Animal & Plant Health Agency

High pathogenicity avian influenza H5N8 and H5N1 outbreaks in Great Britain

United Kingdom

November 2020 to April 2021

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APHA is an Executive Agency of the Department for Environment, Food and Rural Affairs and also works on behalf of the Scottish Government, Welsh Government and Food Standards Agency to safeguard animal and plant health for the benefit of people, the environment and the economy.

Contents

Executive summary

The outbreak of high pathogenicity avian influenza virus in GB from November 2020 to March 2021 consisted of two types of virus, H5N8 (twenty infected premises) and H5N1 (two infected premises). Infection was disclosed across England, Scotland and Wales in commercial layer and broiler flocks, small-holder flocks, game flocks, captive bird collections and birds of prey – including a conservation centre and two animal rescue centres. There was no apparent spatial nor temporal clustering of infected premises.

Extensive epidemiological, tracings and genome sequencing investigations revealed no evidence of spread between any of the infected holdings, neither within the United Kingdom, nor to trading partners. The only spread between infected premises occurred on one large holding, where the three separate premises were located in close proximity and were operated as one business that shared staff and equipment across the sites.

The epidemiological, tracings and genome sequencing evidence strongly supports that all of the infected premises became infected as a result of independent, direct or indirect, introductions from wild birds, apart from the three premises that were immediately adjacent to each other, shared staff and equipment and were functionally part of the same business. A number of common risk factors for the introduction of infection were identified: bedding management, building maintenance (especially roofs), flooding events, staff and visitor biosecurity discipline, and proximity to large water bodies.

The assertions above were supported by full genome sequence data demonstrating greater than 98.7% sequence identity (including with H5N8 wild bird cases from the same period) with other H5N8 UK report case isolates detected and characterised during the autumn/winter 2020/2021 period. Genetically these viruses cluster together and cannot be distinguished. The haemagglutinin gene of the H5N8 isolates detected across GB during autumn/winter 2020/2021 is closely related to the H5N8 viruses detected across Europe in the months preceding the GB outbreak events.

Despite the high level of genetic identity, the geographical split of cases across the UK suggests that there is no direct relationship between infected premises and supports multiple independent introductions from wild birds with minimal viral divergence. This was also supported by the results of the tracing investigations, i.e. there were no epidemiological links established between the IPs

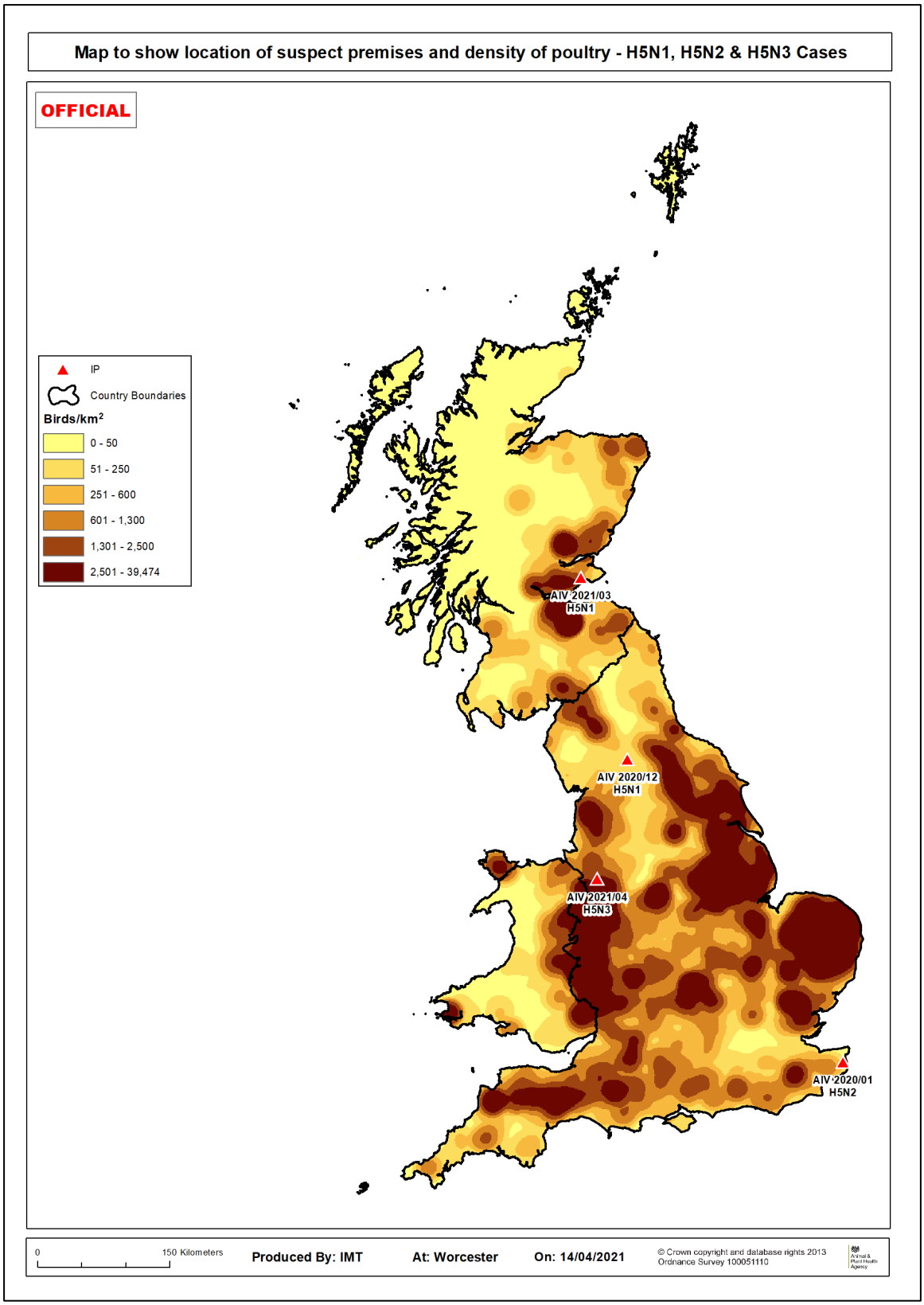
The most likely ancestral virus has been determined to be a common ancestral virus to that responsible for spread across Middle East/Central Asia Furthermore, the current isolates are distinct from those H5N8 viruses detected in the UK in 2016-

