretically possible but not documented.

Nonsusceptible animals

Nonsusceptible animals may act as contaminated fomites for LSD virus and may facilitate the movement of arthropod vectors. Application of insect repellents to animals on affected and neighbouring farms may help mitigate these risks (Tuppurainen et al 2017).

People

People can potentially act as contaminated fomites for LSD virus. Tuppurainen et al (2017) recommend that people leaving affected premises disinfect their hands, boots and clothes, and subsequently wash their clothes at a water temperature above 60 °C. There is also merit in adding a sanitiser or disinfectant when washing clothing, towels and so on. Use of a clothes dryer on high setting is probably also very effective (as it is for killing ticks on clothes). Training station workers, transport operators and so on in correct disinfection technique will be vital to minimising the spread of the virus through their movements.

Crops, grains, hay, silage and mixed feeds

Experimentally, transmission has occurred between cattle in adjacent insect-proof enclosures only if they shared access to water or feed (Weiss 1968, Kononov et al 2020).

Long survivability of the virus in the environment and the potential for cross-contamination of feed may allow contaminated feed to act as a transmission pathway into naive populations (Spickler 2017).

Vehicles, including empty livestock transport vehicles

Vehicles can potentially act as contaminated fomites for LSD virus and may facilitate the movement of arthropod mechanical vectors. Cleaning and disinfection of the interior and exterior of the vehicle, and use of insecticides, mitigate these risks (Tuppurainen et al 2017).

Equipment, including personal items

Equipment and personal items can potentially act as contaminated fomites for LSD virus. Although not specifically documented, reuse of needles and surgical equipment contaminated with blood from viraemic animals may mechanically transmit LSD virus to uninfected animals. The Food and Agriculture Organization of the United Nations LSD field manual for veterinarians (Tuppurainen et al 2017) recommends decontamination of equipment on exit from affected premises.

2.4.3 Factors influencing transmission

The prevalence of insect vectors may affect the rate of transmission of LSD virus. This could account for the wide variation in morbidity (1–95%) in different situations (EFSA AHAW Panel 2015). The sharp reduction in transmission of LSD after cold weather and frosts, which are associated with reduced insect vector populations, supports this hypothesis. A clear seasonal pattern was observed in outbreak events in the Balkans, Turkey and the Russian Federation (EFSA 2020). Studies that modelled outbreaks have drawn similar conclusions (Allepuz et al 2019, Machado et al 2019).

Movement of infected stock has been the cause of much of the spread of LSD between countries. Whereas insect vectors are important in local spread, road and rail transport play an important role in rapidly spreading the disease over large geographical distances (Tuppurainen et al 2017). In the Balkans, LSD spread mostly up to 4 km at a time (via vectors), but transmission events occurred over much longer distances (via animal movements) (EFSA 2018, Manić et al. 2019). In Odisha state, India, the average distance between outbreaks in 2019 was 6 km inside districts and 54 km between districts (Sudhakar et al 2020).

Larger herd sizes and proximity to lakes (presumably related to increased vector activity) have been associated with an increase in prevalence of LSD (Sevik & Dogan 2017).

Viral uptake by vectors and spread of disease are much more efficient from clinically affected animals than asymptomatic animals (Sanz-Bernardo et al 2021).

2.5 Diagnostic criteria

2.5.1 Clinical signs

LSD typically presents in cattle and buffalo as fever, followed by the development of multiple nodules on the skin and mucous membranes; these nodules gradually become necrotic.

Clinical signs in cattle may range from inapparent to severe. Water buffalo may show similar clinical signs but are reported to be less severely affected (Sharawi & Abd El-Rahim 2011).

A fever of 40–41.5 °C may last 6–72 hours, occasionally up to 10 days, and is accompanied by increased lacrimation, increased nasal and pharyngeal secretions, loss of appetite, reduction in milk production, varying degrees of depression and reluctance to move.

Within 1–2 days, a cutaneous eruption of nodules occurs, which may cover the whole body. The most common sites are the head and neck, perineum, genitalia and udder, and limbs. The nodules are 5–50 mm or more in diameter, initially appearing as round, circumscribed areas of erect hair, firm and slightly raised from the surrounding skin. There is hyperaemia, and drops of serum appear on the surface. The lesions are full skin thickness, involving the epidermis, dermis and subcutis, which may be oedematous. Regional lymph nodes are enlarged and oedematous.

Lesions develop in the muzzle, nostrils, mouth and pharynx. They show a ring-like margin where there has been separation from the surrounding healthy epithelium. Lesions in the larynx and trachea, and throughout the alimentary tract, especially the abomasum, become ulcerated and necrotic. Mucopurulent nasal discharges, persistent hypersalivation, coughing, and stertorous (snoring) and often distressed respiration result. Inflammation of the conjunctiva and cornea of the eyes is common.

Inflammatory and oedematous swellings of the limbs, brisket and genitalia may develop. Skin lesions become necrotic. Some remain in situ, and others slough, leaving a hole of full skin thickness, known as a 'sitfast', which becomes infected by pus-forming bacteria. Large areas of skin may slough. Lesions in the skin, subcutaneous tissue and muscles of the limbs, together with the severe skin inflammation caused by secondary infection of lesions, greatly reduce mobility. Rapid deterioration in body condition results, and animals that recover may remain in extremely poor condition for up to 6 months.

Pneumonia is a common and often fatal complication. Absence of oestrus cycles or abortion is frequent in females, and painful genitalia in bulls can prevent them from serving. Live neonates or aborted fetuses from infected cows may show skin lesions following parturition.

The lesions may persist for 4–6 weeks, and final resolution may take 2–6 months.

Morbidity rates vary greatly and range between 1% and 95% (EFSA AHAW Panel 2015). Mortality rates up to 75% have been reported (Babiuk et al 2008), but 1–5% is more usual (Davies 1991a).

In experimental studies, only about 50% of infected animals may develop clinical signs, but the majority may become viraemic (Tuppurainen et al 2005, Osuagwuh et al 2007, Annandale et al 2010, Sanz-Bernardo et al 2021).

2.5.2 Pathology

Gross lesions

On autopsy, nodules may be found in subcutaneous tissues, muscle fascia and muscles, which are grey-pink with caseous necrotic cores. The subcutis is infiltrated by red, watery fluid. Similar nodules may be scattered through the nasopharynx, trachea, bronchi, lungs, rumen, abomasum, renal cortex, testicles and uterus (DoA & CSIRO 2019). Aborted fetuses may show skin lesions (Spickler 2017).

Microscopic lesions

Prozesky & Barnard (1982) described the histopathology seen with LSD. Clinically affected cattle have a granulomatous reaction in the dermis and hypodermis that extends to the surrounding tissue. In the early stages, a vasculitis and lymphangitis with accompanying thrombosis and infarction can be seen, with resultant necrosis and oedema. Borrel cells or 'cellules claveleuses' (epithelioid cells that infiltrate the lesions), and intracytoplasmic inclusion bodies – similar to the inclusions found with all pox viruses – can be demonstrated on histology.

Electron microscopy reveals virus particles indistinguishable from the orthopoxviruses. These can be readily differentiated from the virus particles of contagious ecthyma (also known as contagious pustular dermatitis, scabby mouth or orf).

2.5.3 Differential diagnosis

The following diseases or conditions should be considered in the differential diagnosis of LSD (OIE 2017).

Endemic:

- urticaria
- pseudo-lumpy skin disease (bovine herpes mammalitis; herpesvirus 2)
- bovine papular stomatitis (parapoxvirus)
- dermatophytosis
- pseudocowpox (parapoxvirus)
- pseudocowpox (parapoxvirus)
- streptothricosis (*Dermatophilus congolensis*)
- demodicosis
- insect or tick bites
- photosensitisation
- onchocercosis.

Exotic:

- rinderpest
- *Hypoderma bovis* infection
- skin tuberculosis.

2.5.4 Laboratory tests

Samples required

Diagnosis of LSD is based primarily on detection of the virus in lesions. Detection of antibody in serum may also aid diagnosis. Specimens that should be collected from live animals include blood (from animals with fever), serum, nodular fluid, scabs, and skin scrapings from lesions or skin biopsies.

Virus can be detected in blood and secretions such as oral/nasal fluid, but is present in significantly lower concentrations and for shorter periods than in skin lesions. Non-skin samples should not be relied on for exclusion of disease.

At postmortem, a range of samples, both fresh and fixed, should be taken from skin lesions, lesions in the respiratory and gastrointestinal tracts, and other internal organs.

Following the initial diagnosis, a more restricted sample set, still based on sampling lesions, may be defined.

Transport of specimens

Specimens should be submitted in accordance with agreed state or territory protocols. Specimens should initially be forwarded to the state or territory laboratory for appropriate analysis, and assessment of whether further analysis will be required by the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP), Geelong.

If the state or territory laboratory deems it necessary, duplicate samples of the specimens should be forwarded to CSIRO-ACDP for emergency disease testing, after the necessary clearance has been obtained from the chief veterinary officer (CVO) of the state or territory of the suspect case, and after the CVOs of Victoria and Australia have been informed about the case and the transport of the specimens to Geelong (for the first case). Sample packaging and consignment for delivery to CSIRO-ACDP should be coordinated by the relevant state or territory laboratory.

LSD virus is a security sensitive biological agent (SSBA). Entities handling and transporting samples known or suspected to contain LSD virus should ensure that they meet their obligations under the SSBA Regulatory Scheme.

For further information, see the **AUSVETPLAN management manual *Laboratory preparedness***.

Packing specimens for transport

Unpreserved tissue specimens should be chilled and forwarded with water ice or frozen gel packs. If delays of more than 48 hours are anticipated in transit, these specimens should be frozen, if practical, and forwarded packed in dry ice. Frozen specimens will result in a better diagnostic outcome than those that are not frozen, but it is recognised that there may be challenges in keeping specimens frozen when travelling long distances from remote areas.

2.5.5 Laboratory diagnosis

CSIRO-ACDP tests

The testing method used by CSIRO-ACDP is shown in Figure 2.1. Further details of tests currently available at CSIRO-ACDP are shown in Table 2.1.

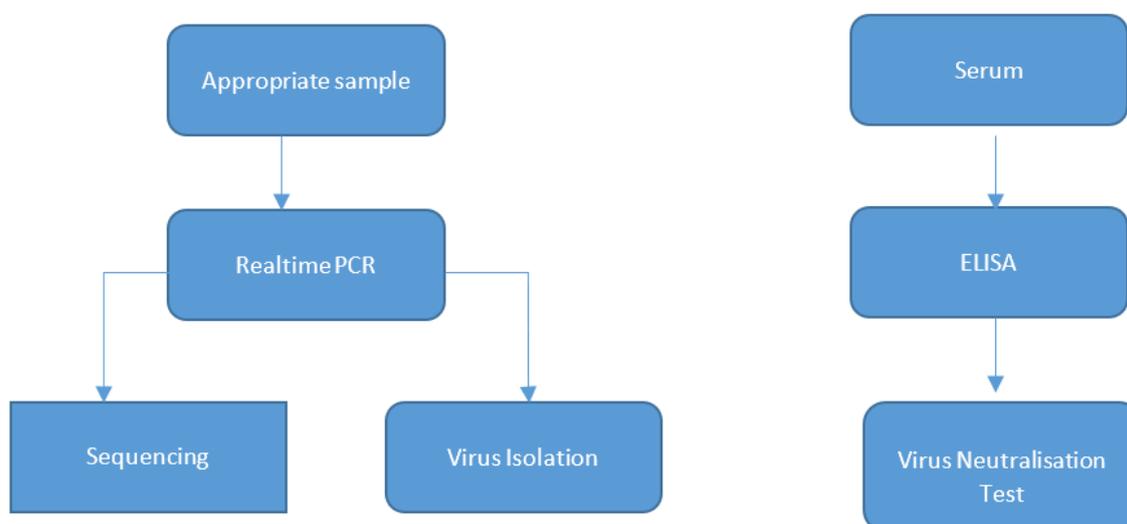


Figure 2.1 Current approach to diagnostic testing at CSIRO-ACDP for LSD

Table 2.1 Laboratory tests currently available at CSIRO-ACDP for diagnosis of LSD

Test	Specimen required	Test detects	Time taken to obtain result
Agent detection			
Capripoxvirus real-time PCR	Scabs, blood, tissues or cultured virus	Viral DNA	4–5 hours
LSD virus real-time PCR	Scabs, blood, tissues or cultured virus	Viral DNA	4–5 hours
Agent characterisation			
Sequencing	Scabs, blood, tissues or cultured virus	Viral genome	2 days
Virus isolation	Scabs, blood or tissues	Virus	5–10 days
Serology			
ELISA	Serum	Antibody	4–5 hours
Virus neutralisation	Serum	Antibody	7 days

ELISA = enzyme-linked immunosorbent assay; PCR = polymerase chain reaction

Source: Information provided by CSIRO-ACDP, 2022 (refer to CSIRO-ACDP for most up-to-date information).

A number of real-time and gel-based PCR methods are available for detection of capripoxviruses, several of which are species-specific and allow differentiation of LSD virus from sheep pox virus and goat pox virus (Bowden et al 2008; Le Goff et al 2009; Lamien et al 2011a, b; Gelaye et al 2013). Recently, a PCR method allowing differentiation of eight pox viruses has been developed; this also allows differentiation of LSD virus from bovine papular stomatitis, pseudocowpox and cowpox viruses (Gelaye et al 2017). Virus may also be isolated from cell culture assays. Sequencing of the viral genome, either from primary samples or from cultured material, will further aid characterisation of the causative agent and provide useful information to inform understanding of the epidemiology of the disease.

A tentative diagnosis of LSD can be made by electron microscopy and histopathology of tissue samples; however, with the advent of molecular techniques, these methods are now less commonly used for diagnosis.

Other tests

The virus neutralisation test and ELISA tests are validated serological tests for LSD virus (OIE 2021). ELISA is the preferred test for serosurveillance. The virus can be detected in milk; however, sensitivity is reduced when milk is pooled, thus making bulk milk surveillance unfeasible (Milovanović et al 2020). As all members of the *Capripoxvirus* genus share a common neutralising antigen, serological assays cannot distinguish between the individual members of the genus.

The immune response to LSD virus infection is dominated by cell-mediated immunity. For disease surveillance, although it may be difficult to detect low titres in individual animals, a herd-based approach is reasonable.

Other serological tests for LSD, such as indirect immunofluorescence and immunodiffusion, are possible, but lack specificity, cross-reacting with related viruses. These are not currently available in Australia.

DIVA testing

Recently, PCR tests have been developed that can differentiate certain vaccine strain viruses from wild-type strains, potentially allowing the limited use of DIVA (differentiating infected from vaccinated animals) testing as part of a vaccination strategy. The efficacy of this test will need to be assessed for any newly developed vaccines.

Most DIVA approaches for other diseases depend on detection of a serological response to the agent, rather than direct detection of virus, and this capability is required for any longer-term monitoring of vaccinated populations. No such assay exists for LSD, but the development of novel vaccines may offer an opportunity for parallel development of a serological DIVA assay.

2.6 Resistance and immunity

Susceptible cattle of all ages can develop serious clinical disease if infected with LSD virus. In countries previously free from LSD, mortality rates up to 75% have been reported (Babiuk et al 2008), but 1–5% is more usual (Davies 1991a) once the disease becomes endemic with rapid spread likely.

Different cattle breeds show different susceptibilities to LSD (see Section 2.2).

Maternal immunity provides some protection to calves born to vaccinated or previously exposed cows (Davies 1991c). In countries where vaccination against LSD is used, calves are vaccinated at 3–4 months of age.

Active immunity develops in response to vaccination or previous exposure to capripoxviruses. All strains of capripoxvirus share a major neutralising site, so that animals that have recovered from infection or are vaccinated with one strain are resistant to infection with any other strain. Animals that have recovered from natural infection with capripoxviruses are thought to have lifelong immunity. They do not become carriers.

2.7 Vaccination

Australia

Vaccines against LSD are not currently available in Australia; however, a regulatory assessment of a candidate vaccine is underway.

Overseas

A range of live, attenuated, homologous (LSD virus) and heterologous (sheep pox and goat pox viruses) vaccines are commercially available overseas. These vaccines have predominantly been used for control of endemic disease and only recently employed for eradication purposes in certain areas (eg the Balkans).

Use of certain commercial vaccines from overseas can be risky (see Appendix 3 for further information).

2.8 Treatment of infected animals

There is no effective cure for LSD.

2.9 Control overseas

Control of LSD overseas has invariably involved vaccination of cattle and buffalo with heterologous or homologous vaccines. Accompanying measures have differed according to the overall objective of a country's control program.

In endemic countries, herds are vaccinated annually and usually before periods that are associated with a high risk of transmission, to reduce overall clinical disease burden. Stamping out or other eradication activities are not usually undertaken in this scenario because the goal is to minimise the

clinical effects, not eradicate disease from a region. The vaccine used is ideally homologous, but heterologous vaccines are also used for LSD control where goat pox and sheep pox are also present, and resources are limited.

Prevention or eradication of the disease requires additional measures.

Refer to Appendix 4 for further information.

3 Implications for Australia

3.1 Potential pathways of introduction

The most likely route for introduction of lumpy skin disease (LSD) into Australia is entry of vectors carrying the virus to northern Australia following establishment of the disease in neighbouring countries to the north.

Currently, the potential for LSD to enter Australia via insects from countries in the region is high – especially since the disease has been detected in Indonesia. There is an increased risk of infected insects translocating across the seas north of Australia or entering through international ports, despite disinsection protocols; changing insect resistance profiles may alter the risk rating for this entry pathway (Schmidt et al 2019).