2017. Again, this assessment supports the conclusion that this virus has been recently introduced into the UK through migratory wild birds entering the UK as part of their winter migration

The unusual detection of H5N8 of avian origin in four seals and a fox that had been brought as casualties from the wild and which were being held in close proximity to infected wild swans, while all were undergoing treatment in a rehabilitation centre, indicated that cross-species transmission can occur should conditions allow. However, thorough analysis of genetic data generated from samples taken in the investigation of this isolated event, indicated that no significant adaptive genetic changes had occurred to increase the affinity for mammalian tissues, and that the risk of human infection from this virus remained low.

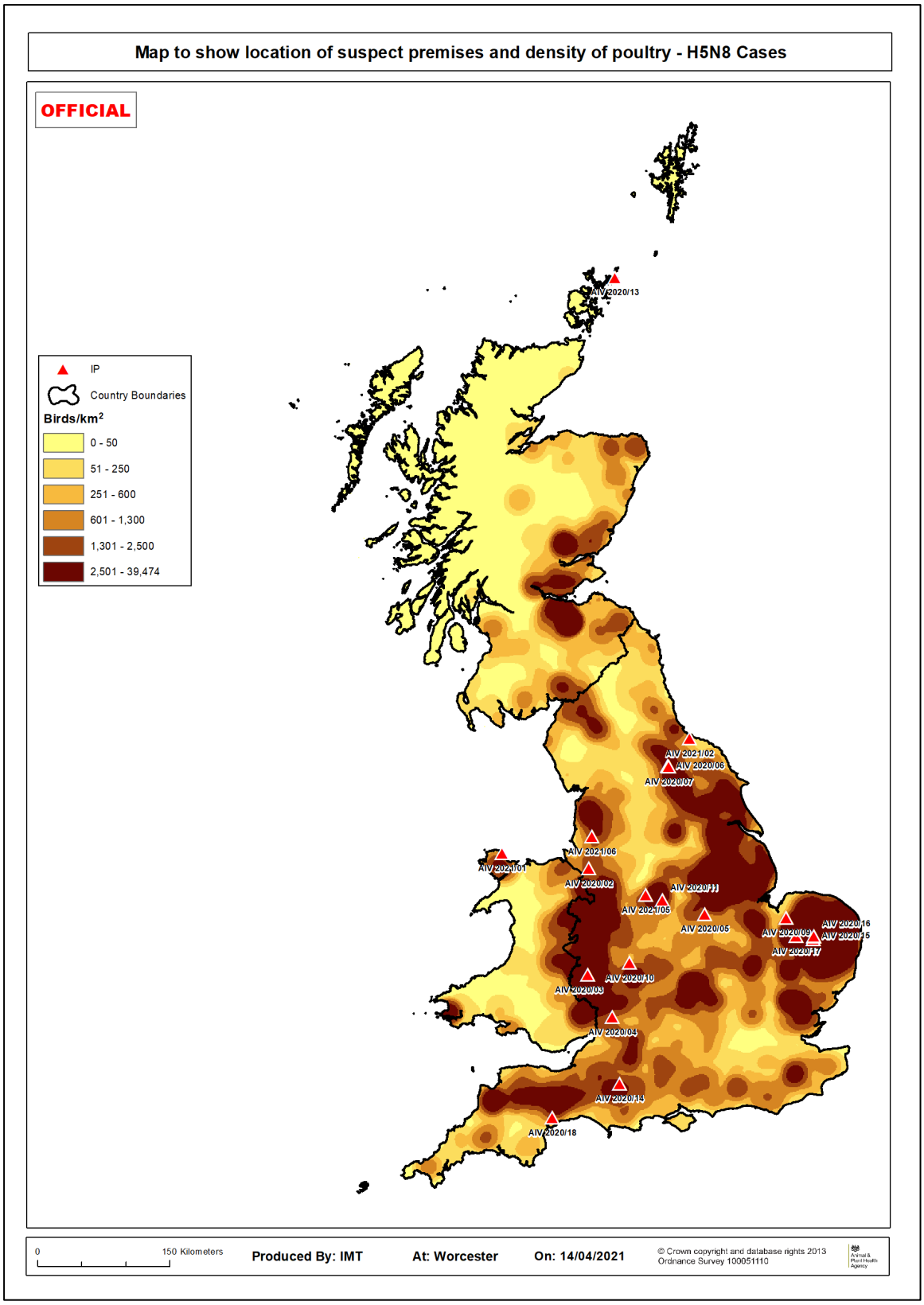
Location of the HPAI H5N1, LPAI H5N2 &H5N3 cases