With cattle produced in many parts of Australia and water buffalo present in northern Australia, it is reasonable to assume that infection would establish and an outbreak would occur if infected vectors encountered cattle or water buffalo. Extensive grazing of cattle and buffalo across northern Australia may lead to delays in recognition of an incursion.

Spread of LSD by the movement of infected animals that then interact with transmission vectors is one mechanism by which the disease is spread to new premises or new areas. However, there is little possibility of the disease entering Australia by this means because live bovids or their germplasm are not imported from LSD-endemic countries.

Introduction of LSD via insects entering Australia on aircraft or ships represents a relatively low risk because LSD virus has a short survival time in insects, and the numbers of vectors entering Australia in this way would be low. However, the World Organisation for Animal Health (WOAH) recommends that disinsection be conducted on aircraft coming from countries where animal diseases transmitted by insect vectors are present.

Because of the long survivability of the virus in the environment, stockfeed, supplements and fomites such as skins, hides or equipment may act as a transmission pathway into naive populations. However, Australia's strict biosecurity rules mean that this route would pose a low risk of introduction.

3.2 Social, economic and environmental effects

LSD is one of the biggest biosecurity threats to Australia's cattle (and buffalo) industries; the effect on animals and animal products would be significant. Trading partners would be expected to introduce emergency measures until any outbreak situation became stable, significantly disrupting exports of meat, dairy and other bovine-derived animal products. The impacts may include closure of markets, increased testing requirements, increased requirements for pre-export quarantine, vaccination requirements, and reductions in price premiums for Australian commodities.

The Meat & Livestock Australia *State of the industry report 2020*⁸ records that Australian beef exports were valued at \$10.8 billion in 2019 and that Australian live cattle exports were valued at \$1.6 billion in 2018–19, with 1.3 million animals exported. The gross value of Australian cattle and calf production (including live cattle exports) in 2019–20 is estimated at \$15.1 billion (ABARES Agricultural Commodities, September 2020). Australian dairy product exports were valued at \$3.3 billion in 2021,

⁸ www.mla.com.au/news-and-events/industry-news/state-of-the-industry-report-2020-released

and the dairy industry also contributed to high-value live export of heifers and export of meat commodities (Dairy Australia 2021). The full range of bovine-derived products affected would depend on individual trading partners' requirements for these commodities.

An incursion of LSD is very likely to involve an extended disease response and surveillance to establish proof of freedom. Under WOAHP provisions, the earliest time to claim freedom from LSD is 14 months after stamping out of the last case or vaccinated animal. Disease response activities of naive countries trying to eradicate the disease (eg in the Balkans) have lasted many years. A swift return to country freedom status is also impeded by uncertainties about the ability of LSD virus to overwinter and persist in the environment. Trade impacts may occur before formal notification from Australian authorities to WOAHP.

Most of northern Australia is dependent on cattle production and would suffer significant socioeconomic impacts in the event of an outbreak of LSD in Australia.

If stamping out of large numbers of animals was required, there would be a negative societal reaction to the killing of the animals, as well as effects on tourism and Australia's way of life.

3.3 Critical factors for an Australian response

Critical considerations for formulating a policy for the response to an incident of LSD in Australia include the following:

- LSD is a highly contagious disease of cattle (especially *Bos taurus*), with low mortality but medium to high morbidity predicted for a naive population. The disease has a characteristic clinical presentation, so should become apparent relatively soon after introduction where cattle are regularly observed.
- Responding to an incursion of LSD would be challenging in parts of Australia that have significant numbers of feral cattle and buffalo, and large areas that are only accessible with extreme difficulty (eg northern Australia, especially during the wet season). For example, administering vaccine to feral buffalo poses significant logistical difficulties.
- Susceptible cattle of all ages may develop serious clinical disease.
- Acute cases (the most common type in naive populations) should be readily diagnosed clinically.
- Identification of disease in feral or free-range buffalo and cattle may be difficult because these animals are not regularly observed.
- Recovered animals are immune, and there is no carrier state; however, recovery can be prolonged.
- Most infection is thought to result from mechanical transmission by insects.
- Under Australian conditions, understanding mechanical transmission by biting flies is important. Non-biting insects are also implicated. Daily flight ranges of flies and other insects will inform the likely transmission area.
- Fomites may be involved in spread of the disease.
- The virus is stable in the environment, especially in cool, shaded areas – this poses an increased risk for feedlots (and potentially live export depots in the north).
- The virus is susceptible to a range of disinfectants.
- Vaccination, if available, is recommended to support disease control procedures, because stamping out alone may not be sufficient to eradicate the disease.
- Vaccines are not currently available in Australia, so procurement of a stock of vaccine well in advance of any outbreak is vital. Vaccines vary in quality, so careful consideration must be given to the selection of any vaccine for use in Australia. A regulatory assessment of a candidate vaccine is underway.

- Market fluctuations due to public health perceptions or product withdrawals would reduce the value of the cattle industry.
- There is a risk that LSD could become endemic or be present in Australia for several years if the disease is not promptly controlled. Recurring incursions may be a risk if the disease becomes endemic in countries in the region.

4 Policy and rationale

4.1 Introduction

Lumpy skin disease (LSD) is a World Organisation for Animal Health (WOAH)–listed disease that has the potential for rapid spread, and has a significant negative impact on cattle production and trade.

4.1.1 Summary of policy

The premise of AUSVETPLAN as it underpins the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses (Emergency Animal Disease Response Agreement – EADRA) is the establishment of a mechanism to facilitate a rapid response to an outbreak of LSD, and control and eradication, or containment with a view to eradication, of the disease. Thus, the policy set out in this AUSVETPLAN response strategy is to eradicate LSD in the shortest possible time, while minimising social, economic, animal welfare and environmental impacts, using *stamping out* with or without *vaccination*,⁹ supported by a combination of strategies, including:

- *immediate quarantine* of animals, animal products and fomites (facilities, equipment and other items) on infected premises (IPs) and dangerous contact premises (DCPs)
- rapid recognition and laboratory confirmation of cases
- immediate assessment of the epidemiological situation
- implementation of legislated *declared areas* for disease control purposes and to minimise the spread of infection
- *quarantine and movement controls* over animals, animal products and fomites in declared areas, to minimise the spread of infection
- *tracing and surveillance* to determine the source and extent of infection (including, as necessary, in feral animals), and to provide proof of freedom
- immediate stamping out on IPs and DCPs based on risk assessment to reduce disease transmission – *modified stamping out* (stamping out of clinically affected animals with nodules) is the priority
- assessment of likely vector species, their distribution and their ecology
- *management of insect vectors*, to minimise mechanical transmission of the virus
- *enhanced biosecurity* on all premises with cattle and buffalo
- *valuation and destruction* of cattle and buffalo on IPs and potentially on DCPs, subject to risk assessment
- *sanitary treatment and/or disposal* of destroyed animals and contaminated animal products, to remove sources of infection
- *decontamination and/or disposal of fomites* to minimise the spread of the virus from infected animals and premises
- *vaccination*, if available, to support eradication efforts
- provision of *epidemiological and other information* to support the resumption of international trade
- *zoning and/or compartmentalisation* (where appropriate) to support resumption of market access
- *management of feral cattle and buffalo populations*, where required, based on the epidemiological assessment

⁹ Currently, no vaccines are available in Australia, and there may be difficulties with sourcing vaccine overseas because of regulatory requirements and biosecurity risk assessment for importation. Preparations to import appropriate vaccine should be made before LSD is confirmed in Australia.

- a public awareness campaign
- *industry engagement* to improve understanding of the issues, facilitate cooperation and address animal welfare issues.

Vaccination, if available, is recommended to support disease control procedures, because stamping out alone may not be sufficient to eradicate the disease. However, if an incursion is detected very early and there has been very limited spread, stamping out alone may be a feasible option. If vaccine is not available, an aggressive response should be mounted as quickly as possible, using all the strategies listed above, to attempt to eradicate the disease. The nature of the disease means that this may ultimately result in large numbers of cattle being slaughtered without complete control of the disease being achieved.

4.1.2 Case definition

For the purposes of this response strategy, a case of LSD is defined as laboratory-confirmed¹⁰ infection with LSD virus in one or more cattle and/or buffalo with or without clinical signs.

Notes:

- Positive serology in the absence of detection of LSD virus, with no clinical or epidemiological evidence supporting infection, does not constitute a case.
- AUSVETPLAN case definitions dictate when a response to an emergency animal disease (EAD) incident should be undertaken. AUSVETPLAN case definitions do not determine when international reporting of an EAD incident is required.
- At the time of an outbreak, revised or subsequent case definitions may be developed with the agreement of the Consultative Committee on Emergency Animal Diseases (CCEAD).

4.1.3 Cost-sharing arrangement

In Australia, LSD is included as a Category 3 EAD in the EADRA.¹¹ When cost sharing of the eligible response costs of an incident is agreed, Category 3 diseases are those for which costs will be shared 50% by government and 50% by industry.

¹⁰ See Section 2.5.5 for details of laboratory diagnosis.

¹¹ Information about the EADRA can be found at <https://animalhealthaustralia.com.au/eadra>.

4.1.4 Criteria for proof of freedom

The WOAH *Terrestrial animal health code* states that a country may be considered to be free from LSD when LSD is a notifiable disease in the country concerned and the country has been historically free from the disease.

When a case of LSD occurs in a country previously free from LSD, one of the following waiting periods are applicable to regain free status when a stamping-out policy has been applied:

- 14 months after the slaughter of the last case, or after the last vaccination if emergency vaccination has been used, whichever occurred last, and during which period clinical, virological and serological surveillance demonstrated no occurrence of infection with LSD virus
- 26 months after the slaughter of the last case, or after the last vaccination if emergency vaccination has been used, whichever occurred last, and during which period clinical surveillance alone demonstrated no occurrence of infection with LSD virus.

The levels and types of surveillance that are necessary to provide proof of freedom are discussed in Section 7.1. Physical examination of animals on risk premises will also be necessary.

Australia will need to provide detailed information to demonstrate that surveillance and examinations in both the free and infected areas have been adequate, that quarantine movement controls have been maintained, and that the virus is not present in insect populations.

4.1.5 Governance

Governance arrangements for the response to EADs are outlined in the **AUSVETPLAN Overview**.

Information on the responsibilities of a state coordination centre and local control centre is available in the **AUSVETPLAN management manual *Control centres management (Parts 1 and 2)***.

4.2 Control and eradication policy

LSD is primarily a mechanically transmitted vector-borne disease. Without sufficient susceptible hosts or sufficient infectious vectors, the transmission cycle in a region will slow and halt. Interrupting transmission cycles to stop progression should therefore focus on:

- animal movement controls, including the creation of cattle- and buffalo-free buffers
- stamping-out activities
- widespread regional vaccination
- vector control.

In declared areas, consideration of regional vaccination and/or development of cattle- and buffalo-free areas to create a minimum buffer of 80–100 km from the nearest IP is likely to be required to halt spread of LSD. This distance is recommended because of the long potential incubation period (up to 28 days); the continuous, local propagation by mechanical vectors; and the time required to develop effective immunity through vaccination (potentially 21–28 days). Spread rates of 1 km/day have been recorded (Tuppurainen et al 2020); therefore, a buffer of vaccinated animals of at least 40 km (80–100 km using a precautionary approach) would be needed ahead of the disease front. These distances are given as guidance based on successful overseas responses; the actual distance for Australian conditions will depend on climatic conditions, vector species, epidemiology and geography (see Section 4.2.1). Vectors present in Australia and their relative importance in the spread of LSD are

currently poorly understood – a better understanding will inform the creation of appropriate buffers in each specific situation. Buffers should ideally be based on sound epidemiological and geographic parameters rather than the classic circular shape (Tuppurainen et al 2020). Reactive local ring vaccination strategies in other countries have repeatedly failed to contain the disease. Appendixes 3 and 4 provide more context and history on why larger vaccination areas are required for an effective LSD response.

Animal movement controls are required to prevent movement of potentially infected animals. The long potential incubation period of LSD, coupled with the time it takes to develop effective immunity through vaccination and potential failure of the vaccine to induce immunity, means that animals that are at risk of infection or have been vaccinated should not be moved into uninfected areas.

The large number of cattle in Australia and the significant number of potential vectors mean that disease spread could be rapid. Eradication of virus from an infected area, including decontamination of the area, is a long-term project. Thus, initial response phases may also prioritise the creation of physical barriers against spread into new regions.

Stamping-out activities should prioritise clinically affected animals with nodules (ie modified stamping out), because these are the animals most at risk of providing virus for biting vectors to spread the virus within a region. Stamping out of all animals in an infected herd should be attempted if sufficient resources are available to ensure that this action will not impede vaccination activities.

Control (including appropriate treatments), destruction and sanitary disposal of risk materials and commodities are also required, because these items constitute additional potential transmission pathways.

Vaccination and stamping-out activities would be supported by a range of strategies, including ongoing epidemiological assessment, quarantine and movement controls, tracing and surveillance, disinsection and use of insect preventives on premises at risk of contact, decontamination of premises and potentially contaminated fomites, enhanced biosecurity on premises with cattle or buffalo, vector management, industry engagement and public awareness campaigns.

These strategies may be complemented by the implementation of zoning and compartmentalisation, where appropriate, and this may support a return to international trade (see Section 4.2.4 for more detail).

4.2.1 Epidemiological assessment

Epidemiological investigation or assessment draws on multiple sources of information to build understanding of the disease and how it is behaving in an outbreak. This helps inform response decision making.

The key objectives for an epidemiological assessment will be to identify:

- the spatial distribution of infected and free animal populations
- potential vectors involved, including as potential amplifying hosts
- the relative competency of vectors
- virus survival in vectors
- the source of infection
- the prevalence of infection
- pathways of spread and the likely size of the outbreak
- risk factors for the presence of infection and susceptibility to disease (including weather and insect populations).

Epidemiological assessment, and tracing and surveillance activities (see Section 4.2.3) in an EAD response are interrelated activities. Early findings from tracing and surveillance will be inputs into the initial epidemiological assessment (eg considering spatial distribution of infection). The outcomes of the initial epidemiological assessment will then guide decisions on subsequent tracing and surveillance priorities.

The outcomes of the epidemiological assessment will also be used initially to determine the feasibility of eradication versus long-term control, and to guide the selection of other appropriate response measures (including the application of movement controls) and assess the progress of disease control measures.

Ongoing epidemiological assessment is important for any EAD response to aid evaluation of the continued effectiveness and value of response measures, and assessment of the progress of disease control measures. Ongoing epidemiological assessment will consider the outcomes of tracing and surveillance activities, and will contribute evidence to support any later claims of disease freedom.

4.2.2 Biosecurity and movement controls

Guidance on declared areas and premises classifications can be found in the **AUSVETPLAN guidance document *Declared areas and allocation of premises definitions in an EAD response***.

Quarantine

Quarantine will be immediately imposed on all IPs and DCPs. Individual IPs and DCPs will remain under quarantine until at least 56 days after the completion of disease control activities on the premises (see Section 5.3 for further guidance).

Quarantine will also be immediately imposed on suspect premises (SPs) and trace premises (TPs) on a risk-assessed basis. These properties will remain under quarantine until their status has been further classified through risk assessment. The time for lifting of quarantine from these premises will depend on their assessed status (ie assessed negative or reclassified as IP, DCP, etc).

Movement controls

Implementation of movement controls will be underpinned by the use of legally declared areas and the associated permitted movements to and from these areas. The assistance of police and other relevant authorities will be sought to enforce these, as necessary.

Section 6 provides details on movement controls for live animals, reproductive material (semen and in vivo-derived embryos), animal products and byproducts, waste products and effluent, vehicles, equipment, animal feed, people and other items that might be contaminated.

Cultural, logistical, land ownership and land type (eg land trust land vs freehold land) issues will need to be addressed.

4.2.3 Tracing and surveillance

Tracing will need to include the movements from any IPs of cattle, products, people, vehicles and other things, such as equipment and feedstuff, that could have been involved in transmission of LSD virus. The period to be covered should be from at least 28 days before the first clinical signs were seen on the initial IP to the time that movement restrictions were imposed.

The surveillance will include an epidemiological investigation of the possible vectors that are present, and the environmental and ecological factors that may influence their distribution and survival. Surveillance will also determine the extent of infection and of vector activity within the area of the IPs and DCPs, to enable a realistic restricted area (RA) and control area (CA) to be established.

If they have not been destroyed, cattle and buffalo on DCPs, TPs and SPs should be examined every day during the first 4 weeks of quarantine for signs of infection. If numbers are large, a statistically appropriate sample of animals on these premises must be examined.

Following destruction, disposal and decontamination on IPs, DCPs and vaccinated at-risk premises (ARPs), the waiting period before restocking will be long. It will be based on a risk assessment that considers criteria such as season, climatic conditions and the infection status of the area. Stocking with nonsusceptible species may be possible.

If sentinel animals are part of the surveillance and restocking strategy, they may be introduced to the property earlier than the recommended period for general restocking, based on risk assessment and the need to demonstrate the low-risk status of a given property sooner.

See Section 7.1 for further details on surveillance.

Tracing

Rapid trace-back and trace-forward of movements of high-risk items from IPs are essential to effectively contain LSD.

Trace-back will be applied for a minimum of 28 days (one incubation period) before the onset of clinical signs but may be up to 56 days (two incubation periods) to allow for the possibility that the first reported case (index case) is not the primary case. Similarly, trace-forward will be applied for a minimum of 56 days before the index case and up to the time that quarantine was imposed. Given the extended incubation period, epidemiological analysis at the time may suggest that the periods for trace-back and trace-forward of movements should be extended.