Figure 1: Location of HPAI H5N1, LPAI H5N2 & H5N3 cases



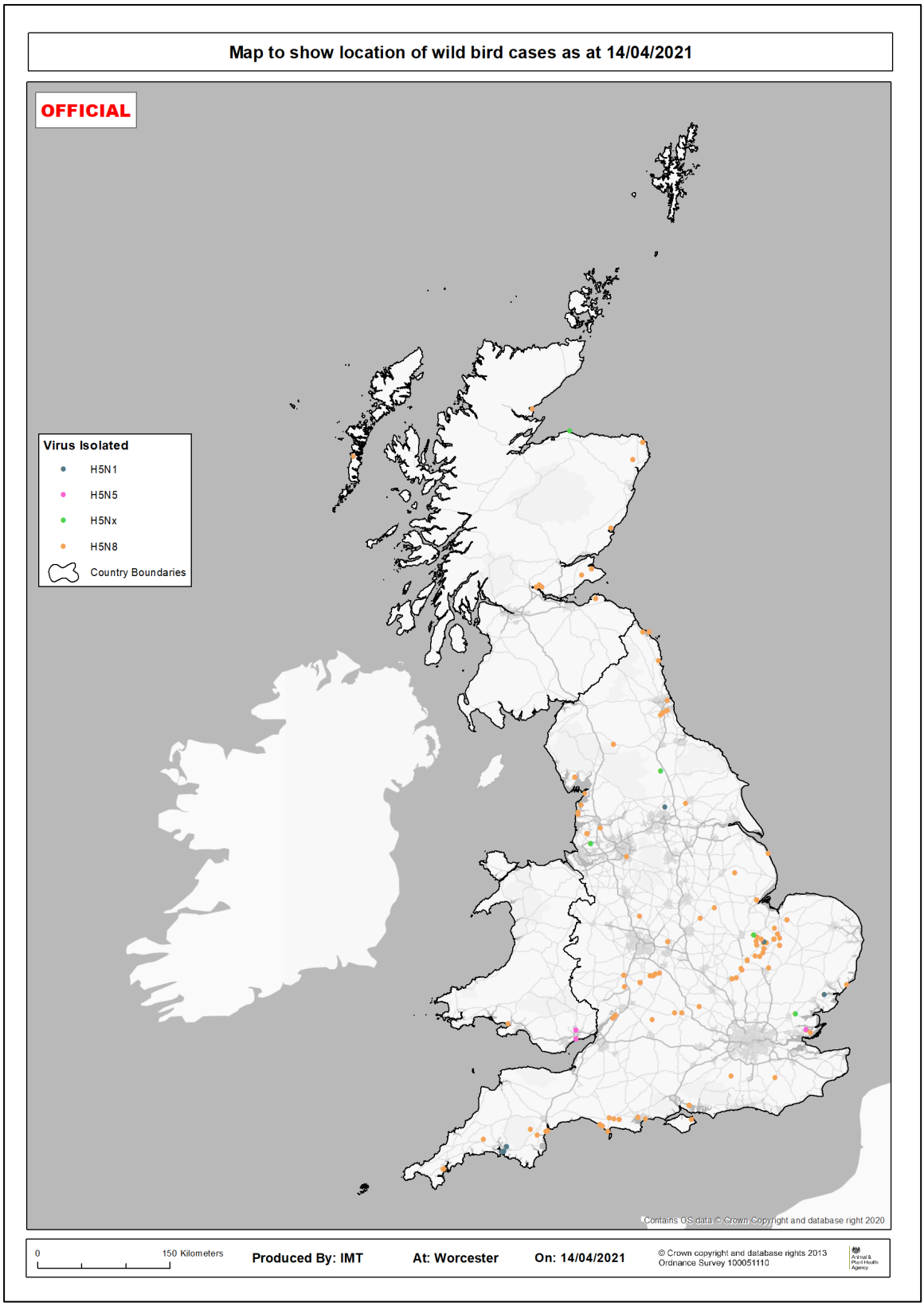
Location of the HPAI H5N8 cases

Figure 2: Location of HPAI H5N8 cases



Location of wild bird cases 2020-2021

Figure 3: Location of wild bird cases 2020-2021 season



Analysis of the virus

H5N8 virus

Description of the virus – H5N8

The haemagglutinin gene of the H5N8 isolates detected across GB during autumn/winter 2020/2021 is closely related to the H5N8 viruses detected across Europe in the months preceding the GB outbreak events. The viruses across GB and Northern Ireland all share high (>98.7%) sequence identity across all genes. Genetically these viruses cluster together and cannot be distinguished. This high level of genetic identity indicates that despite the emergence of these viruses and spread through multiple wild bird species, there has been very limited opportunity for divergent evolution.

A broader comparison of viral genetic sequence data from international outbreaks during the same time period demonstrated high sequence identity between GB isolates and wild bird subtype H5N8 clade 2.3.4.4b sequences from a common ancestral virus to that responsible for spread across Middle East/Central Asia. Although there are likely gaps in the detection of this virus in different species, the current data set makes this the most likely ancestral virus. This genetic linkage suggests that the H5N8 virus has been introduced into the UK during autumn 2020, most likely through migratory wild birds entering the UK as part of their migratory activity.