For extensively managed properties and areas with free-ranging cattle and/or buffalo, consideration must be given to the timing of the most recent mustering, an estimation of the percentage of animals mustered from the area and other relevant information (eg data from the Bureau of Meteorology on weather conditions that may have brought vectors into the area).

Tracing should be prioritised according to the risk of further transmission events, particularly to other regions.

The primary means of transmission is vector spread between susceptible hosts, and thus the first priority for tracing is all live cattle and buffalo. This will be mainly domestic cattle, but consideration should be given to wild or feral animals if an epidemiologically significant population exists. Priority should also be given to predicting vector dispersal and expected rate of spread in the outbreak region. These predictions should be based on travel patterns of the biting vectors present and other relevant data, such as expected wind dispersal or significant meteorological events (eg storms, wind events).

Indirect transmission (eg via contact with fomites or animal products) is an inefficient method of transmission, but the risk will increase with greater volumes of contaminated materials or greater contact with cattle or buffalo. Therefore, tracing for products involved in indirect transmission pathways should be prioritised according to local or regional circumstances. For example, animal feed, hay and feed trucks (especially relevant for feedlot situations) are associated with large volumes of potential fomites coming into contact with cattle and buffalo and so should generally be a tracing priority for the commodity and fomite pathways.

Germplasm provides a direct pathway for transmission into animals in naive areas but is generally stored before use and therefore might be addressed by a national prohibition on using material collected after a certain date.

Although personal vehicles might have a role as contaminated fomites, this pathway would generally be ranked lower in prioritisation for tracing. However, strong on-farm biosecurity practices should include a record of vehicle movements onto and off the property.

Overall, tracing should include:

- cattle and buffalo, including wild and feral animals
- nonsusceptible species, which may require consideration as fomites
- dispersal and likely movement of vectors
- animal products – meat, offal, milk and dairy products, skins, hides, semen and embryos, and wastes from the processing of these items
- vehicles – milk tankers, livestock transport vehicles, feed trucks, farm visitors' cars, local government cars (eg rangers) and other vehicles (eg forestry contractors, service companies)
- materials – hay, straw crops, grains and mixed feed
- people and equipment – people who live on the property, veterinarians, tanker and other vehicle drivers, artificial insemination personnel, sales and feed representatives, tradespeople, technicians, visitors, other rural industry contractors (eg pregnancy testing contractors, artificial insemination contractors), and equipment moved off the property that may have been in direct contact with stock.

Follow-up investigation of premises identified by tracing should be prioritised according to the likelihood of transmission and the potential consequences for disease control activities.

Information management systems should be used to support tracing activities, as well as examination of farm records, and interviews with farm workers and managers. Databases for the National Livestock Identification System, and documents such as National Vendor Declarations and other movement records, or Animal Health Statements should be used to assist with tracing and epidemiological investigations.

Additional guidance on tracing can be found in the **AUSVETPLAN guidance document *Tracing and surveillance***.

Surveillance

Surveillance during an LSD outbreak will initially be aimed at:

- defining the extent of infection
- detecting new outbreaks
- identifying the vector species involved and their distribution
- demonstrating that infection is not present in the CA and outside area (OA).

This will be achieved by investigation of SPs, TP and DCPs, and surveillance of premises in declared areas that have cattle and/or buffalo – that is, ARPs in RAs and premises of relevance (PORs) in CAs. Prioritising of surveillance should be risk based, and take into account the apparent rate of transmission, and profiles of cattle, buffalo and implicated insect vectors in the local context. Surveillance may also occur in the OA to follow up on traces, investigate suspect case reports and demonstrate that infection is not present.

Surveillance in extensively managed properties and areas with free-ranging cattle and/or buffalo may require postmortem examination following aerial shooting of cattle and buffalo.

The surveillance program will include clinical, serological, virological and molecular approaches to the surveillance of domestic and feral cattle and buffalo populations. In naive, unvaccinated herds, clinical surveillance for development of the characteristic generalised nodular presentation is reliable for detection. Molecular and virological surveillance of relevant vector populations may also be important.

See Section 7 for further details on surveillance and proof of freedom from LSD.

Additional guidance on surveillance can be found in the **AUSVETPLAN guidance document *Tracing and surveillance***.

4.2.4 Zoning and compartmentalisation for international trade

Where it is not possible to establish and maintain disease freedom for the entire country, establishing and maintaining disease-free subpopulations, through zoning and/or compartmentalisation,¹² may be considered.

In the case of a limited disease outbreak, a containment zone¹³ may be established around the areas where the outbreak is occurring, with the purpose of maintaining the disease-free status of the rest of the country outside the containment zone.

All zoning applications would need to be prepared by the Australian Government in conjunction with the relevant jurisdiction(s) and agreed to by the CCEAD. Zoning is usually negotiated after a disease outbreak has begun.

Compartmentalisation applications typically need to be negotiated before an outbreak occurs, and will require input from the relevant industries.

Recognition of both zones and compartments must be negotiated between the Australian Government and individual overseas trading partners. Zoning and compartmentalisation would require considerable resources that could otherwise be used to control an outbreak. Careful consideration will need to be given to prioritising these activities, because the resulting competition for resources could delay the quick eradication of the disease and recognition of disease freedom.

Agreements between trading partners take time to develop, consider and finalise, because of the need to provide detailed information on activities such as biosecurity, surveillance, traceability and diagnostics to support the approach that is developed. An importing country will need assurance that

¹² With zoning, disease-free subpopulations are defined primarily on a geographical basis. With compartmentalisation, disease-free subpopulations are defined primarily by management practices (such as the biosecurity plan and surveillance practices of enterprises or groups of enterprises).

¹³ WOAHP defines a 'containment zone' as an infected zone within a previously free country or zone, which includes all suspected or confirmed cases that are epidemiologically linked and where movement control, biosecurity and sanitary measures are applied to prevent the spread of, and to eradicate, the infection or infestation. The Australian Government Department of Agriculture and Water Resources commissioned a report on what would be required for the establishment of containment zones in Australia. This report is available at www.ausvet.com.au/tools-resources.

its animal health status is not compromised if it imports from an established disease-free zone in Australia. Trading partners may not accept a zoning or compartmentalisation proposal, regardless of the information provided. Eradication of disease may be achieved before zoning or compartmentalisation applications are finalised.

The WOAH guidelines for zoning and compartmentalisation are in Chapter 4.4 and Chapter 11.9 of the WOAH Terrestrial Code.

4.2.5 Biosafety and biosecurity for personnel

Movements of all personnel onto and off high-risk premises (IPs, DCPs, dangerous contact processing facilities (DCPFs), SPs and TPs) should be restricted and subject to strict biosecurity measures, including change of clothes and footwear, decontamination procedures and record keeping (see Section 6.4).

Personnel involved in destruction, disposal and vaccination activities, and sampling of animals for laboratory testing, should wear appropriate personal protective equipment (PPE) to avoid contamination and potential onward transmission of the disease to cattle and buffalo. Appropriate PPE includes disposable coveralls and footwear. These should remain on the premises and be incinerated on-site.

Details of appropriate controls on the movement of people onto or off high-risk premises are provided in Section 6.4.11.

All other cattle and buffalo production premises, particularly those in declared areas, will be encouraged to practise good on-farm biosecurity to limit the possible transmission of LSD virus by people acting as contaminated fomites.

4.2.6 Biosecurity for equipment

Movements of all equipment (including vehicles) onto or off high-risk premises (IPs, DCPs, DCPFs, SPs and TPs), where permitted, should be restricted and subject to strict biosecurity measures, including disposal or decontamination procedures, and record keeping (see Section 6.4).

Equipment used in destruction, disposal and vaccination activities, and for sampling animals for laboratory testing should be considered contaminated and either disposed of on-site (see Section 4.2.12) or decontaminated (see Section 4.2.13).

Details of appropriate controls on the movement of equipment onto or off high-risk premises are provided in Section 6.4.14.

All other cattle and buffalo production premises, particularly those in declared areas, will be encouraged to practise good on-farm biosecurity to limit the possible transmission of LSD virus by equipment acting as contaminated fomites.

4.2.7 Animal welfare

An incursion of LSD into Australia would be a potentially catastrophic event for infected cattle herds. In the event of an LSD response, maintaining animal welfare standards, consistent with legislation, codes, and national standards and guidelines, is a priority.

Currently, there is no vaccine available for use in cattle before infection and no recognised veterinary treatment for cattle post-infection. An effective animal welfare response should include the rapid destruction of infected cattle and buffalo. It should also consider the destruction of cattle and buffalo at risk of infection to minimise the suffering of these animals.

Welfare issues can be expected to arise in cattle or buffalo infected with LSD. Early destruction of animals is required to prevent welfare issues. Managing welfare conditions is likely to be challenging in extensively managed pastoral areas, where the animals are not frequently observed.

Animal welfare issues may arise during the movement of animals as a result of border closures, the need for livestock inspection and quarantining. Welfare issues may also arise from the inability to transport animals, such as restrictions on movement of intensively housed animals (eg on feedlots) or of dairy animals to milking. Restrictions on the movement of milk and milk products off dairy premises may also necessitate the rapid drying-off of dairy animals, with associated welfare considerations.

If movement controls are applied over the longer term, welfare issues arising from increased stocking densities will need to be managed. Dealing with these welfare issues may include the use of emergency permits for movement or on-site destruction.

EAD respondents are required to refer to, and comply with, a range of existing welfare requirements, including:

- state and territory animal welfare legislation
- the **AUSVETPLAN operational manuals**, including *Livestock welfare and management* and *Destruction of animals*, which describe in detail the recommended operational procedures for an EAD response
- the EADRA guidance document *Livestock welfare management and compensation principles for parties to the Emergency Animal Disease Response Agreement*
- the Australian Animal Welfare Standards and Guidelines,¹⁴ which is a single animal welfare regulation model that can be adopted by each state and territory government; the standards are the legal requirements for livestock welfare, and the guidelines provide recommended practices to achieve desirable livestock welfare outcomes
- *Australian Animal Welfare Standards and Guidelines: land transport of livestock*, which has now been implemented by all states and territories.

Additional guidance on rapid drying-off of dairy cattle is available in the **AUSVETPLAN enterprise manual Dairy processing** [in preparation].

¹⁴ www.animalwelfarestandards.net.au

4.2.8 Vaccination

Vaccine availability

Vaccines against LSD virus are not currently available in Australia; however, a regulatory assessment of a candidate vaccine is underway. The use of vaccination in combination with other control measures (including movement controls and culling) has been critical in the control of LSD overseas (EFSA AHAW Panel 2015). The European Union's experience in trying to control LSD led to several modifications of the control methods recommended by the European Food Safety Authority (originally just stamping out in 2015), resulting in a regional vaccination approach (EFSA 2017). An incomplete understanding of the role of vector species in disease transmission under Australian conditions and the difficulty in managing vector control may increase reliance on a safe and effective vaccine program in Australia.

Vaccination of animals well before exposure to infected vectors is advisable to induce protection before the period of peak challenge. Development of protective immunity is expected to take up to 28 days post-vaccination (EFSA AHAW Panel 2015). Taking into account an incubation period of up to 28 days for clinical disease, this means that vaccination must be conducted well in advance of potential spread of LSD into a region to provide effective immunity and avoid vaccine failure (Gelaye et al 2015).

Currently, importation of an LSD vaccine would be subject to the issuing of import permit(s) from the Australian Government department responsible for agriculture. Supply and use of the vaccine in Australia will require an emergency permit and consent to import from the Australian Pesticides and Veterinary Medicines Authority. Vaccination will be approved by the National Management Group based on the recommendation of the CCEAD.

Spread of LSD due to vector dispersal would be expected during the period between detection of disease and the availability of vaccine in Australia. This will have implications for both the control measures implemented and the overall area affected during this interim period.

Vaccination strategy

If vaccine is to be used in Australia, depending on the type of vaccine used, several issues will need to be considered:

- Export market access will be affected by the use of vaccination in Australia.
- Because products (eg meat and milk) from vaccinated animals are considered safe for human consumption, these animals and products may still potentially enter the domestic market.
- Under an eradication policy, vaccinated animals must be considered potentially infected. Their presence may adversely affect export market access.
- The challenges of balancing the use of different vaccines with side effects and the potential for vaccine failure must be carefully considered in procuring a vaccine and deciding on the vaccination program to be used.

For further information on vaccination considerations, see Appendix 3.

LSD will continue to spread from foci of infection for as long as sufficient susceptible hosts and vectors exist. The preferred vaccination strategy for isolated foci of infection would therefore be to blanket vaccinate in large regional areas (eg all cattle and buffalo up to at least 80–100 km from an outbreak) to provide a sufficient buffer of immune animals to halt disease progression. This approach has been effective overseas (see Section 2.9 and Appendix 4).

Decisions on the boundaries of the vaccination area should take into consideration:

- the delay between administration of vaccination and development of peak immunity (approximately 21 days but up to 28 days, according to overseas experience using homologous vaccines)
- the potential for animals to incubate the disease for up to 28 days before being recognised
- in the northern pastoral region, the presence and location of boundary fencing, the location of water points, and the proximity to populations of feral cattle or buffalo.

The overlap of the first two of these factors has contributed to outbreaks in ‘vaccinated’ herds overseas. However, given the need to vaccinate as many animals as possible around infected herds, it is inevitable that some degree of vaccine failure will occur while a vaccination campaign is being instituted. Delaying or skipping the vaccination of herds in the immediate area at risk of transmission for fear of vaccination failure is not advised, because even herds with partial immunity will reduce the overall production of virus, the number of clinically affected animals and viral uptake by vectors, and thereby contribute to outbreak control.

In a scenario with widespread outbreaks, blanket vaccination at a state or territory level should be considered.

If an appropriate vaccine is available in Australia, vaccination to protect valuable genetic lines will also be considered (see the **AUSVETPLAN guidance document *Risk-based assessment of disease control options for rare and valuable animals***).

Management of vaccinated animals¹⁵

Vaccinated animals need to be permanently identified and easily identifiable to assist interpretation of clinical, serological and molecular tests used for surveillance once the outbreak has been controlled, particularly as no DIVA (differentiating infected from vaccinated animals) test is currently available.

A vaccinate-to-remove (delayed stamping-out) policy is preferred as part of completely eradicating LSD virus and returning to an LSD virus-free status with confidence. LSD virus may still circulate in vaccinated populations because:

- available vaccines offer incomplete protection, so a proportion of vaccinated animals will become infected if challenged with field virus
- available vaccines may be incompletely attenuated, so a proportion of vaccinated animals will develop clinical disease and shed vaccine virus.

Vaccinated animals would therefore be considered potentially infected. Under an eradication policy, their presence in the Australian herd may not be acceptable to overseas trading partners.

However, the overall situation should be reassessed once the outbreak has been controlled to decide whether stamping out or removal of these populations is still appropriate, taking into account the total number of herds affected and the impact of stamping out.

As well, the cost of controlling and eradicating an incursion of LSD into Australia needs to be balanced with the risk of reincursion in future monsoon seasons.

It is likely that the Australian Government will need to discuss health requirements for LSD with key markets in Southeast Asia with a view to allowing trade in cattle to continue.

¹⁵ See Chapter 11.9 of the WOAHS Terrestrial Code for details on recovery of free status following use of vaccination (www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/?id=169&L=0&htmlfile=chapitre_lsd.htm).

4.2.9 Treatment of infected animals

There is no specific treatment for animals infected with LSD virus. To manage risks to animal welfare, including where destruction may be delayed, clinically affected animals should be isolated, protected from insects and provided with supportive care, where appropriate.

4.2.10 Treatment of animal products and byproducts

Meat from infected animals has not been implicated in the transmission of LSD. Although WOAHP does not have any restrictions on the trade of meat, meat for human consumption in Australia still needs to meet the relevant Australian standard to ensure that it is a wholesome product. Movement controls will apply to the movement of meat within Australia (see Section 6.4.4).

Milk and milk products from cattle and buffalo, including from IPs, can be processed for human consumption if appropriately treated (ie pasteurised, or chemically treated by acidification). Alternatively, milk and milk products from cattle and buffalo on IPs can be chemically treated by acidification or heat treated (if the process is available on the premises) and buried on the premises. The reason for these treatments is the potential for vectors to contact milk that has been disposed of.

Feed, and wastes such as faeces and straw will be treated and disposed of on the premises.

Untreated cattle hides present a major risk. If they originate from IPs and DCPs within 28 days before diagnosis of the disease, they will be destroyed unless they are already at a processing plant, in which case they will be immediately treated or destroyed. Suitable treatments would include commercial tanning because the pH levels achieved during the normal commercial processing of skins and hides are sufficient to inactivate the virus. This applies to fully tanned, 'wet blue' (lightly or fully chrome tanned, but not dried) or 'wet white' (pretanned with aluminium sulfate, but limed and acid pickled only) skins and hides (DAFF 2001).

Virus can contaminate semen and embryos, which may be sources of infection, so semen and embryos collected from animals on IPs and DCPs after the likely date of infection will be destroyed. An informed judgment on semen and embryos in storage may be made when all relevant information is available.

Feedstuff from IPs will be destroyed.

4.2.11 Destruction of animals

Destruction plans should be developed for each premises in which animals may be destroyed.

Guidance on destruction methods can be found in the **AUSVETPLAN operational manual** *Destruction of animals*.

Stamping out

Stamping out refers to the strategy of eliminating infection from premises through the destruction of live cattle and buffalo in a manner that permits appropriate disposal of carcasses and decontamination of the site. Where resources are limited, stamping out clinically affected animals (predominantly animals with skin nodules) should be prioritised because these animals will contribute significantly more to disease spread than asymptomatic animals.