Analysis of the virus - H5N8

Avian influenza A viruses (subtype H5N8) isolated and characterised from each of the listed IPs share high levels of genetic similarity across all genes. Full genome sequence data demonstrated >98.7% sequence identity (including H5N8 wild bird cases from the same period) with other H5N8 UK report case isolates detected and characterised during the autumn/winter 2020/2021 period. Genetically these viruses cluster together and cannot be distinguished.

Despite the high level of genetic identity, the geographical split of cases across the UK suggests that there is no direct relationship between infected premises and supports multiple independent introductions from wild birds with minimal viral divergence. Of course, movement of birds prior to development of disease may have facilitated outbreaks in geographically distinct areas, but evidence to conclude whether this had occurred is not available. One exception to this is the closely linked IPs at AIV2020/06 and AIV2020/07 (Yorkshire) where genetic analyses demonstrated that the viruses characterised from the two sites were 99.9% identical at the consensus nucleotide level with no-amino acid changes from the small

number of synonymous nucleotide substitutions observed. This strongly suggests transfer by fomite between the two closely located and co-managed sites. However, separate introductions from the same wild bird population into the two sites cannot be excluded as a source of introduction. For all sites, the high number of detections of H5N8 in wild birds supports a relatively high infection pressure and environmental contamination across the UK. This supports the likelihood that each incursion was due to either direct contact with local wild birds or indirect transfer of infectious material.

The levels of genetic similarity, in excess of 98.7% at the full-genome level, between all viruses indicates that following the emergence of these viruses and spread through multiple wild bird species, there has been very limited opportunity for divergent evolution. The viral data generated to date has demonstrated limited genetic diversity which reduces the power and reliability of molecular epidemiology in providing evidence supporting virus origins and associated pathways for spread. The lack of genetic divergence may also reflect the rapidity of viral diagnosis, and reactive measures to stamp out infection that have likely prevented secondary spread between geographically-linked premises. If infection were to be allowed to spread through sustained transmission, then genetic divergence above that observed would be expected, especially in galliform hosts. This evidence is also reflected by genetic clustering of UK isolates with those reported across Europe where a high homogeneity in European wild bird H5N8 HPAI viruses has been observed. Such findings make assumptions about specific origins unreliable, other than being most probably from a 'wild bird' source, including consideration of other epidemiological factors. The virus genotype, determined by sequencing all eight viral genes, indicates the GB strains are of a single genotype and appear to cluster with European viruses detected within the same timeframe. This indicates the GB strains were a result of a consecutive introduction pathways, with incursions across Eurasia and Europe being seen prior to introduction into the UK at the beginning of November.

The GB viruses were assessed for zoonotic potential using previously applied genetic analyses and it can be concluded that all the viruses are still essentially avian viruses, with no specific increased affinity for mammalian species including humans. The unusual detection of H5N8 of avian origin in four seals and a fox that had been brought as casualties from the wild and which were being held in close proximity to infected wild swans, while all were undergoing treatment in a rehabilitation centre, indicated that cross-species transmission can occur should conditions allow. However, again thorough analysis of genetic data generated from samples taken in the investigation of this isolated event indicated that no significant adaptive genetic changes had occurred and that the risk of human infection from this virus remained low. Reports of human infection with H5N8 in Russia are documented although again genetic evaluation of material recovered did not indicate strongly adaptive mutations.

A broader genetic comparison of sequence data from international outbreaks demonstrated high sequence identity with wild bird subtype H5N8 clade 2.3.4.4b sequences from Iraq, the Netherlands, Germany, the Russian Federation and the Republic of Kazakhstan from September-November 2020 with the most likely ancestral virus being from a common ancestral virus to that responsible for spread across Middle East/Central Asia. Again, this assessment suggests that this virus has been recently introduced into the UK through migratory wild birds entering the UK as part of their winter migration. All sequences identified during this outbreak form a single genetic group within clade 2.3.4.4b and are genetically distinct from H5N8 European wild bird isolates from early 2020 and suggests a separate introduction into Europe. Further, these isolates are distinct from those H5N8 viruses detected in the UK in 2016-2017. Either direct or indirect interaction with wild birds or infectious material excreted from wild birds is considered to be the likely source of infection.

H5N1 virus

Description of the virus H5N1

The haemagglutinin gene of the H5N1 isolates sequenced show 99.9% sequence identity between the isolates sequenced and for the HA, these isolates cluster with the H5N8 viruses detected within the same period including European isolates from the Netherlands and Italy from autumn 2020. Genetically these viruses cluster together and cannot be distinguished across the HA. Indeed, all of the segments from each of the GB H5N1 isolates form a distinct cluster with Eurasian counterparts from recent years, even though the origins of these genes appear to have diverse origins.

Across the genomes, genetic identity is in excess of 99.7% between each of the H5N1 viruses sequenced in their entirety. This data set includes a wild bird H5N1 isolated from an infected swan and demonstrates that despite the emergence of these viruses and spread through multiple wild bird species, there has been very limited opportunity for divergent evolution.

A broader comparison of viral genetic sequence data from international outbreaks during the same time-period demonstrated high sequence identity across HA with wild bird subtype H5N8 clade 2.3.4.4b sequences from the Netherlands and Italy from September-November 2020. The genetic origin of other viral segments can be defined as it is clear that reassortment of a clade 2.3.4.4b virus with Eurasian wild bird influenza A viruses has occurred resulting in the acquisition of six distinguishable gene segments. Segments predominantly cluster with the same viruses, primarily H5N1 viruses from Italy and the Netherlands. It is most likely that the H5N1 virus has been introduced into the UK during autumn 2020, most likely through migratory wild birds entering the UK as part of their migratory activity.