Until a vaccine is available, movement controls and stamping out are key to containing (and potentially eradicating) LSD. However, the nature of the incursion and the time taken to detect it will likely influence the success of stamping-out activities and movement controls. Without access to a vaccine, successful containment and eradication will depend on a fast and aggressive response.

Where a vaccine is available, stamping out may be used in conjunction with movement controls and a stringent vaccination program. For stamping out in remote locations, there may be a delay between destruction and carcass disposal. In these cases, carcasses should be protected from predation and access by insect vectors, where possible. Destruction and disposal strategies will be logistically difficult, and public perceptions about animals left in situ following aerial shooting will need to be managed.

4.2.12 Disposal of animals, and animal products and byproducts

Carcasses, animal products and byproducts, feedstuff, wastes and bedding that may have been contaminated on IPs and DCPs will be disposed of as soon as possible to reduce exposure to vectors. The disposal method chosen will be influenced by the type of material to be disposed of, resources available, the local environment, the prevailing weather, legislative requirements (including environmental protection legislation) and the risk of disease transmission.

Where possible, disposal will be by burial, burning or composting on-site. Other methods and potential locations will be considered under certain circumstances, based on risk assessment. This is especially the case for inaccessible locations that require aerial shooting of feral or infected animals, where burying or burning of carcasses is not possible, and access of insect vectors to carcasses cannot be prevented. Regions where carcass disposal is challenging and/or 'destroy and let lie' policies are enacted (eg northern Australia) may allow propagation of disease and will need to be considered in vaccination programs.

If there is a delay between destruction and disposal, methods of vector control should be implemented, taking into consideration local vector species and population dynamics. For example, items for disposal could be sprayed with sodium hypochlorite or Virkon (for their virucidal properties), or chemicals from the pyrethroid family (to prevent insects feeding on carcasses).

Decontamination of all equipment and machinery involved in on-site disposal will be required.

Disposal must also be in accordance with the requirements in Section 6, and auditable in terms of biosecurity, traceability and financial requirements.

Additional guidance on disposal options and methods can be found in the **AUSVETPLAN operational manual *Disposal***.

Disposal of milk

Disposal of milk will not usually be required. If it is required based on a risk assessment, it will pose a major challenge for a dairying area, especially if large volumes of milk require disposal (depending on the time of year, and the location and size of the outbreak). Further information on the disposal of bulk milk can be found in the **AUSVETPLAN enterprise manual *Dairy processing*** [in preparation].

To limit the volumes of milk requiring disposal, dairy animals on premises subject to stamping out should be prioritised for destruction. For high-risk premises not subject to stamping out, options such as drying off cows (see the **AUSVETPLAN enterprise manual *Dairy processing*** [in preparation]) and using calves already on the farm may be considered to reduce the amount of milk that ultimately requires disposal.

4.2.13 Decontamination

Fomites such as bedding materials, feedstuff, footwear, clothing, and cattle-handling facilities and equipment will be appropriately decontaminated or destroyed.

Vehicles, people and equipment leaving the premises will be decontaminated. If decontamination cannot be reliably achieved, contact with cattle and buffalo will be prohibited for a specified period that will be determined by other disease control activities at the time (eg use of vaccination in cattle and buffalo).

Further information is available in the **AUSVETPLAN operational manual *Decontamination***, and in DoA & CSIRO (2019).

4.2.14 Wild animal management

Disposal of contaminated materials (including feedstuffs) and carcasses will be prompt to minimise exposure of susceptible feral cattle and buffalo, wild predators and vermin to LSD virus. Feral and free-ranging cattle and buffalo are very difficult to contain; where there are infected cattle, it is very likely that feral and free-ranging populations in the same geographical area will also become infected. Aerial shooting is the most common method of control for feral populations that cannot be mustered. Control measures must be such that wild animal populations are not induced to disperse out of the RA. Remoteness, accessibility and ruggedness of the terrain will require consideration when selecting destruction methods. A range of options may be available, such as baiting, trapping, decoy feeding and aerial shooting.

4.2.15 Vector management

With input from an entomologist, a vector monitoring program will be implemented to identify the vectors of concern. A targeted approach to vector control to break the transmission cycle will then be devised. Recent literature has found that *Stomoxys calcitrans*, *Culicoides nubeculosis* and *Aedes aegypti* are potentially efficient transmitters of LSD virus (Sanz-Bernardo et al 2021).

Since several vector species are present in Australia, a range of approaches may be required to manage the risks. These may include aerial and ground application of insecticides as ultra-low volume (ULV) fogs, and treatment of cattle with either a systemic insecticide (eg ivermectin), an insecticidal or insect-repellent ear tag, or a topical (eg pour-on) insecticide, ideally to both repel insects and reduce the population of target insects. The treatment radius would be determined by risk assessment. Topical insecticides that repel insects and prevent or reduce biting are preferred, to reduce the likelihood of a naive herd becoming infected. The use and application of each of these options would vary in different areas of Australia and during different seasons, and will need to take into account safety, efficacy, environmental and food safety issues.

Where practicable, insect-proof housing for animals might also be considered. Cattle and buffalo producers should be encouraged to avoid placing animals in paddocks with high levels of insect activity (eg swampy areas).

The area over which vector management is undertaken should be determined taking into consideration the local vector species, vector dispersal, vector breeding sites, and the possibility of windborne spread of vectors.

If infected source animals can be destroyed and disposed of quickly, the risk of transmission to new vector populations will be reduced. Ticks as vectors will require consideration with regard to ongoing transmission risk.

Expertise in areas such as virology (including arbovirology), vector epidemiology and mapping will be sought to assist with any outbreak, and help provide surveillance data and other advice for use in reopening international trade.

4.2.16 Public awareness and media

A considered public information campaign will help to address any public health concerns, and foster engagement and support for response activities.

Key public information messages in an outbreak of LSD will include:

- advice that LSD is not zoonotic
- advice that Australian beef and dairy products remain safe for human consumption
- information to support early recognition and reporting of the disease
- information to generate understanding of, and support for, disease control measures (eg movement controls, highlighting animal welfare; vaccination; culling)
- advice to address environmental concerns if aerial spraying for vector control is used
- advice on where more detailed information can be obtained.

Additional guidance on managing public information can be found in the **AUSVETPLAN resource document *Biosecurity incident public information manual***.

4.3 Funding and compensation

Details of the cost-sharing arrangements can be found in the EADRA.¹⁶ Details of the approach to the valuation of, and compensation for, livestock and property in disease responses can be found in the **AUSVETPLAN operational manual *Valuation and compensation***.

¹⁶ <https://animalhealthaustralia.com.au/eadra>

5 Declared areas and premises

When an emergency animal disease (EAD) is first suspected, the premises involved would undergo a clinical and/or epidemiological investigation. If the case definition, as defined in the relevant AUSVETPLAN response strategy, is met (ie the index case¹⁷), the relevant chief veterinary officer (CVO) or their delegate will determine the premises classification and may declare the premises an infected premises (IP).

After the identification of the first IP, a restricted area (RA) and a control area (CA) may be declared.¹⁸ A transmission area (TA) may also be defined, if appropriate. All premises within these areas will be classified.

At the beginning of an EAD incident, the initial premises classifications would be IP, at-risk premises (ARP), premises of relevance (POR), unknown status premises (UP) and zero susceptible species premises (ZP).

Any premises within the RA or CA will have only one classification at any one time. After an epidemiological investigation, clinical assessment, risk assessment or completion of control measures, a premises may be reclassified.

Once the first IP has been identified, intelligence gathering through veterinary epidemiological investigations would quickly lead to the identification of suspect premises (SPs) and trace premises (TPs). These would be high priorities for follow-up investigation by the relevant state or territory authorities. In a worst-case scenario, an SP could become an IP; therefore, SPs need to be investigated as a matter of very high priority. Similarly, investigation and risk assessment of a TP might identify it as an IP, dangerous contact premises (DCP) or dangerous contact processing facility (DCPF). An SP or TP might also be assessed as negative and qualified as SP-AN or TP-AN, and eventually reclassified as an ARP, POR or ZP.

All premises classifications are subject to change as a result of a modification in the case definition(s) or investigation(s) as the incident response proceeds.

Classifications should be applied with information needs of managers in mind. They should assist managers to monitor and report progress. Premises classifications to be used should be agreed early in a response, so that control centre personnel can apply the correct and consistent classifications and definitions from the outset of the investigation and response.

¹⁷ The first case to come to the attention of investigators

¹⁸ This is invariably the case with highly contagious diseases (eg foot-and-mouth disease, equine/avian/swine influenza, classical swine fever) but may not apply to less contagious diseases (eg Hendra virus, anthrax, Australian bat lyssavirus).

5.1 Declared areas

Maintaining movement restrictions on areas for long periods has important implications for resource management, animal welfare, business continuity, and socioeconomic impacts on producers and regional communities.

During the course of an EAD response, it may become necessary for a CA or RA to be expanded, as additional geographical areas or new foci of infection are identified. Later in the response, as control is achieved, mechanisms for gradually reducing the size of the CA and RA can be introduced.

An EAD may involve multiple foci of infection, with several jurisdictions potentially involved. Since disease might be controlled at different rates in different areas, there may be the opportunity to progressively lift restrictions on an area basis. This would involve reclassifying previously declared areas (RAs and CAs), with a staged approach to lifting of movement restrictions. This is a key step in the recovery process and will have positive benefits on the community.

5.1.1 Restricted area (RA)

An RA will be an appropriately sized declared area¹⁹ within the CA and within which the disease is contained, and will focus on the highest-risk regions, including all IPs and DCPs, and including as many SPs, TPs and DCPFs as practicable. Based on risk assessment, the RA is subject to intense surveillance and movement controls, and other relevant disease controls. The purpose of the RA is to minimise the spread of the EAD. The RA does not need to be circular but can have an irregular perimeter, provided that the boundary is initially an appropriate distance from the nearest IP, DCP, DCPF, SP or TP. Multiple RAs may exist within one CA.

The boundaries will be modified as new information becomes available, including from an official surveillance program. The actual distance in any one direction will be determined by factors such as terrain, the pattern of livestock movements, livestock concentrations, the weather (including prevailing winds), the distribution and movements of relevant wild (including feral) animals and known characteristics of the disease agent. In practice, major geographic features and landmarks, such as rivers, mountains, highways and roads, are frequently used to demarcate the boundaries of the RA. Although it would be convenient to declare the RA based on local government areas, this may not be practical, as such areas can be larger than the particular circumstances require.

5.1.2 Control area (CA)

A CA is a disease-free buffer between the RA and the outside area (OA). Specific movement controls, surveillance strategies and other relevant disease controls will be applied within the CA to maintain its disease-free status and prevent spread of the disease into the OA.

An additional purpose of the CA is to control movement of cattle and buffalo for as long as is necessary to complete tracing and epidemiological studies, to identify risk factors and forward and backward risk(s).

The CA will be a larger declared area around the RA(s) – initially, possibly as large as the state or territory in which the incident occurs – where restrictions will reduce the risk of disease spreading from the RA(s). The CA will have a minimum radius of at least 80–100 km beyond the boundary of the RA. The actual distance in any one direction will be determined by factors such as terrain, the pattern

¹⁹ As defined under relevant jurisdictional legislation

of livestock movements, livestock concentrations, the weather (including prevailing winds), the distribution and movements of relevant wild (including feral) animals, and known characteristics of the disease agent. In practice, major geographic features and landmarks, such as rivers, mountains, highways and roads, are frequently used to demarcate the boundaries of the CA. The boundary will be adjusted as confidence about the extent and distribution of the incident increases.

In general, surveillance and movement controls will be less intense in the CA than in the RA, and disease-susceptible animals and their products may be more likely to be permitted to move under permit within and from the area than those originating from the RA.

5.2 Other areas

5.2.1 Transmission area (TA)

A TA is not a legally declared area, but may be useful in epidemiological modelling to provide some guidance on where transmission of the disease may occur over time, based on the activity and range of the vectors that carry lumpy skin disease (LSD) virus.

While competent vectors are not clearly defined in the Australian context, the extent of the TA should take into consideration the likely range of possible vectors, the prevailing weather, and the possibility of wind dispersal and movement with moving stock.

5.3 Premises classifications

Detailed guidelines for classifying premises statuses are provided in the **AUSVETPLAN guidance document *Declared areas and allocation of premises classifications in an emergency animal disease response***. Definitions are in the glossary.

5.3.1 Premises status classifications

For LSD, the premises classifications to be used are:

- infected premises (IP)
- suspect premises (SP)
- trace premises (TP)
- dangerous contact premises (DCP)
- dangerous contact processing facility (DCPF)
- approved processing facility (APF)
- approved disposal site (ADS)
- at-risk premises (ARP)
- premises of relevance (POR)
- resolved premises (RP)
- unknown status premises (UP)
- zero susceptible species premises (ZP).

5.3.2 Qualifiers

Refer to the **AUSVETPLAN guidance document *Declared areas and allocation of premises classifications in an emergency animal disease response*** for more detail on qualifiers.

For LSD, the qualifiers to be used are:

- assessed negative (AN)
- sentinels on site (SN)
- vaccinated (VN).

5.4 Reclassifying premises and previously declared areas

Maintaining movement restrictions on areas for long periods has important implications for resource management, animal welfare, business continuity, and socioeconomic impacts on producers and regional communities. Therefore, attention should be given to reclassifying premises and previously declared areas as quickly as possible.

Detailed guidelines for reclassifying previously declared areas are provided in the **AUSVETPLAN guidance document *Declared areas and allocation of premises classifications in an emergency animal disease response***.

6 Movement controls

6.1 Principles

General principles for movement controls for managing emergency animal diseases (EADs) are provided in the **AUSVETPLAN guidance document *Movement controls***.

Key considerations for movement controls for managing lumpy skin disease (LSD) are as follows:

- LSD is primarily a mechanically transmitted vector-borne disease. Biting vectors continually spread the disease as they encounter naive hosts, which, in turn, encounter new vectors. Infected animals (including vaccinated animals) present a significant, proven risk of spread to new areas when moved, including outside declared areas.
- Transmission may also occur by direct and indirect pathways between animals and involving their secretions; however, these pathways are less efficient.
- Animals with clinical disease are highly infectious.
- *Bos taurus* cattle appear more susceptible than *Bos indicus* cattle; however, all breeds should be treated as equally susceptible when implementing control policies.
- Infected animals may shed virus without showing clinical signs. Infected animals can incubate the disease for up to 28 days.
- LSD virus is relatively stable in the environment.
- Germplasm may carry and transmit infection.
- LSD virus is not known to be shed in the faeces or urine of naturally infected animals.

6.2 Guidelines for issuing permits

In an EAD event, quarantine and movement controls must strike a balance between quick and effective disease control and business continuity. Therefore, it is not appropriate to simply prohibit all movement of animals and products on a national scale. On the other hand, diligence needs to be applied to minimise the risk of further spread of the disease.

Recommended biosecurity and movement controls in each **AUSVETPLAN response strategy** provide guidance on which movements can be allowed and under what conditions. This is based on an analysis of the disease risks that are presented by a specific movement, of a specific commodity, at a specific time during the EAD response phase. Each disease response strategy will indicate whether a proposed movement is:

- allowed (under normal jurisdictional, including interstate, requirements)
- prohibited – except under the conditions of a general, special or emergency permit
- prohibited.

Permits may not be available until the relevant chief veterinary officer (CVO) provides approval for movements, and this may not be available in the early stages of a response. When assessing risk for the purposes of issuing a permit, the elements to consider may include:

- sources of risk
 - risk material such as live or dead cattle and buffalo, semen, embryos, meat, meat products, waste products, offal, paunch screenings, manure, render material, fertiliser, biological

- specimens, casings, used wrappers and cartons, effluent and fomites (vehicles, people, nonsusceptible animals, crops, grains, hay, silage and mixed feeds)
- presence of the disease agent on both the originating and destination premises, and uncertainty
- location of source and destination premises
- fate at destination premises (eg for slaughter vs for growing out)
- current vector activity, if relevant
- organisation and management issues (ie confidence in animal tracing and surveillance, biosecurity)
- proposed use of the animals or products
- proposed transport route
- vaccination status of the animals, if relevant
- security and monitoring at the destination
- environment and natural events
- community and human behaviour
- risk of sabotage
- technology
- regulations and standards
- available resources for compliance and enforcement
- areas of impact
 - livestock health (health of affected species, including animal welfare)
 - human health (including work health and safety), noting that LSD is not zoonotic
 - trade and economic impacts (including commercial and legal impacts)
 - environmental impacts
 - organisational capacity
 - political impacts
 - reputation and image
 - proposed risk treatment measures
 - vaccination
 - destruction and disposal of animals and/or animal products
 - processing of product
 - disinfection or other treatment of animals, vehicles and fomites
 - vector control, if relevant
 - security
 - communication.

6.3 Types of permits

Permits are either general or special. Emergency permits are a form of special permit. Permits are legal documents that describe the animal(s), commodities or things to be moved, the origin and destination, and the conditions to be met for the movement. Either type of permit may include conditions. Once permit conditions have been agreed from an operational perspective, all permit conditions must be met for every permit. Both general and special permits may be in addition to documents required for routine movements between or within jurisdictions (eg health certificates, waybills, consignment notes, National Vendor Declarations).

General permit

General permits (GPs) are used for lower-risk movements, and create a record of each movement to which they apply. They are granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or gazetted inspector of stock. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version, or electronic copy on an electronic device, of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. GPs may not be available until the relevant CVO gives approval for general movements, and this may not be available in the early stages of a response.

Special permit

Special permits (SpPs) are issued by the relevant government veterinarian or gazetted inspector of stock. They are used for higher-risk movements, and therefore require formal application and individual risk assessment. SpPs describe the requirements for movement of an animal (or group of animals), commodity or thing, for which a specific assessment has been conducted by the relevant government veterinarian or gazetted inspector of stock. A printed version, or electronic copy on an electronic device, of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements.

Emergency permit

An emergency permit is an SpP that specifies strict legal requirements for an otherwise high-risk movement of an animal, to enable emergency veterinary treatment to be delivered, to enable animals to be moved for animal welfare reasons, or to enable any other emergency movement under exceptional circumstances. These permits are issued on a case-by-case basis under the authorisation of the relevant CVO.

Other movement requests

Movements not reflected within any of the movement control matrixes or narratives may be considered by the relevant jurisdictional CVO on a risk-assessed case-by-case basis.

6.4 Recommended movement controls

GPs and SpPs may not be available until the relevant CVO gives approval for movements, and this may not be available in the early stages of a response.

Permit conditions are listed in Appendix 2.

6.4.1 Live susceptible animals

Cattle on live export vessels will be assessed as individual consignments by the Department of Agriculture, Fisheries and Forestry and relevant jurisdiction(s) to determine options for cattle unloading or disposal.

See Section 6.4.10 for movement controls for nonsusceptible animals.

Other than to slaughter

Table 6.1 outlines the controls for the movement of live cattle and buffalo other than to slaughter.

Table 6.1 Movement controls for live animals moving other than to slaughter

	To	RA		CA	OA
From		IP, DCP, SP, TP	ARP	POR	
RA	IP, DCP, SP, TP	Prohibited	Prohibited	Prohibited	Prohibited
	ARP	Prohibited	Prohibited, except under SpP – conditions 1, 2, 3, 4, 5, 6, 7, 14, 18, 19	Prohibited	Prohibited
CA	POR	Prohibited	Prohibited	Prohibited, except under SpP – conditions 1, 2, 3, 4, 5, 6, 7, 14, 18, 19	Prohibited
OA		Prohibited	Prohibited	Prohibited, except under SpP – conditions 1, 2, 3, 4, 5, 6, 7, 18, 19	Allowed under normal jurisdictional or interstate movement requirements

ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises

To slaughter

Table 6.2 outlines the controls for the movement of live cattle and buffalo to slaughter.

Table 6.2 Movement controls for live animals moving to slaughter

	To	RA			CA	OA
From		IP, DCP, SP, TP	DCPF ^a	APF	APF	
RA	IP, DCP, SP, TP	Prohibited	Prohibited, except under SpP – conditions 2, 3, 4, 5, 6, 10, 12, 13, 14, 15, 18, 19	Prohibited	Prohibited	Prohibited
	ARP	Prohibited	Prohibited, except under SpP – conditions 1, 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19	Prohibited, except under SpP – conditions 1, 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19	Prohibited	Prohibited
CA	POR (including premises with VN status)	Prohibited	Prohibited	Prohibited, except under SpP – conditions 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19	Prohibited, except under SpP – conditions 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19 ^a	Prohibited, except under SpP – conditions 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19 ^{b,c}
OA		Prohibited	Prohibited	Prohibited, except under SpP – conditions 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19 ^d	Prohibited, except under SpP – conditions 2, 3, 4, 5, 6, 12, 13, 14, 15, 18, 19 ^{a,c}	Allowed under normal jurisdictional or interstate movement requirements

APF = approved processing facility; ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; DCPF = dangerous contact processing facility; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises; VN = vaccinated

a It is important to ensure that processing facilities have approved the receiving of live cattle and/or buffalo before the animals leave the premises.

b The transit route taken by the consignment will ideally not cross into an RA or transmission area (TA).

c Should only be issued if there is no APF available in the RA or CA.

d Should only be issued if there is no abattoir reasonably available in the OA.

6.4.2 Carcasses

The definition of the term 'carcass' for the purposes of AUSVETPLAN is 'the body of an animal that died in the field' (see the glossary).

Table 6.3 outlines the controls for the movement of carcasses.

Table 6.3 Movement controls for carcasses

From	To	RA			CA		OA
		IP, DCP, SP, TP	ARP	ADS ^a	POR	ADS	
RA	IP, DCP, SP, TP	Prohibited	Prohibited	Prohibited, except under SpP – conditions 1, 3, 4, 5, 6, 24, 25, 26, 27	Prohibited	Prohibited	Prohibited
	ARP	Prohibited	Prohibited	Prohibited, except under SpP – conditions 1, 3, 4, 5, 6, 24, 25, 26, 27	Prohibited	Prohibited, except under SpP – conditions 3, 4, 5, 6, 24, 25, 26, 27 ^b	Prohibited
CA	POR	Prohibited	Prohibited	Prohibited, except under SpP – conditions 1, 3, 4, 5, 6, 24, 25, 26, 27	Prohibited	Prohibited, except under SpP – conditions 3, 4, 5, 6, 24, 25, 26, 27	Prohibited
OA		Prohibited	Prohibited	Prohibited, except under SpP – conditions 3, 4, 5, 6 ^c	Prohibited, except under SpP – conditions 3, 4, 5, 6	Prohibited, except under SpP – conditions 3, 4, 5, 6 ^c	Allowed under normal jurisdictional or interstate movement requirements

ADS = approved disposal site; ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises

a The ADS in the RA could be another IP for the purposes of communal disposal, with appropriate biosecurity conditions.

b This movement is only permitted if there is no ADS in the RA.

c The preference is to use an ADS within the OA, or, if none available, the CA, or, if none available, the RA.

6.4.3 Semen and embryos from live susceptible animals

Movements of fresh semen and embryos into, within and from the RA and CA should be prohibited.

Table 6.4 outlines the controls for the movement of frozen semen and embryos from live cattle and buffalo.

Table 6.4 Movement controls for frozen semen and embryos from live cattle and buffalo

	To	RA		CA	OA
From		IP, DCP, SP, TP	ARP	POR	
RA	IP, DCP, SP, TP	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited
	ARP	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited
CA	POR	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited
OA		Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Prohibited, except under SpP – conditions 23, 29, 30	Allowed under normal jurisdictional or interstate movement requirements

ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises

6.4.4 Meat and meat products

The World Organisation for Animal Health (WOAH) recommends that the following commodities should not require any LSD-related conditions, regardless of the status of the animal population of the exporting country, because the risk of transmission of the virus is very low: skeletal muscle meat, casings, gelatine and collagen, tallow, and hooves and horns. Therefore, meat can be safely moved. However, movement controls on vehicles to avoid vector dispersal will still apply for the RA and CA (see Section 6.4.9).

Meat and meat products are still required to pass antemortem and postmortem inspection, to ensure the wholesomeness of the product. All meat that is to be exported must also comply with trading partner requirements, which may be more prescriptive than the WOAH requirements.

Table 6.5 outlines the controls for the movement of meat and meat products.

Table 6.5 Movement controls for meat and meat products

From	To	RA		CA		OA
		IP, DCP, SP, TP, ARP	APF, DCPF, ADS	POR	APF, DCPF, ADS	
RA	IP, DCP, SP, TP, ARP	Prohibited, except under GP – conditions 3, 5, 6	Prohibited, except under GP – conditions 3, 5, 6	Prohibited, except under GP – conditions 3, 5, 6	Prohibited, except under GP – conditions 3, 5, 6	Prohibited, except under GP – conditions 3, 5, 6
CA	POR	Prohibited, except under GP – condition 3				
OA	Allowed under normal jurisdictional or interstate movement requirements.					

ADS = approved disposal site; APF = approved processing facility; ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; DCPF = dangerous contact processing facility; GP = general permit; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; TP = trace premises

6.4.5 Milk and milk products

The risk of transmission of LSD virus by milk not intended for animal consumption can be mitigated by pasteurisation and transport in closed containers (Tuppurainen et al 2017). The WOAHP recommendations for importation of milk and milk products include pasteurisation.

Table 6.6 outlines the controls for the movement of milk and milk products.

Table 6.6 Movement controls for milk and milk products

From	To	RA			CA		OA
		IP, DCP, SP, ARP	TP	APF, DCPF, ADS ^a	POR	APF, DCPF, ADS	
RA	IP, DCP, SP	Prohibited	Prohibited	Prohibited, except under SpP – conditions 3, 5, 6, 21, 22, 31	Prohibited	Prohibited, except under SpP – conditions 1, 3, 5, 6, 21, 22, 31	Prohibited
	TP	Prohibited	Prohibited, except under SpP – conditions 3, 5, 6, 22, 28	Prohibited, except under SpP – conditions 3, 5, 6, 21, 22	Prohibited	Prohibited, except under SpP – conditions 1, 3, 5, 6, 21, 22	Prohibited
	ARP	Prohibited	Prohibited, except under SpP – conditions 3, 5, 6, 22, 28	Prohibited, except under SpP – conditions 3, 5, 6, 21, 22	Prohibited	Prohibited, except under SpP – conditions 1, 3, 5, 6, 21, 22	Prohibited, except under SpP – conditions 1, 3, 5, 6, 21, 22
CA	POR	Prohibited, except under SpP – conditions 3, 5, 6, 22, 28	Prohibited, except under SpP – conditions 3, 5, 6, 22, 28	Prohibited, except under SpP – conditions 3, 5, 6, 21, 22	Prohibited, except under SpP – conditions 3, 5, 6, 22, 28	Prohibited, except under SpP – conditions 3, 5, 6, 21, 22	Prohibited, except under SpP – conditions 1, 3, 5, 6, 21, 22
OA		Allowed under normal jurisdictional or interstate movement requirements.					

ADS = approved disposal site; APF = approved processing facility; ARP = at-risk premises; CA = control area; DCP = dangerous contact premises; DCPF = dangerous contact processing facility; IP = infected premises; OA = outside area; POR = premises of relevance; RA = restricted area; SP = suspect premises; SpP = special permit; TP = trace premises

a It is important to ensure that processing facilities have approved the receiving of milk and milk products before collection from the premises.

6.4.6 Hides, skin, wool and other fibres

LSD virus is found in the skin of infected animals, and unprocessed or partially processed hides pose a potential risk of transmission (via the contamination of mechanical vectors and fomites).

Hides that are fully tanned may be allowed to move without restriction, but records of their origin and the processing undertaken should be kept.

Partially tanned hides in the restricted area (RA) may move to an approved processing facility (APF) under SpP for further processing (full tanning). The issuance of an SpP will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks (eg conditions to ensure biosecurity of the hides in transit, appropriate biosecurity and treatment at the APF, record keeping).

Movement of unprocessed hides in the RA is prohibited, except under SpP to an approved disposal site (ADS). The issuance of an SpP will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks (eg conditions to ensure biosecurity of the hides in transit, appropriate biosecurity and disposal at the ADS, record keeping).

Unprocessed or partially tanned hides originating from the control area (CA) may move to an APF under SpP for further processing (full tanning). The issuance of an SpP will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks (eg conditions to ensure biosecurity of the hides in transit, appropriate biosecurity and treatment at the APF).

Unprocessed or partially tanned hides originating from the outside area (OA) may be allowed to move without restriction, although records of their origin and any processing undertaken should be kept if they are processed at a premises within the RA or CA.

6.4.7 Other animal byproducts

Permission for movements of other animal byproducts will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks.

6.4.8 Waste products and effluent

At the time the outbreak is declared, management of all wastes from the RA or CA will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks. The risk assessment should take into consideration the origin (and therefore the expected LSD virus status) of the animal products, any processing undertaken on the waste material, the potential for any post-processing cross-contamination from infected material, and the intended site and means of disposal of the wastes (including any proposed use for irrigation).

6.4.9 Vehicles, including empty livestock transport vehicles and associated equipment

Empty livestock transport vehicles and associated equipment may play a role in spread of infection by acting as fomites and carriers of insect vectors.

Movements from infected premises (IPs), dangerous contact premises (DCPs) and trace premises (TPs) are prohibited except under SpP. The issuance of an SpP will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks. Conditions will include thorough cleaning and decontamination, vector control, inspection before leaving the premises, and appropriate record keeping.

Movements from the RA to the CA, or from the CA to the OA, are prohibited except under SpP. The issuance of an SpP will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks. Conditions will include thorough cleaning and decontamination, disinfection to destroy the virus, vector control, inspection before leaving the premises, and appropriate record keeping.

For movements originating on at-risk premises (ARPs) or premises of relevance (PORs), a GP is required, with the following conditions: vehicles and equipment are thoroughly cleaned before exit from the premises, and records are kept of the movement (origin, destination and cleaning undertaken).

Movements originating in the OA are allowed without restriction.

6.4.10 Nonsusceptible animals

Nonsusceptible animals may play a role in spread of infection by acting as fomites.

Movement of nonsusceptible animals from IPs, DCPs, TPs and SPs will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks (eg cleaning to remove mud, limiting access to cattle and buffalo at the destination). The risk assessment and conditions applied should also consider the potential for vector movement associated with the proposed animal movement; for example, some species of ticks may be present on both horses and cattle.

Movement of nonsusceptible animals from ARPs and PORs will also be based on risk assessment, taking into consideration the factors outlined above.

Movement of nonsusceptible animals from the OA is allowed without restriction (although permit requirements and conditions may apply to the movement of vehicles out of declared areas – see Section 6.4.9).

6.4.11 People

People may play a role in spread of infection by acting as fomites.

The conditions applied to movements of people off IPs, DCPs, SPs and TPs should be based on risk assessment, taking into consideration any potential contact with livestock and contaminated environments. Where the assessed risk is high, a change of clothes, headwear and footwear, or decontamination procedures, and record keeping should be implemented. Because viruses can be transmitted in nasal cavities, hair and so on, consideration should also be given to the potential need for showering before entering another property where there are cattle or buffalo.

For ARPs, PORs and premises in the OA, no specific controls are required, but owners should be encouraged to enhance biosecurity measures on their premises to limit the movement of potential environmental contaminants (see also Section 4.2.5).

6.4.12 Specimens

The movement of biological specimens for laboratory testing is allowed without restriction.

6.4.13 Crops, grains, hay, silage and mixed feeds

Crops, grains, hay, silage and mixed feeds from IPs, DCPs, SPs and TPs may present a risk of transmission by acting as fomites.

Movements of these items should be based on risk assessment, taking into consideration a range of factors, including their location on the property (and the potential for contamination or cross-contamination), the time of harvest (feeds harvested on the premises within two incubation periods from the onset of infection would be considered high risk), the intended end use, and any processing to be undertaken. Consideration should be given to the possibility of using only feed that is from a FeedSafe-accredited supplier or has a vendor declaration stating that the feed has not come into contact with cattle.

Potential animal welfare issues – especially for feedlots, where bringing feed into the premises is vital – will need to be considered in the risk assessment process.

Movement of crops, grains, hay, silage and mixed feeds from ARPs should also be subject to risk assessment, taking into consideration the factors outlined above and the proximity of the ARP to known and expected areas of infection. Movements from the RA to the CA or OA are prohibited except under GP, with conditions 3, 5 and 6 (see Appendix 2).

Movement of crops, grains, hay, silage and mixed feeds from premises in the CA or OA to the RA is prohibited except under GP, with conditions 3, 5 and 6 (see Appendix 2).

6.4.14 Equipment, including personal items

Equipment that has had direct contact with cattle, buffalo or contaminated environments – or may be associated with potentially infected vectors – should be managed in the same manner as empty livestock transport vehicles and associated equipment (see Section 6.4.9).

Movements of other equipment and personal items are allowed without restriction.

6.4.15 Sales, shows and other events

Sales, shows and other events involving cattle or buffalo in declared areas are prohibited.

6.4.16 Stock routes and rights of way

Movements of cattle and buffalo on stock routes and rights of way in declared areas are prohibited.

6.4.17 Animal movements for emergency (including welfare) reasons

Permission for the movement of animals for emergency (including welfare) reasons will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks.

6.4.18 Other movements

Permission for other movements will be based on risk assessment and subject to appropriate conditions to mitigate the identified risks.

7 Surveillance and proof of freedom

7.1 Surveillance

The key objectives and priorities for surveillance in response to an outbreak of lumpy skin disease (LSD) are outlined in Section 4.2.3. General considerations, and those specific to surveillance for LSD virus, are discussed below. The approach to surveillance on premises of different status is then outlined.

7.1.1 General considerations

General considerations for surveillance for LSD include the following:

- Evidence to support later proof of freedom should be collected throughout the response.
- Appropriate biosecurity measures must be used to prevent disease spread by surveillance activities; this includes preventing unnecessary property visits.
- Surveillance regimes may vary with different premises statuses; higher-risk premises will be subject to more intense surveillance.
- All properties with cattle and/or buffalo within declared areas should be recorded on the information management system as soon as practicable, to enable generation of surveillance and tracing schedules and reports, and management of premises classifications.
- A standardised investigation protocol, and reporting and laboratory submission forms should be used.
- Following field surveillance visits, reporting, debriefing and provision of samples to the laboratory should follow a schedule that minimises delays in laboratory diagnosis.
- Communication strategies targeted at producers and animal health professionals (eg veterinarians, stock inspectors, meat inspectors) should outline key clinical signs, to encourage the early reporting of any suspicions of LSD to government veterinary services.