Analysis of the virus H5N1

The avian influenza A viruses (subtype H5N1) isolated and characterised from each of the two IPs share high levels of genetic similarity across all genes. Full genome sequence data demonstrated >99.7% sequence identity across all genes from the report cases. When extending analyses to wild bird isolates, sequence divergence was similar with increased divergence in the NS gene where a small genetic deletion in this protein from an H5N1 positive swan resulted in 98.7% sequence identity. Regardless, there is clearly high levels of sequence identity between these isolates and genetically these viruses cluster together and cannot be distinguished.

The isolates detected from infected premises are geographically split, originating in chickens in North Yorkshire (AIV2020/12) and in pheasants in Fife (AIV2021/03). Therefore, the introduction of virus is most likely to have been via independent introductions from wild birds. There have been 15 wild bird positives with H5N1 across the UK with species affected including swans, a red kite, a common buzzard and a Canadian goose. The number of detections of H5N1 in wild birds has been dwarfed by H5N8 detections in wild birds (284) and so infection pressure with H5N1 must be considered low, as must environmental contamination across the UK. However, the existence of such subtypes, despite the dominance of the H5N8 virus, demonstrates viral fitness within the H5N1 enabling co-circulation.

The levels of genetic similarity, in excess of 99% at the full-genome level between the two viruses indicates that, despite disparate detections there is limited genetic diversity which negates the ability to utilise genetics to provide evidence supporting virus origins and associated pathways for spread. The lack of secondary spread at either of the infected premises may be a factor of rapid response to outbreaks of disease with reactive measures to stamp out infection likely preventing onward spread to geographically-linked premises.

The virus genotype, determined by sequencing all eight viral genes, indicates the GB strains are of a single genotype and appear to cluster with European viruses detected within the same timeframe. This cluster is distinct from a group of H5N1 viruses recently characterised as circulating in Bangladesh during 2019. It is likely that the viruses that entered and infected birds within the UK were the result of a consecutive introduction pathway, with incursions across Eurasia and Europe being seen prior to introduction into the UK at the beginning of November.

Further genetic analysis has demonstrated that whilst the HA and MP genes cluster with the H5N8 20/2021 isolates, the remaining segments have different origins: the polymerase genes (PB2 and PA) and the nucleoprotein gene (NP) are most closely related to H5N8 viruses of Russian origin (*A/chicken/Russia_Novosibirsk_region/3-15/2020 H5N8*); the PB1 gene is most closely related to a Mongolian duck H5N3 isolate (A/duck/Mongolia/637/2019/H3N6/ 2019-09/13); the PA branches off viral sequences detected in a Russian duck (A/Moscow/4206/2010/H3N8); and the NA

cluster appears to originate from an H3N1 chicken isolate from Belgium in 2019 (A/gallus gallus/Belgium/06-09-2019 H3N1). Either direct or indirect interaction with wild birds or infectious material excreted from wild birds is considered to be the most likely source of infection. Despite these different progenitors, sequence identity is high suggesting minimal genetic divergence and stable virus genotype.

The GB viruses were assessed for zoonotic potential using previously applied genetic analyses and it can be concluded that all the viruses are avian viruses, with no specific increased affinity for mammalian species including humans. Genetic evaluation demonstrated that the H5N1 viruses were distinct from Asian H5N1 viruses historically associated with human infection.

Surveillance activities

A census to identify all premises containing poultry was undertaken in both the Protection and Surveillance Zones, in line with EU legislative requirements.

Guidance notes were sent to all holdings within the PZ to raise awareness and remind keepers of the restrictions applying in this zone.

The poultry on these premises in the PZ, together with their production and medicine records were also clinically inspected by APHA personnel (and sampled and tested where there was unlikely to be effective mixing of non-indicator species with indicator species) with no evidence of HPAI virus being identified. This surveillance was repeated prior to the merging PZ into the SZ.

Owners of premises within the SZ were sent guidance notes to raise awareness and also remind keepers of the restrictions applying in this zone.

For all HPAI IPs confirmed after 01 January 2021, enhanced surveillance was implemented within 0-10km for a period of 90 days following effective preliminary C&D on the relevant IPs.

Public health impact

Food safety

The advice of the Food Standards Agency and Food Standards Scotland is that on the basis of the current scientific evidence, avian influenzas pose a very low food safety risk for UK consumers. Properly cooked poultry and poultry products, including eggs, remain safe to eat.

H5N8 HPAI

Public health officials undertook a risk assessment following confirmation of H5N8 HPAI and concluded that the risk to the general public was very low to low – given there have been no reported cases of human infection with H5N8 HPAI in the UK or Europe, and the low probability of exposure to infected birds.

The risk to persons occupationally exposed to H5N8 HPAI (i.e. workers on the IP) was determined to be slightly higher than the general public, but still low. Officials provided antiviral prophylaxis and health surveillance to those directly involved in handling and culling the affected flock and at the identified rendering plant, and provided advice on the need for appropriate Personal Protective Equipment (PPE).

The GB viruses were assessed for zoonotic potential by the OIE and UK National Reference Laboratory, Weybridge UK, using previously applied genetic analyses and it can be concluded that all the viruses are still essentially avian viruses, with no specific increased affinity for mammalian species including humans.

The unusual detection of H5N8 of avian origin in four seals and a fox that had been brought as casualties from the wild and which were being held in close proximity to infected wild swans, while all were undergoing treatment in a rehabilitation centre, indicated that cross-species transmission can occur should conditions allow. However, again thorough analysis of genetic data generated from samples taken in the investigation of this isolated event indicated that no significant adaptive genetic changes had occurred and that the risk of human infection from this virus remained low.

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H5N1 HPAI

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The GB viruses were assessed for zoonotic potential by the OIE and UK National Reference Laboratory, Weybridge UK using previously applied genetic analyses and it can be concluded that all the viruses are avian viruses, with no specific increased affinity for mammalian species including humans.

Genetic evaluation demonstrated that the H5N1 viruses were distinct from Asian H5N1 viruses historically associated with human infection.

Remaining uncertainty

There remains some uncertainty around the risk posed by wild birds, and when and where further cases or outbreaks may occur. There is evidence of this AI strain still circulating in Europe, therefore we consider that there is an on-going risk of another outbreak occurring in poultry on individual premises, but this likelihood will reduce over the summer of 2021 and is largely dependent on the level of biosecurity on the individual premises.

Concluding remarks

Extensive epidemiological investigations did not detect the presence of infection in any further premises investigated in connection with the IPs, either by known contact (source and spread tracings), or as a result of proximity (protection and surveillance zones).

Although the epidemiological investigation concludes that the most likely route of introduction of virus onto these infected premises was direct or indirect contact with wild birds, an incursion such as these onto an individual premises remains a low likelihood event and is influenced by the effectiveness of biosecurity measures that have been implemented.

The OIE/FAO International Reference Laboratory/UK National Reference Laboratory at Weybridge has the necessary ongoing proven diagnostic capability for these strains of virus, whether low or high pathogenicity AI, and continually monitors changes in the virus.

Acknowledgements

The views expressed in this report are those of the National Emergency Epidemiology Group (NEEG). However, we would like to express our thanks to the avian virology experts within APHA, members of the APHA National Wildlife Management Centre, the Cardiff APHA Specialist Service Centre Tracings Team and the many other APHA colleagues who have assisted with this investigation.

The NEEG is comprised of staff from APHA's Veterinary, Operations and Science Directorates.

HIGH PATHOGENICITY AVIAN INFLUENZA H5N1

IP1 AIV 2020/12 (Hawes)

IP2 AIV 2021/03 (Glenrothes)

AIV 2020/12, Hawes

Description of the premises

Overview of the premises and the wider business

The infected premises was a small-holding near Richmond in North Yorkshire, with a small flock of eight sheep and a flock of twenty-two free-range laying hens. Eggs produced were used for home consumption, or occasionally given to a neighbour.

The farm includes a residential property along with the fields behind and a boarding kennel business, which was not operating at the time of the investigation. This was part of a collection of buildings that were originally one large farm, but was currently divided into a cattle and sheep farm (with no poultry) and several residential properties . There were no poultry identified on any of the properties in the immediate vicinity of the infected premises.

The last introduction to the poultry flock took place in March 2020 (a group of 16 rescue hens from one source). The most recent animal moves off were two lambs on 06/11/2020, both movements took place outside the risk period.

Description of the housing

The poultry were normally free-range, with access to a wooden shed; the shed was in relatively good condition; however, it was not completely vermin or wildlife proof. Since 07/12/2020, the flock was housed in the shed as per requirements pf the Avian Influenza Protection Zone, with access to a small run covered with chicken wire. However, three chicken escaped on 08/12/2020 into the next-door cattle farm and were retrieved on 09/12/2020.

Species and number of each present

22 chickens (all laying hens).

Description of the surrounding area

The infected premises was located in the Yorkshire Dales National Park, near the village of Thwaite, and in a valley between two rivers, in a low-density poultry area.

Following foot patrols, the premises and stock in protection (PZ) and surveillance (SZ) zones are:

Surveillance activity

PZ (0-3km)

7 premises with poultry holding between 1-20 birds

(0 premises with 50 or more birds)

SZ (3-10km)

14 premises with poultry holding between 1-18,700 birds

(6 premises with 50 or more birds)

Ornithological assessment

A desk top ornithological assessment determined that wildfowl were likely to be scarce immediately around the IP.