7.1.2 Specific considerations

Specific considerations for surveillance for LSD include the following:

- Surveillance for LSD virus will include an epidemiological investigation of the potential vectors that are present, and the environmental and ecological factors that may influence their distribution and survival. Surveillance will also determine the extent of infection and vector activity within the area of infected premises (IPs) and dangerous contact premises (DCPs), to enable a realistic restricted area (RA) and control area (CA) to be established.
 - There is a strong possibility that the disease will have already spread at the time of initial diagnosis, so establishment of RA and CA boundaries must account for the need for wider surveillance to establish the extent of spread (EFSA AHAW Panel et al 2021).
 - Allowance should be made for the possibility of virus overwintering in arthropod vectors, with subsequent seasonal resurgence of the disease.
 - Transovarial, transstadial and mechanical (intrastadial) transmission by hard tick species has been reported.
 - The National Arbovirus Monitoring Program undertakes surveillance of midge populations in Australia and may provide information to support an LSD virus surveillance program.

- Public health vector monitoring programs may provide information on other potential vector populations in Australia.
- Surveillance of feral cattle and buffalo populations in areas where disease is present will be important, because these may act as reservoirs of infection.
- Clinical surveillance should include groups of animals seen as high risk (eg through enhanced clinical inspection of livestock at abattoirs, saleyards and other aggregation points).
- In vaccinated populations, the severity of clinical disease may be significantly reduced; as a result, passive surveillance may have poor sensitivity for detection of disease. Therefore, active surveillance based on clinical examination (67–75% sensitivity in experimental trials) with confirmatory PCR testing on skin and blood samples will be more effective (EFSA 2019).
- Serological cross-reactions occur between LSD virus and sheep pox and goat pox viruses (although these are not present in Australia).
- Serological tests are of limited value for individual animals, as a result of low assay sensitivity, but may provide some information at the herd level.
 - Antibodies developed remain detectable for at least 3–6 months post-infection; further studies to ascertain long-term antibody persistence have not been done to date. This will be an important consideration for proof-of-freedom testing, which will need to rely on serological testing without having DIVA (differentiating infected from vaccinated animals) capability.
- The survey design should anticipate the occurrence of false positive reactions (as no diagnostic tests have perfect specificity), although specificity is generally very high in the assays proposed for this purpose, so the number of false positives is expected to be small. Appropriate follow-up procedures will be needed, including additional sampling from the animal or herd.
- If vaccination is used as part of the disease response, the use of laboratory tests that allow DIVA will be important.
 - There is no serological DIVA capability for LSD virus. DIVA is achieved through duplex PCR assays that detect vaccine strains vs wild type; however, these tests are proving ineffectual against the new recombinant LSD virus strains.

7.1.3 Surveillance on suspect premises

Surveillance on suspect premises (SPs) is a priority and should occur as soon as possible after suspicious signs are recognised or links to known IPs are identified. Where the number of these premises is large (compared with available resources), prioritisation of surveillance should be risk based, taking into consideration the likelihood that infection may be present and the impact on the response if infection were present on the premises.

Laboratory investigation is required to confirm the status of the suspect animals. Sampling should target cattle with clinical signs, and samples should be submitted for PCR testing with or without virus isolation.

If the laboratory results are positive, the premises will be reclassified as an IP.

If the initial laboratory results are negative, additional testing to establish an alternative diagnosis may be considered. If there is no alternative diagnosis, further actions will be based on risk assessment, taking into consideration the likelihood that the negative result is a true reflection of the status of the premises – for example, by considering the number of animals affected, the number of samples taken, the level of clinical suspicion, the implications for disease control if the result is a false negative result, the duration of clinical disease on the premises and the expected incubation period. Additional testing after a period may be warranted before the property is assessed negative and subsequently reclassified.

7.1.4 Surveillance on trace premises

Surveillance on trace premises (TPs) is a priority and should occur as soon as possible after links to known IPs are identified. Where the number of these premises is large (compared with available resources), prioritisation of surveillance should be risk based, taking into consideration the likelihood that infection may be present and the impact on the response if infection were present on the premises.

Surveillance on TPs should include clinical inspection of livestock by surveillance teams. Ideally, every mob of cattle or buffalo will be inspected and numbers accounted for. If the number of cattle or buffalo on a premises is large, a statistically appropriate sample of animals on these premises must be examined, targeting those at higher risk of infection (eg those with known links to IPs and those in contact with these cattle). Because the expected disease prevalence remains low for some time after introduction into a naive population, for active surveillance to be effective, a large number of herds would need to be sampled at high frequency to allow early detection and prevent further spread of the disease (EFSA et al 2018).

Laboratory samples (EDTA blood in the absence of skin lesions) for PCR testing should be taken from higher-risk cattle at day 0. If the laboratory results are positive, the premises will be reclassified as an IP.

If the initial laboratory results are negative, stock should be monitored for development of clinical signs (see 'Surveillance on at-risk premises and premises of relevance') and higher-risk cattle retested at day 28.

If the laboratory results from day 28 testing are positive, the premises will be reclassified as an IP.

If the laboratory results are negative from testing samples at days 0 and 28, and there have been no clinical signs of LSD, the premises may be assessed as negative and subsequently reclassified.

7.1.5 Surveillance on dangerous contact premises

Cattle on DCPs will be subject to stamping out based on risk assessment. If there is a delay in stamping out (eg due to resource availability), clinical surveillance should be undertaken (see 'Surveillance on at-risk premises and premises of relevance'). Development of clinical signs and confirmation of infection on these premises may alter their prioritisation for destruction, disposal and decontamination activities.

7.1.6 Surveillance on at-risk premises and premises of relevance

On other properties at risk (at-risk premises (ARPs) and premises of relevance (PORs)), clinical surveillance should be undertaken to facilitate early reporting of suspected infection. The characteristic clinical signs of LSD mean that producers and stock managers can conduct clinical surveillance for these premises. Producers and stock managers should be provided with clear information on signs of LSD. They should be advised to inspect all groups of animals on the property – on declaration of the outbreak and regularly thereafter. Inspection would ideally occur twice weekly, but the frequency will be based on risk assessment, taking into consideration expected vector dispersal (including the potential for long-distance dispersal events), production systems and resource availability. Producers and stock managers should be given a standard reporting form to capture all relevant information and should be advised of triggers for reporting suspicion to the local control centre. Surveillance activities and resource allocation are a jurisdictional decision.

This surveillance should be maintained until the declared area in which the premises is located is resolved. Periodic field visits by surveillance teams to clinically inspect stock should be considered, subject to resource availability and risk assessment.

Where required, laboratory samples may be taken to support such investigations.

7.1.7 Restocking of infected premises, dangerous contact premises and vaccinated at-risk premises

Following destruction, disposal and decontamination on IPs, DCPs and vaccinated ARPs, the waiting period before restocking will be long. Decisions on the length of this period will take into consideration season, climatic conditions and the infection status of the area. A minimum waiting period of 6 months is recommended, but this may be substantially extended in wet or cooler conditions, or if infection is still present or suspected in the area.

7.2 Proof of freedom

Providing confidence that LSD virus is no longer circulating in Australia will be important to satisfy trading partners and regain access to international markets, and to underpin import controls to prevent reintroduction of the virus.

Although Chapter 11.9 of the World Organisation for Animal Health (WOAH) Terrestrial Code provides guidelines for recovering LSD-free status, acceptance of LSD-free status following an outbreak will have to be negotiated with individual trading partners and may take considerably longer than the minimum periods prescribed in the Terrestrial Code.

To support proof of freedom, a comprehensive surveillance program will be required to provide confidence that there are no seropositive animals remaining in the Australian herd and that there is no longer any virus circulation. As the persistence of antibodies post-infection and post-vaccination is not well understood, culling of vaccinated animals is likely to be required to avoid a prolonged proof-of-freedom phase; identification of vaccinated animals is therefore critically important. This program will build on the surveillance, tracing and diagnostic testing done during the control phase. It will include clinical, serological, molecular and virological surveillance in cattle and buffalo, and surveillance in relevant vector populations. The surveillance program will be designed to take into consideration the characteristics of the outbreak, and the general and specific considerations for surveillance for LSD outlined in Section 7.1.

Appendix 1

LUMPY SKIN DISEASE FACT SHEET

Disease and cause

Lumpy skin disease (LSD) is an acute, highly infectious disease of cattle.

The disease is caused by a virus of the family *Poxviridae* that is similar to the viruses that cause sheep pox and goat pox. The virus is mostly transmitted by biting insects.

Species affected

LSD affects ruminants, primarily cattle, although a few cases have been seen in water buffalo.

LSD is not a zoonotic disease (ie it does not affect humans).

Distribution

The disease has never been recorded in Australia.

LSD is generally considered endemic in sub-Saharan Africa, parts of the Middle East and Turkey. Since 2015, it has spread to the Balkan countries, the Caucasus and the Russian Federation.

Since 2019, outbreaks have been reported in south and east Asia, including Bangladesh, India and China. More recently, outbreaks have been reported in a territory of Taiwan and in Nepal, Indonesia and Singapore (possibly from the movement of flies or mosquitoes from neighbouring countries).

In 2022, the disease was reported in northern Indonesia.

Potential pathways for introduction into Australia

LSD may be spread by the movement of infected animals. However, it is unlikely that the disease will enter Australia through importation of live cattle or their germplasm, as cattle and genetic material are not imported from LSD-endemic countries.

The most likely route for the introduction of LSD into Australia is following establishment of the disease in neighbouring countries to the north, with the virus then carried by vectors into northern Australia.

Currently, the potential for introduction of LSD via insects entering Australia from countries in the region is high – especially since the disease has been detected in Indonesia. There is an increased risk of infected insects translocating across the seas north of Australia, or entering through international ports.

Key signs

Firm, raised nodules up to 50 mm in diameter develop on the skin within 1–2 days, especially around the head, neck, genitals and limbs. The centres of the nodules die, after which the resultant scabs ('sitfasts') may fall out, leaving large, ulcerous holes that are subject to secondary bacterial infections.

Nodules also develop in the nose, throat and gut. Oedema of the limbs, brisket and genitals also occurs.

Susceptible cattle of all ages can develop serious clinical disease if infected with LSD virus. Therefore, introduction of LSD into Australia could result in high mortalities and rapid spread of the disease.

Spread

LSD virus is present in eye, nose and mouth secretions, and in the semen, milk and blood of infected animals. Under Australian conditions, mechanical transmission of the virus by biting insects may be important. Non-biting insects have also been implicated in the transfer of infected body fluids.

Many different types of biting insects may be involved in transmission, but particularly mosquitoes and flies. Insect vectors on ships and aircraft may spread the disease, and the virus can be readily transported on clothing and equipment.

Spread by direct contact between cattle does not occur easily, unless animals share a water trough.

Persistence of the virus

LSD virus is very resistant to inactivation in the environment. It has been isolated from shed skin tissue up to 4 months after infection, and may be found in blood for 16–28 days, saliva and nasal discharges for up to 18 days, and semen for 42 days.

Impacts for Australia

LSD is one of the biggest biosecurity threats to Australia's cattle (and buffalo) industries; the effect on products would be significant. Trading partners would be expected to introduce emergency measures until an outbreak situation became stable, significantly disrupting exports of meat, dairy and other bovine-derived animal products. The impacts may include closure of markets, increased testing requirements, increased requirements for pre-export quarantine, vaccination requirements, and reductions in price premiums for Australian commodities.

Appendix 2

PERMIT CONDITIONS

1	No evidence of clinical disease in cattle or buffalo on the premises on the day of movement or in the previous 28 days.
2	Physical identification of animals (ie National Livestock Identification System – NLIS), with appropriate accompanying movement documentation (ie National Vendor Declaration – NVD, waybill).
3	Livestock, meat/meat products, carcass or milk transport vehicles and associated equipment are cleaned and treated with insecticide before transport to prevent adult competent vectors travelling.
4	Animals/carcases/carcasses are treated before transport to control vectors.
5	Agreed transport route and destination that includes only pre-approved stops (no spelling or rest stops).
6	The permit accompanies the livestock or vehicle during movement, and the person responsible retains a copy of the permit, consistent with the legal requirements of the jurisdiction.
7	Animals are not permitted to move again for 28 days (ie they must remain resident at the destination for a minimum of 28 days).
9	For animals originating in the restricted area (RA), movements to slaughter in the control area (CA) are allowed only if there is no suitable abattoir within the RA.
10	No evidence of clinical disease in animals being moved.
11	Animals are treated to control vectors, and withholding period or export slaughter interval is completed before slaughter.
12	Movement directly to abattoir (either a dangerous contact processing facility (DCPF) or an approved processing facility (APF)) with no stopping en route.
13	Appropriate biosecurity at the DCPF or APF, including quality assurance systems; record keeping; compliance with traceability requirements; controlled entry of people, equipment and vehicles; pest and vector control, addressing transmission pathways for LSD virus; and training to recognise LSD and report suspicion or confirmation of disease.
14	Onward movement of animals is not permitted.
15	Animals are slaughtered within 24 hours of arrival at the abattoir (DCPF or APF).
16	Only if the RA contains the only appropriate abattoir.
17	Animals are slaughtered within 48 hours.
18	Animals were born on the property or resident on the property for the consecutive 28 days immediately before movement.
19	Any animals that develop any clinical signs following movement are immediately reported to a government veterinary officer.
21	Heat treatment/pasteurisation (72 °C for 15 seconds) or approved disposal process for the commodity or product to inactivate the virus.

22	Milk is not for bovine consumption.
23	The semen is collected a minimum of 56 days ²⁰ before identification of the index case, and a risk assessment is conducted.
24	Carcases/carcasses are protected from contact with vectors (eg treated for vectors; disposed of within hours, such as by burial).
25	Carcases/carcasses for further processing are treated to inactivate virus.
26	Consignment is processed in a single processing run.
27	Facility is cleaned, decontaminated and disinfected following processing of the consignment.
28	Milk products remain contained in transport vehicle.
29	Frozen semen and embryos are delivered to predetermined low-risk location, such as the edge of the property.
30	The valuation of animals on a premises is the valuation at the time of first declaration of premises status, and is not increased with subsequent improvements (eg insemination or implantation of embryo).
31	No further stops en route before arrival at the approved destination.

²⁰The appropriateness of the 56-day period will need to be considered based on epidemiological considerations (eg site of collection, whether the site is outside the declared areas).

Appendix 3

VACCINATION

Currently, both homologous vaccines (live, attenuated lumpy skin disease (LSD) virus) and heterologous vaccines (live, attenuated sheep pox virus or goat pox virus) are available for LSD. The homologous vaccines provide better protection against LSD virus than the heterologous types (Tuppurainen et al 2021). More information on vaccination can be found in Section 4.2.8.

Several live, attenuated homologous vaccines against LSD virus are available, containing a Neethling LSD virus strain (eg Lumpivax™ – Kenyan Veterinary Vaccines Production Institute; Herbivac® LS – Deltamune, South Africa; lumpy skin disease vaccine – OBP, South Africa) or the SIS Neethling-type LSD virus strain (eg Lumpyvax® – MSD Animal Health, South Africa; Bovivax LSD – MCI Sante Animale, Morocco). These vaccines are generally administered annually.

The degree of attenuation of these live vaccines requires consideration:

- Side effects from the vaccine have been reported, including nodular skin disease, fever, viraemia and death, as well as a significant reduction in milk production (Ben-Gera et al 2015, ESFA 2017, Bedeković et al 2018, Katsoulos et al 2018).
- Vaccine viral particles have been detected in milk, skin nodules, blood and nasal swabs, and virus has been isolated on cell culture up to 21 days post-vaccination (Bedeković et al 2018).

Heterologous vaccines are not recommended for use in a country free from sheep pox and goat pox for the following reasons:

- Efficacy is variable, and recent evidence shows that they confer only partial immunity to LSD virus (Ayelet et al 2013, Tageldin et al 2014, Tuppurainen et al 2014, Gari et al 2015, Abutarbush et al 2016). However, goat pox vaccines are likely to afford better protection against LSD virus than sheep pox vaccines (Gari et al 2015, Zhugunissof et al 2020).
- The Kenyan sheep pox and goat pox strain vaccines (KSGP 0-240 and 0-180) have recently been found to be LSD virus strains (ie these vaccines are homologous), and therefore their use is not recommended until trials in cattle are undertaken to determine true attenuation (Tulman et al 2002, Lamien et al 2011b, Tuppurainen et al 2014).
- There is a risk of clinical disease in vaccinated cattle due to low-level attenuation. The attenuation and quality of the available live sheep pox and goat pox strain vaccines may be associated with a risk of reversion, which could introduce sheep pox or goat pox into Australia during the response to LSD. This has not historically been an issue because countries with LSD have also had sheep pox and goat pox; however, it is a strong consideration for countries free from sheep pox and goat pox.

An inactivated vaccine has recently been developed. Under experimental conditions, it provides good protection, but requires multiple doses and 6-monthly boosters. Inactivated virus vaccines would be safer than live, attenuated vaccines in terms of negating the risk of reversion of vaccine virus in naive populations. However, there are potential challenges with increased time and cost for a program – multiple doses and booster doses may be required to produce sufficient immunity (Tuppurainen et al 2021).

DIVA-capable (differentiating infected from vaccinated animals) vaccines are not commercially available but are in development (Tuppurainen & Oura 2012, De Vleeschauwer et al 2017, Hamdi et al 2020). Likewise, no specific DIVA test is available.