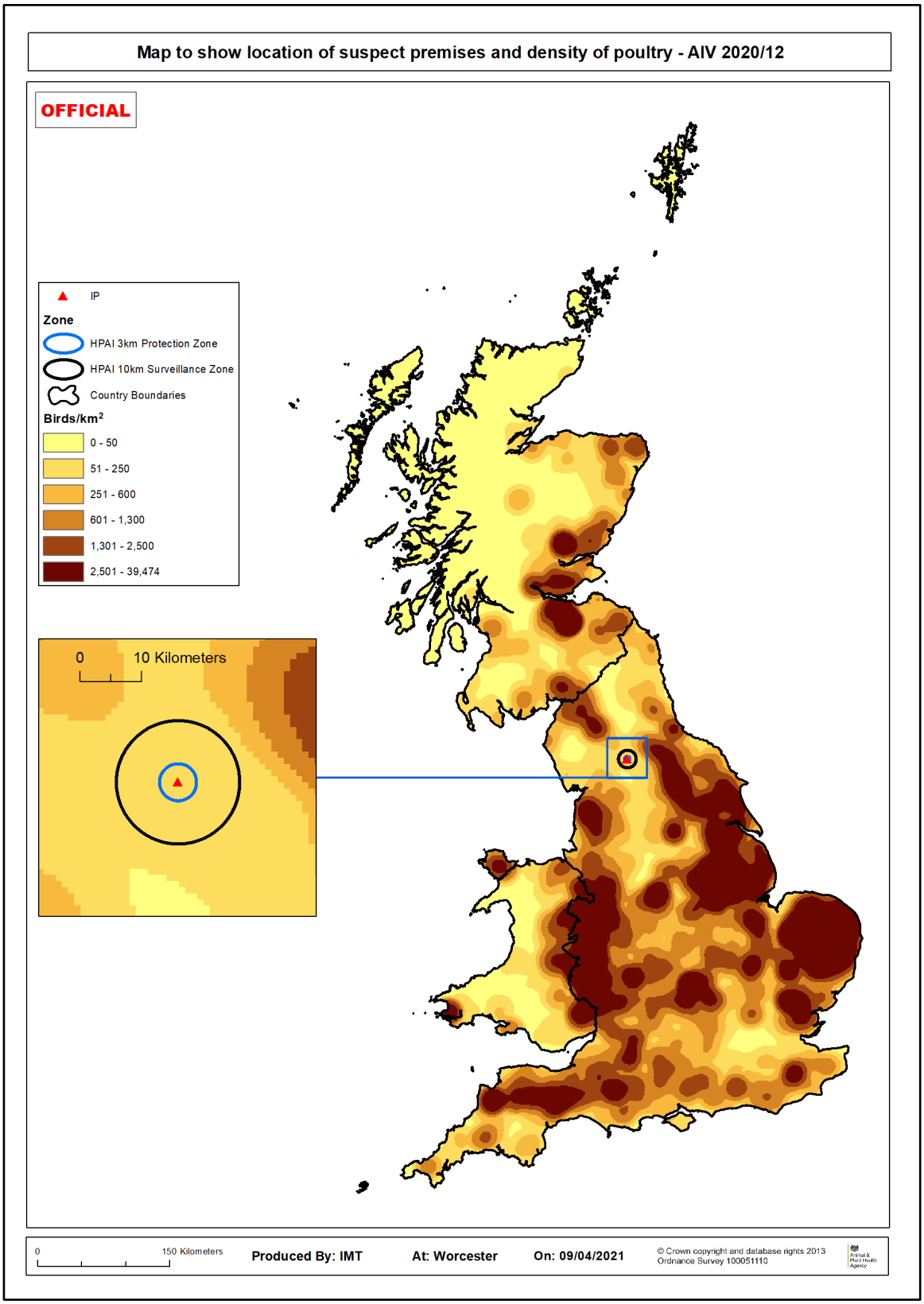
The narrow river valleys around the IP provide both forage and a movement corridor for gulls and other bridge species (corvids and starlings). Whilst gulls were unlikely to be abundant, the daily inspection of farm sites by these bold species were likely to mean that they may exploit any opportunity to forage.

The overall assessment was that wild birds represent a possible source of infection pressure.

However, the local investigation reported that the farm was in an area with a famous gun shoot (the most common species were pheasant and grouse. There were also pigeons, crows, ducks, partridges, and seagulls). This increases the likelihood of wild birds as a source of infection pressure.