Appendix 4

CONTROL OVERSEAS

Since 2015, lumpy skin disease (LSD) has spread throughout the Balkans (Europe). The application of stamping out and then standard ring vaccination strategies did not appear to halt the progression of the disease. Initial recommendations from the European Food Safety Authority (EFSA) in 2015 considered the 'rapid detection and prompt culling of infected herds' as effective measures in limiting spread and impact. Adjunct measures included a protection zone of 3 km, a surveillance zone of 10 km and a restricted zone of 20 km (minimum); if vaccination was required, it should be used in the restricted zone (20 km). However, LSD propagated through Greece and into Bulgaria.

The 2016 EFSA recommendations changed to pre-emptive regional vaccination against LSD, to minimise the number of outbreaks. Vaccinating entire regions and countries well in advance of disease incursion brought the overall situation under control. This assertion is based on the distribution of outbreaks in the Balkans with respect to the level of vaccination coverage. In regions with sufficient pre-emptive vaccination coverage (eg northern Bulgaria, northern Serbia, Montenegro), the disease slowed, and progression halted. In the west and southwest Balkans, where vaccination coverage was insufficient and not far enough ahead of the disease, LSD outbreaks continued to occur, including among vaccinated herds.

EFSA produced a time-lapse video in 2018 demonstrating the progression of outbreaks through the Balkans with respect to vaccination coverage (EFSA 2017).

Other challenges encountered in the European response include:

- vaccine failure (eg outbreaks in herds vaccinated only a week or two before)
- significant geographical jumps of LSD (eg initial outbreaks in Greece made jumps of 80–100 km; early cases in Bulgaria were 80 km or more from the border with Turkey and Greece); it is not known whether these were due to movements of vectors, live animals or commodities
- the presence of many small, unconsolidated or backyard cattle herds in association with extensive or hilly production areas; for example, 70% of the outbreaks in Bulgaria were on farms with less than 10 cattle.

Animals may miss out on vaccination or routine clinical observation as a result of the remoteness and/or inaccessibility of their location, difficulties in mustering and/or lack of infrastructure.

LSD was first noted in Turkey in 2013. Controls included heterologous vaccination in response to outbreaks. In 2014, Turkey observed that transmission of LSD virus was faster than its vaccination program and opted to expand vaccination to any areas neighbouring outbreak regions. This was expanded in 2015 to include all provinces in the country. Animal movement controls have been progressively strengthened over time to deal with unregulated movements; it was recognised that asymptomatic animals (vaccinated or unvaccinated) have been linked to spread. LSD has affected most of Turkey, which can be considered endemic for the disease at present; controls are ongoing.

Greece, in response to outbreaks in Turkey close to the Greek border, set up an enhanced safeguard zone 10 km from the border. In this zone, enhanced clinical surveillance was performed by veterinarians, and authorisation was required to move cattle. When the first outbreaks began at the end of 2015, Greek authorities were limited to stamping out because pre-emptive vaccination and importation of vaccine were not legally permitted. With the eventual importation of vaccine, a traditional ring vaccination and surveillance method was initially applied to regional units where disease had been detected. However, in 2016, with ongoing spread of disease, the decision was made to apply blanket, preventive vaccination to the entire mainland and then the Greek isles. With the

exception of the southwest region of Greece, by 2018, most of the mainland had suffered outbreaks, including sporadic cases in vaccinated populations (usually linked to naive animals but demonstrating continued viral circulation).

The Bulgarian response to LSD in 2016 involved total stamping out, movement controls, vector controls and vaccination of the entire country. Vaccination was initially conducted using a 20 km ring strategy, but the competent authority opted to expand this to blanket vaccination on observing the ongoing progression of LSD throughout the Balkans. Vaccination commenced in naive regions well in advance (~100 km) of outbreaks in neighbouring regions, with the result that LSD propagation was limited or not detected in these regions.

The former Yugoslav Republic of Macedonia (FYROM) was affected by LSD in April 2016. Stamping out was initially used to attempt to control the disease, but the strategy soon shifted to vaccination of infected regions and finally blanket vaccination of the entire country. However, although the number of outbreaks decreased significantly in response to vaccination of 100% of the national herd, outbreaks were recorded across the entire country between April 2016 and December 2016 (the area of the FYROM is approximately 100 km by 120 km). A significant number of outbreaks were noted in animals post-vaccination. The FYROM concluded that an incubation period of 28 days combined with a 28-day²¹ period post-vaccination for immunity to peak should be used for planning purposes. Outbreaks were noted in 2017 in vaccinated animals, and the FYROM concluded that LSD virus was still circulating in the country.

Preventive vaccination was employed by Croatia (2016) in response to the progression of LSD through the Balkans. Annual vaccination of susceptible animals is conducted. Ongoing vaccination is performed for risk animals (eg newborn calves from unvaccinated dams, unvaccinated animals imported into Croatia). Surveillance for viral presence is performed using quantitative PCR. Surveillance is complicated by the lack of a DIVA-capable (differentiating infected from vaccinated animals) vaccine, in addition to vaccine virus shedding in various cattle secretions (Bedečković et al 2018). Croatia did not report any outbreaks in 2016 or 2017.

A strategy for return to LSD country freedom in the Balkans has not commenced but is expected to be challenging, given the evidence of viral circulation in vaccinated populations.

Efforts to control LSD in Asia via vaccination campaigns are ongoing.

Israel has suffered several outbreaks during the past few decades and has responded differently each time. The 1989 outbreak was reportedly eradicated by culling all cows in the region and vaccinating with a heterologous vaccine within 10 km of the outbreak. However, the 2006 and 2007 outbreaks led to ongoing vaccination and other measures in risk regions to prevent recrudescence. In 2012, another outbreak occurred and spread across the northern half of the country; it was not controlled until August 2013. Use of both heterologous and homologous vaccines was studied during this outbreak; one study demonstrated that the homologous (Neethling) vaccine was significantly more effective. The outbreak was eventually controlled (without culling) by vaccination of approximately 80% of the country's cattle. Relevant points not already covered include the following:

- Transport of infected animals caused disease spread (100 km).
- Transfer of diseased carcasses seems to have caused disease spread (40 km).
- Some outbreaks may have been caused by long-range dispersal of infected vectors from other countries (eg Klausner et al 2017).

²¹ The exact period for peak immunity is still debated, some authors using 21 days or other values; it will depend on the vaccine used, among other considerations.

The approach currently favoured by Israel's competent authority is modified stamping out in combination with homologous vaccine coverage, as allowed by available resources. This is not sufficient if using a heterologous vaccine.

Vector controls (eg dipping, repellent spray) have been applied at a local herd level as adjunct measures. Larger-scale vector control (eg aerial spraying) has not typically been employed by countries. Throughout overseas responses, a link has been noted between climatic conditions favourable to vector propagation and outbreaks or renewed spread of LSD. Favourable conditions include proximity of holdings to rivers and water courses (FAO 2017). Import restrictions on live bovines and certain bovine commodities have formed a part of control responses for both infected and naive countries.

This analysis is not comprehensive. Further information and case reports are available from the Balkan countries, including Albania, Montenegro, Serbia and Kosovo (FAO 2017). Several overarching lessons can be drawn:

- Control of LSD invariably involves vaccination, and movement restriction on live animals and commodities (including infected carcasses).
- Delays in vaccine procurement and administration have contributed to significant disease spread through countries.
- Movement restrictions should apply even to vaccinated or asymptomatic animals from transmission risk zones.
- Vaccination needs to be performed aggressively, pre-emptively and well in advance of disease progression to be effective in preventing spread into new regions. Reactive, local-zone ring vaccination strategies have repeatedly failed. Vaccination coverage should involve every susceptible herd in a risk region (because efficacy of individual vaccinations may vary from 60% to 90%). Bulgaria assessed the coverage required as a minimum of 85%. Turkey assessed the required coverage as 80–90%. EFSA in 2016 found that, with 95% of farms vaccinated, 75% of the vaccinated animals are effectively protected. Live, attenuated, homologous vaccines are the most effective for disease control.
- One of the most commonly reported reasons for vaccine failure is insufficient time between administration of the vaccine and natural challenge by the virus.
- Continuous, or somewhat contiguous, propagation of outbreaks is expected until the disease encounters a barrier of vaccinated animals (or temporary somnolence due to climatic conditions such as winter that are generally not conducive to vector spread).
- Larger leaps of disease may occur. They may be due to movement of infected animals, long-range vector dispersal and commodity movements.
- Viral circulation may be ongoing in vaccinated populations; naive animals within large, vaccinated units have been subject to infection.
- A return to country freedom may not be possible in short timeframes.
- During the 2019 Israel outbreak, bluetongue virus contamination in a vaccine batch delayed the vaccination program for a number of days (EFSA 2020). Contamination of a live, attenuated vaccine with other viruses, such as bovine viral diarrhoea virus, is a considerable risk that may reflect issues with the quality and control of production inputs and the virus attenuation process for this type of vaccine. Reversion of attenuated vaccines to virulence and potential recombination with field strains are noted risks (Biswas et al 2020, Lamien 2020, Sprygin et al 2020).

Appendix 5

FLOWCHART OF AN EMERGENCY ANIMAL DISEASE RESPONSE

An overview of Australia's emergency animal disease (EAD) response structures and governance is provided in the *Control centres management manual* and summarised below to highlight the role of AUSVETPLAN.

The chief veterinary officer (CVO) in the state or territory in which the incident occurs is responsible for instituting animal disease control action within that state or territory. The strategies to control the disease, including the budget for the proposed response actions, are documented in an Emergency Animal Disease Response Plan (EADRP). Where the EAD is suspected or confirmed to be a zoonosis, the EADRP is developed in collaboration with the chief health officer (CHO) of the affected state or territory.

For a response to be cost shared under the Emergency Animal Disease Response Agreement (EADRA), EADRP's must be consistent with, and guided by, any relevant AUSVETPLAN manuals. However, the Consultative Committee on Emergency Animal Diseases (CCEAD) can, if it thinks reasonable, recommend to the National Management Group (NMG) an EADRP even if part of the response plan deviates from AUSVETPLAN (eg due to new knowledge). For responses that are not cost shared under the EADRA, the development of response plans consistent with AUSVETPLAN is voluntary and is usual practice. AUSVETPLAN therefore serves as the authoritative reference on policies and guidelines for the management of EADs in Australia.

The CVO is responsible for recommending the EADRP to the CCEAD. Unaffected jurisdictions may also need to develop response plans to address jurisdictional activities that may be eligible for cost sharing.

The CCEAD provides technical review of the EADRP and may recommend it to the NMG convened for the incident. The NMG decides on whether cost sharing will be invoked (following advice from the CCEAD) and whether to approve the EADRP.

CVOs and, where relevant, CHOs implement disease control measures as agreed in the EADRP and in accordance with relevant legislation. They make ongoing decisions on follow-up disease control measures – including termination of the response – in consultation with the CCEAD and, where applicable, the NMG, based on epidemiological information about the outbreak.

It is also important to note that the overall response policy contained in the various AUSVETPLAN manuals is used in informing responses to new and emerging diseases.

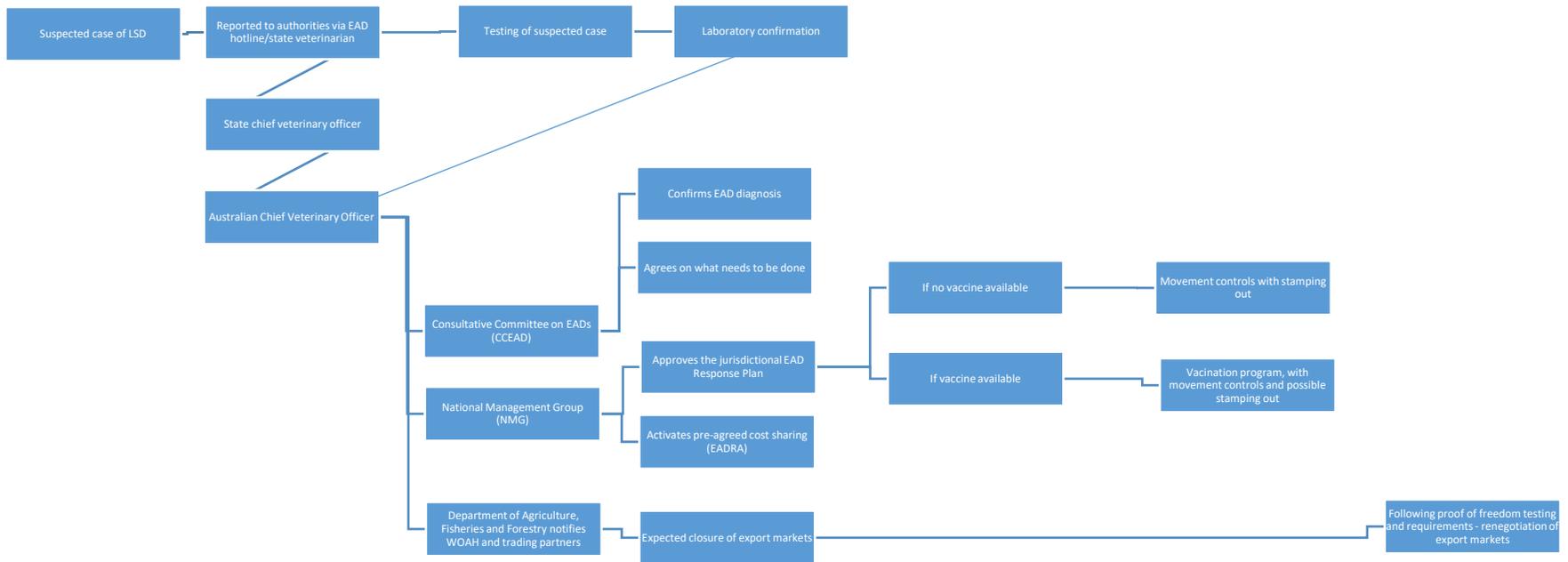


Figure A5.1 Summary of steps in the reporting of an emergency animal disease

Glossary

Disease-specific terms

Abomasum	Fourth stomach of ruminants; also called the 'true' or 'rennet' stomach or 'reed'. Leads into the small intestine.
Hyperaemia	An increase in the amount of blood in a tissue or organ due to dilation of the supplying arteries or constriction of the veins.
Immunodiffusion test	A serological test to identify antigens or antibodies by precipitation of antibody–antigen complexes after diffusion through agar gel.
Indirect immunofluorescence	A technique in which the presence of antigen or antibody in a sample can be detected by binding of a specific antibody bound to a fluorescent marker molecule, which is visible under a fluorescence microscope.
Mucopurulent	Consisting of mucus and pus.
Regional blanket vaccination	Vaccination applied to large numbers of animals within regions where disease spread is suspected to be high.
Serosurveillance	Surveillance of an animal population by testing serum samples for the presence of antibodies to disease agents.
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Zebu (cattle)	Bovine animals (<i>Bos indicus</i>) with a characteristic large hump over the shoulders. Widely distributed in India, China, eastern Africa, etc. and used for cross-breeding in Australia.

Standard AUSVETPLAN terms

Term	Definition
Animal byproducts	Products of animal origin that are not for consumption but are destined for industrial use (eg hides and skins, fur, wool, hair, feathers, hoofs, bones, fertiliser).
Animal Health Committee	A committee whose members are the chief veterinary officers of the Commonwealth, states and territories, along with representatives from the CSIRO Australian Centre for Disease Preparedness (CSIRO-ACDP) and the Australian Government Department of Agriculture, Fisheries and Forestry. There are also observers from Animal Health Australia, Wildlife Health Australia, and the New Zealand Ministry for Primary Industries. The committee provides advice to the National Biosecurity Committee on animal health matters, focusing on technical issues and regulatory policy. <i>See also</i> National Biosecurity Committee

Term	Definition
Animal products	Meat, meat products and other products of animal origin (eg eggs, milk) for human consumption or for use in animal feedstuff.
Approved disposal site	A premises that has zero susceptible livestock and has been approved as a disposal site for animal carcasses, or potentially contaminated animal products, wastes or things.
Approved processing facility	An abattoir, knackery, milk processing plant or other such facility that maintains increased biosecurity standards. Such a facility could have animals or animal products introduced from lower-risk premises under a permit for processing to an approved standard.
At-risk premises	A premises in a restricted area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, dangerous contact premises, dangerous contact processing facility, suspect premises or trace premises.
Australian Chief Veterinary Officer	The nominated senior veterinarian in the Australian Government Department of Agriculture, Fisheries and Forestry who manages international animal health commitments and the Australian Government's response to an animal disease outbreak. <i>See also</i> Chief veterinary officer
AUSVETPLAN	<i>Australian Veterinary Emergency Plan</i> . Nationally agreed resources that guide decision making in the response to emergency animal diseases (EADs). It outlines Australia's preferred approach to responding to EADs of national significance, and supports efficient, effective and coherent responses to these diseases.
Carcase	The body of an animal slaughtered for food.
Carcass	The body of an animal that died in the field.
Chief veterinary officer (CVO)	The senior veterinarian of the animal health authority in each jurisdiction (national, state or territory) who has responsibility for animal disease control in that jurisdiction. <i>See also</i> Australian Chief Veterinary Officer
Compartmentalisation	The process of defining, implementing and maintaining one or more disease-free establishments under a common biosecurity management system in accordance with WOAH guidelines, based on applied biosecurity measures and surveillance, to facilitate disease control and/or trade.
Compensation	The sum of money paid by government to an owner for livestock or property that are destroyed for the purpose of eradication or prevention of the spread of an emergency animal disease, and livestock that have died of the emergency animal disease. <i>See also</i> Cost-sharing arrangements, Emergency Animal Disease Response Agreement
Consultative Committee on Emergency Animal Diseases (CCEAD)	The key technical coordinating body for animal health emergencies. Members are state and territory chief veterinary officers, representatives of CSIRO-ACDP and the relevant industries, and the Australian Chief Veterinary Officer as chair.
Control area (CA)	A legally declared area where the disease controls, including surveillance and movement controls, applied are of lesser intensity

Term	Definition
	than those in a restricted area (the limits of a control area and the conditions applying to it can be varied during an incident according to need).
Cost-sharing arrangements	Arrangements agreed between governments (national and state/territory) and livestock industries for sharing the costs of emergency animal disease responses. <i>See also</i> Compensation, Emergency Animal Disease Response Agreement
Dangerous contact animal	A susceptible animal that has been designated as being exposed to other infected animals or potentially infectious products following tracing and epidemiological investigation.
Dangerous contact premises (DCP)	A premises, apart from an abattoir, knackery or milk processing plant (or other such facility) that, after investigation and based on a risk assessment, is considered to contain a susceptible animal(s) not showing clinical signs, but considered highly likely to contain an infected animal(s) and/or contaminated animal products, wastes or things that present an unacceptable risk to the response if the risk is not addressed, and that therefore requires action to address the risk.
Dangerous contact processing facility (DCPF)	An abattoir, knackery, milk processing plant or other such facility that, based on a risk assessment, appears highly likely to have received infected animals, or contaminated animal products, wastes or things, and that requires action to address the risk.
Declared area	A defined tract of land that is subjected to disease control restrictions under emergency animal disease legislation. There are two types of declared areas: restricted area and control area.
Decontamination	Includes all stages of cleaning and disinfection.
Depopulation	The removal of a host population from a particular area to control or prevent the spread of disease.
Destroy (animals)	To kill animals humanely.
Disease agent	A general term for a transmissible organism or other factor that causes an infectious disease.
Disease Watch Hotline	24-hour freecall service for reporting suspected incidences of exotic diseases – 1800 675 888.
Disinfectant	A chemical used to destroy disease agents outside a living animal.
Disinfection	The application, after thorough cleansing, of procedures intended to destroy the infectious or parasitic agents of animal diseases, including zoonoses; applies to premises, vehicles and different objects that may have been directly or indirectly contaminated.
Disinsection	The destruction of insect pests, usually with a chemical agent.
Disposal	Sanitary removal of animal carcasses, animal products, materials and wastes by burial, burning or some other process so as to prevent the spread of disease.
Emergency animal disease	A disease that is (a) exotic to Australia or (b) a variant of an endemic disease or (c) a serious infectious disease of unknown or uncertain

Term	Definition
	cause or (d) a severe outbreak of a known endemic disease, and that is considered to be of national significance with serious social or trade implications. <i>See also</i> Endemic animal disease, Exotic animal disease
Emergency Animal Disease Response Agreement	Agreement between the Australian and state/territory governments and livestock industries on the management of emergency animal disease responses. Provisions include participatory decision making, risk management, cost sharing, the use of appropriately trained personnel and existing standards such as AUSVETPLAN. <i>See also</i> Compensation, Cost-sharing arrangements
Endemic animal disease	A disease affecting animals (which may include humans) that is known to occur in Australia. <i>See also</i> Emergency animal disease, Exotic animal disease
Enterprise	<i>See</i> Risk enterprise
Enzyme-linked immunosorbent assay (ELISA)	A serological test designed to detect and measure the presence of antibody or antigen in a sample. The test uses an enzyme reaction with a substrate to produce a colour change when antigen-antibody binding occurs.
Epidemiological investigation	An investigation to identify and qualify the risk factors associated with the disease. <i>See also</i> Veterinary investigation
Epidemiology	The study of disease in populations and of factors that determine its occurrence.
Exotic animal disease	A disease affecting animals (which may include humans) that does not normally occur in Australia. <i>See also</i> Emergency animal disease, Endemic animal disease
Exotic fauna/feral animals	<i>See</i> Wild animals
Fomites	Inanimate objects (eg boots, clothing, equipment, instruments, vehicles, crates, packaging) that can carry an infectious disease agent and may spread the disease through mechanical transmission.
General permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which permission may be granted without the need for direct interaction between the person moving the animal(s), commodity or thing and a government veterinarian or inspector. The permit may be completed via a webpage or in an approved place (such as a government office or commercial premises). A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> Special permit
In-contact animals	Animals that have had close contact with infected animals, such as noninfected animals in the same group as infected animals.
Incubation period	The period that elapses between the introduction of a pathogen into an animal and the first clinical signs of the disease.

Term	Definition
Index case	The first case of the disease to be diagnosed in a disease outbreak. <i>See also</i> Index property
Index property	The property on which the index case is found. <i>See also</i> Index case
Infected premises (IP)	A defined area (which may be all or part of a property) on which animals meeting the case definition are or were present, or the causative agent of the emergency animal disease is present, or there is a reasonable suspicion that either is present, and that the relevant chief veterinary officer or their delegate has declared to be an infected premises.
Local control centre (LCC)	An emergency operations centre responsible for the command and control of field operations in a defined area.
Modified stamping out	A stamping-out policy that is modified – based on risk assessment – to culling only a selected group of animals instead of all susceptible animals that are either infected or exposed to the agent of disease. This modified strategy may be implemented when the destruction of all susceptible animals is not financially or practically feasible. The term ‘modified’ is used when the stamping-out measures are not implemented in full.
Monitoring	Routine collection of data for assessing the health status of a population or the level of contamination of a site for remediation purposes. <i>See also</i> Surveillance
Movement control	Restrictions placed on the movement of animals, people and other things to prevent the spread of disease.
National Biosecurity Committee (NBC)	A committee that was formally established under the Intergovernmental Agreement on Biosecurity (IGAB). The IGAB was signed on 13 January 2012, and signatories include all states and territories except Tasmania. The committee provides advice to the Agriculture Senior Officials Committee and the Agriculture Ministers’ Forum on national biosecurity issues, and on the IGAB.
National Management Group (NMG)	A group established to approve (or not approve) the invoking of cost sharing under the Emergency Animal Disease Response Agreement. NMG members are the Secretary of the Australian Government Department of Agriculture, Fisheries and Forestry as chair, the chief executive officers of the state and territory government parties, and the president (or analogous officer) of each of the relevant industry parties.
Native wildlife	<i>See</i> Wild animals
Operational procedures	Detailed instructions for carrying out specific disease control activities, such as disposal, destruction, decontamination and valuation.
Outside area (OA)	The area of Australia outside the declared (control and restricted) areas.

Term	Definition
Owner	Person responsible for a premises (includes an agent of the owner, such as a manager or other controlling officer).
Polymerase chain reaction (PCR)	A method of amplifying and analysing DNA sequences that can be used to detect the presence of viral DNA or RNA.
Premises	A tract of land including its buildings, or a separate farm or facility that is maintained by a single set of services and personnel.
Premises of relevance (POR)	A premises in a control area that contains a live susceptible animal(s) but is not considered at the time of classification to be an infected premises, suspect premises, trace premises, dangerous contact premises or dangerous contact processing facility.
Prevalence	The proportion (or percentage) of animals in a particular population affected by a particular disease (or infection or positive antibody titre) at a given point in time.
Proof of freedom	Reaching a point following an outbreak and post-outbreak surveillance when freedom from the disease can be claimed with a reasonable level of statistical confidence.
Qualifiers	
- assessed negative	Assessed negative (AN) is a qualifier that may be applied to ARPs, PORs, SPs, TPs, DCPs or DCPFs. The qualifier may be applied following surveillance, epidemiological investigation, and/or laboratory assessment/diagnostic testing and indicates that the premises is assessed as negative at the time of classification.
- sentinels on site	Sentinels on site (SN) is a qualifier that may be applied to IPs and DCPs to indicate that sentinel animals are present on the premises as part of response activities (ie before it can be assessed as an RP).
- vaccinated	The vaccinated (VN) qualifier can be applied in a number of different ways. At its most basic level, it can be used to identify premises that contain susceptible animals that have been vaccinated against the EAD in question. However, depending on the legislation, objectives and processes within a jurisdiction, the VN qualifier may be used to track a range of criteria and parameters.
Quarantine	Legally enforceable requirement that prevents or minimises spread of pests and disease agents by controlling the movement of animals, persons or things.
Resolved premises (RP)	An infected premises, dangerous contact premises or dangerous contact processing facility that has completed the required control measures, and is subject to the procedures and restrictions appropriate to the area in which it is located.
Restricted area (RA)	A relatively small legally declared area around infected premises and dangerous contact premises that is subject to disease controls, including intense surveillance and movement controls.
Risk enterprise	A defined livestock or related enterprise that is potentially a major source of infection for many other premises. Includes intensive piggeries, feedlots, abattoirs, knackeries, saleyards, calf scales, milk factories, tanneries, skin sheds, game meat establishments, cold

Term	Definition
	stores, artificial insemination centres, veterinary laboratories and hospitals, road and rail freight depots, showgrounds, field days, weighbridges and garbage depots.
Sensitivity	The proportion of truly positive units that are correctly identified as positive by a test. <i>See also</i> Specificity
Sentinel animal	Animal of known health status that is monitored to detect the presence of a specific disease agent.
Seroconversion	The appearance in the blood serum of antibodies (as determined by a serology test) following vaccination or natural exposure to a disease agent.
Serosurveillance	Surveillance of an animal population by testing serum samples for the presence of antibodies to disease agents.
Serotype	A subgroup of microorganisms identified by the antigens carried (as determined by a serology test).
Serum neutralisation test	A serological test to detect and measure the presence of antibody in a sample. Antibody in serum is serially diluted to detect the highest dilution that neutralises a standard amount of antigen. The neutralising antibody titre is given as the reciprocal of this dilution.
Slaughter	The humane killing of an animal for meat for human consumption.
Special permit	A legal document that describes the requirements for movement of an animal (or group of animals), commodity or thing, for which the person moving the animal(s), commodity or thing must obtain prior written permission from the relevant government veterinarian or inspector. A printed version of the permit must accompany the movement. The permit may impose preconditions and/or restrictions on movements. <i>See also</i> General permit
Specificity	The proportion of truly negative units that are correctly identified as negative by a test. <i>See also</i> Sensitivity
Stamping out	The strategy of eliminating infection from premises through the destruction of animals in accordance with the particular AUSVETPLAN manual, and in a manner that permits appropriate disposal of carcasses and decontamination of the site.
State coordination centre (SCC)	The emergency operations centre that directs the disease control operations to be undertaken in a state or territory.
Surveillance	A systematic program of investigation designed to establish the presence, extent or absence of a disease, or of infection or contamination with the causative organism. It includes the examination of animals for clinical signs, antibodies or the causative organism.
Susceptible animals	Animals that can be infected with a particular disease.
Suspect animal	An animal that may have been exposed to an emergency disease such that its quarantine and intensive surveillance, but not pre-

Term	Definition
	<p>emptive slaughter, is warranted.</p> <p>or</p> <p>An animal not known to have been exposed to a disease agent but showing clinical signs requiring differential diagnosis.</p>
Suspect premises (SP)	<p>Temporary classification of a premises that contains a susceptible animal(s) not known to have been exposed to the disease agent but showing clinical signs similar to the case definition, and that therefore requires investigation(s).</p>
Swill	<p>Also known as 'prohibited pig feed', means material of mammalian origin, or any substance that has come in contact with this material, but does not include:</p> <p>(i) Milk, milk products or milk by-products either of Australian provenance or legally imported for stockfeed use into Australia.</p> <p>(ii) Material containing flesh, bones, blood, offal or mammal carcasses which is treated by an approved process.¹</p> <p>(iii) A carcass or part of a domestic pig, born and raised on the property on which the pig or pigs that are administered the part are held, that is administered for therapeutic purposes in accordance with the written instructions of a veterinary practitioner.</p> <p>(iv) Material used under an individual and defined-period permit issued by a jurisdiction for the purposes of research or baiting.</p> <p>¹ In terms of (ii), approved processes are:</p> <ol style="list-style-type: none"> 1. rendering in accordance with the 'Australian Standard for the Hygienic Rendering of Animal Products' 2. under jurisdictional permit, cooking processes subject to compliance verification that ensure that a core temperature of at least 100 °C for a minimum of 30 minutes, or equivalent, has been reached. 3. treatment of cooking oil, which has been used for cooking in Australia, in accordance with the 'National Standard for Recycling of Used Cooking Fats and Oils intended for Animal Feeds' 4. under jurisdictional permit, any other nationally agreed process approved by AHC for which an acceptable risk assessment has been undertaken and that is subject to compliance verification. <p>The national definition is a minimum standard. Some jurisdictions have additional conditions for swill feeding that pig producers in those jurisdictions must comply with, over and above the requirements of the national definition.</p>
Swill feeding	<p>Also known as 'feeding prohibited pig feed', it includes:</p> <ul style="list-style-type: none"> • feeding, or allowing or directing another person to feed, prohibited pig feed to a pig • allowing a pig to have access to prohibited pig feed

Term	Definition
	<ul style="list-style-type: none"> • the collection and storage or possession of prohibited pig feed on a premises where one or more pigs are kept • supplying to another person prohibited pig feed that the supplier knows is for feeding to any pig. <p>This definition was endorsed by the Agriculture Ministers' Council through AGMIN OOS 04/2014.</p>
Trace premises (TP)	Temporary classification of a premises that contains susceptible animal(s) that tracing indicates may have been exposed to the disease agent, or contains contaminated animal products, wastes or things, and that requires investigation(s).
Tracing	The process of locating animals, people or other items that may be implicated in the spread of disease, so that appropriate action can be taken.
Unknown status premises (UP)	A premises within a declared area where the current presence of susceptible animals and/or risk products, wastes or things is unknown.
Vaccination	Inoculation of individuals with a vaccine to provide active immunity.
Vaccine	A substance used to stimulate immunity against one or several disease-causing agents to provide protection or to reduce the effects of the disease. A vaccine is prepared from the causative agent of a disease, its products or a synthetic substitute, which is treated to act as an antigen without inducing the disease.
– adjuvanted	A vaccine in which one or several disease-causing agents are combined with an adjuvant (a substance that increases the immune response).
– attenuated	A vaccine prepared from infective or 'live' microbes that are less pathogenic but retain their ability to induce protective immunity.
– gene deleted	An attenuated or inactivated vaccine in which genes for non-essential surface glycoproteins have been removed by genetic engineering. This provides a useful immunological marker for the vaccine virus compared with the wild virus.
– inactivated	A vaccine prepared from a virus that has been inactivated ('killed') by chemical or physical treatment.
– recombinant	A vaccine produced from virus that has been genetically engineered to contain only selected genes, including those causing the immunogenic effect.
Vector	A living organism (frequently an arthropod) that transmits an infectious agent from one host to another. A <i>biological</i> vector is one in which the infectious agent must develop or multiply before becoming infective to a recipient host. A <i>mechanical</i> vector is one that transmits an infectious agent from one host to another but is not essential to the life cycle of the agent.

Term	Definition
Veterinary investigation	An investigation of the diagnosis, pathology and epidemiology of the disease. <i>See also</i> Epidemiological investigation
Viraemia	The presence of viruses in the blood.
Wild animals	
– native wildlife	Animals that are indigenous to Australia and may be susceptible to emergency animal diseases (eg bats, dingoes, marsupials).
– feral animals	Animals of domestic species that are not confined or under control (eg cats, horses, pigs).
– exotic fauna	Nondomestic animal species that are not indigenous to Australia (eg foxes).
WOAH Terrestrial Code	WOAH <i>Terrestrial animal health code</i> . Describes standards for safe international trade in animals and animal products. Revised annually and published on the internet at: https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access .
WOAH Terrestrial Manual	WOAH <i>Manual of diagnostic tests and vaccines for terrestrial animals</i> . Describes standards for laboratory diagnostic tests, and the production and control of biological products (principally vaccines). The current edition is published on the internet at: https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-manual-online-access .
Wool	Sheep wool.
Zero susceptible species premises (ZP)	A premises that does not contain any susceptible animals or risk products, wastes or things.
Zoning	The process of defining, implementing and maintaining a disease-free or infected area in accordance with WOAH guidelines, based on geopolitical and/or physical boundaries and surveillance, to facilitate disease control and/or trade.
Zoonosis	A disease of animals that can be transmitted to humans.

Abbreviations

Disease-specific abbreviations

Abbreviation	Full title
ADS	approved disposal site
DIVA	differentiating infected from vaccinated animals
EFSA	European Food Safety Authority
LSD	lumpy skin disease

Standard AUSVETPLAN abbreviations

Abbreviation	Full title
ACDP	Australian Centre for Disease Preparedness
AN	assessed negative
APF	approved processing facility
ARP	at-risk premises
AUSVETPLAN	Australian Veterinary Emergency Plan
CA	control area
CCEAD	Consultative Committee on Emergency Animal Diseases
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVO	chief veterinary officer
DCP	dangerous contact premises
DCPF	dangerous contact processing facility
EAD	emergency animal disease
EADRA	Emergency Animal Disease Response Agreement
EADRP	Emergency Animal Disease Response Plan
EDTA	ethylenediaminetetraacetic acid (anticoagulant for whole blood)
ELISA	enzyme-linked immunosorbent assay
GP	general permit
IETS	International Embryo Technology Society
IP	infected premises
LCC	local control centre

Abbreviation	Full title
NASOP	nationally agreed standard operating procedure
NMG	National Management Group
OA	outside area
PCR	polymerase chain reaction
POR	premises of relevance
RA	restricted area
RP	resolved premises
SCC	state coordination centre
SP	suspect premises
SpP	special permit
TP	trace premises
UP	unknown status premises
WOAH	World Organisation for Animal Health
ZP	zero susceptible species premises

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