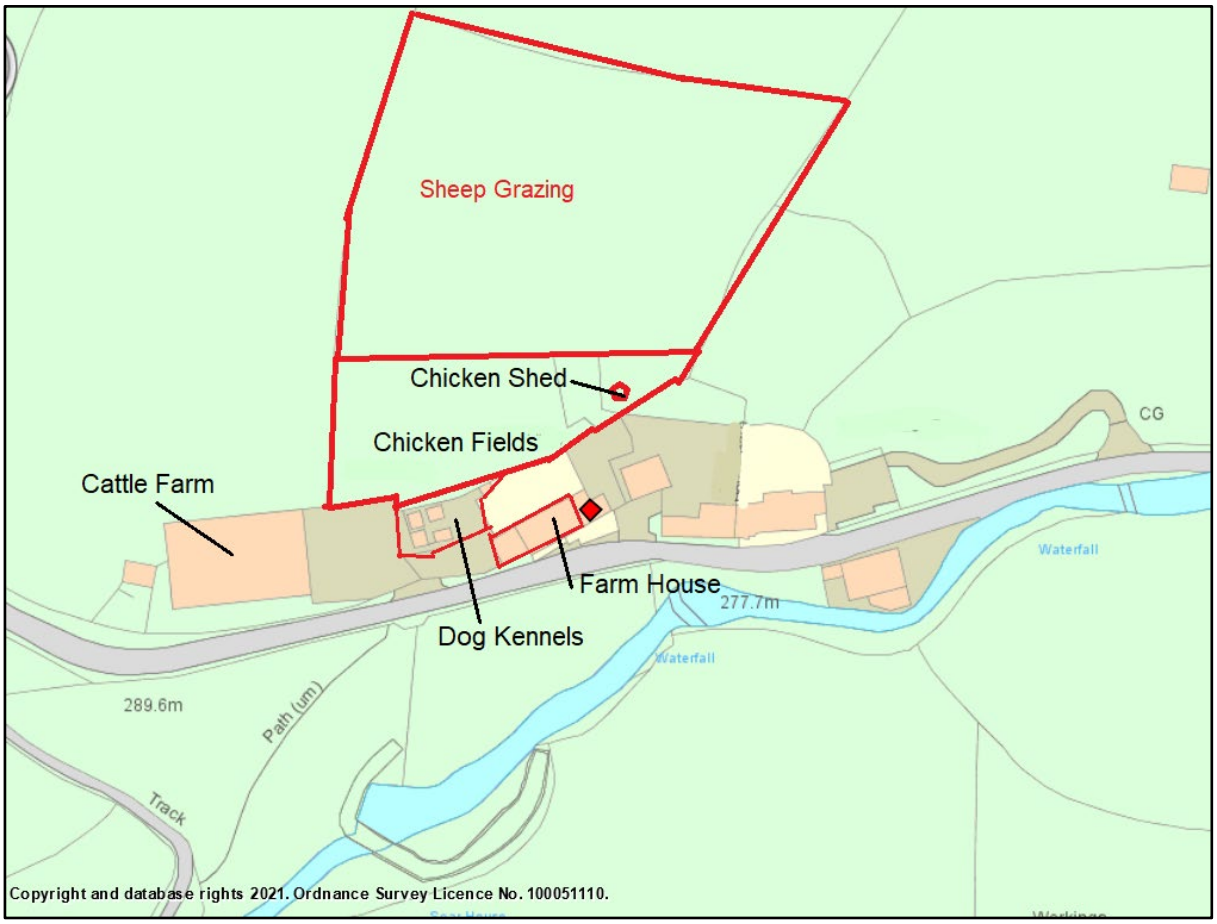
Location in GB

Figure 4: Location of AIV 2020/12



Plan of the infected premises

Figure 5: Plan of AIV 2020/12



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	21/11/2020 – 27/11/2020
Likely:	28/11/2020 – 08/12/2020
High risk:	09/12/2020 – 11/12/2020

Spread tracings window:

Precautionary:	22/11/2020 – 28/11/2020
Likely:	29/11/2020 – 09/12/2020
High risk:	10/12/2020 – 15/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 09/12/2020

Clinical Picture

13/12/2020 - One hen found dead in the morning.

14/12/2020 - Owner reported birds slightly depressed but still eating/drinking.

15/12/2020 - Owner reported 17 found dead in the morning, reporting suspicion of notifiable disease. An APHA vet investigated and was unable to rule out suspicion of avian notifiable disease.

One more died before the report case investigation started and 3 remained alive but were very sick, off food, lethargic, depressed, not moving, have swollen heads and eyes and some diarrhoea too.

A post-mortem examination (PME) was carried out on the most recently dead bird, with the following findings:

- A heavily congested carcase, particularly notable in the breast muscles.
- A full crop.
- Some evidence of intestinal necrosis.
- No evidence of ongoing pathological changes.

Samples were submitted for laboratory testing on 15/12/2020 - blood samples, cloacal / oropharyngeal (OP) swabs and carcases).

The samples were positive by PCR for influenza A, H5 and N1, but negative for N8, H7 and avian paramyxovirus.

17/12/2020 - The CVO confirmed H5N1 avian influenza.

Timeline

Table 1: Timeline for AIV 2020/12

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**21/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**22/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19		23/11/20	
Day 18		24/11/20	
Day 17		25/11/20	
Day 16		26/11/20	
Day 15		27/11/20	
Day 14		**28/11/20**	Start of likely source tracing window (-14d) .
Day 13	Day 1	**29/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	30/11/20	
Day 11	Day 3	01/12/20	
Day 10	Day 4	02/12/20	
Day 9	Day 5	03/12/20	
Day 8	Day 6	04/12/20	
Day 7	Day 7	05/12/20	
Day 6	Day 8	06/12/20	
Day 5	Day 9	07/12/20	
Day 4	Day 10	08/12/20	
Day 3	Day 11	**09/12/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 12	**10/12/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	11/12/20	
	Day 14	**12/12/20**	**Precautionary onset of first clinical signs**
	Day 15	13/12/20	First clinical signs (one dead chicken).
	Day 16	14/12/20	Clinical signs in other chickens (depression).
	Day 17	**15/12/20**	17 dead chickens. Report case initiated (DPR 2020/56) and restrictions issued. 1 dead chicken. Three remaining chickens euthanased on welfare grounds by APHA.
	Day 18	16/12/20	
	Day 19	17/12/20	H5N1 confirmed (AIV 2020/12).
	Day 20	**18/12/20**	Pathogenicity confirmed as highly pathogenic.
	Day 21	19/12/20	Preliminary C&D completed
	Day 22	**20/12/20**	Preliminary C&D effective
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possiblity of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possiblity of spread from the IP on these		

Investigations on the infected premises

Overview of biosecurity

As expected for a backyard free-range flock, biosecurity was poor. The owner wore specific footwear when working with the chickens and the sheep, and this was kept at the back door of the house.

The birds were confined to the shed and the chicken wire run on 07/12/2020 in an attempt to limit contact with wild birds. However, indirect contact with wildlife was likely and three chickens escaped on 08/12/2020 into the next-door cattle farm, before being retrieved on 09/12/2020.

Overview of tracing activities

Two main lines of tracing investigations were carried out:

- Keeper movements (mainly a daily job outside the farm – following investigation it was concluded that there was a very low risk of spread.
- Building contractors contiguous to the infected premises – it was concluded that there was very low risk of spread following investigation.

Source investigations

Hypothesis for the source

The incursion of H5N1 was likely to have occurred due to direct or indirect contact with infected wild birds, with a low level of uncertainty.

Assessment and evidence base for the likely source.

This was the first of only two H5N1 outbreaks detected in domestic poultry in GB in the 2020/2021 outbreak.

The hens were free-range, and range on land within an area where numerous wild birds were known to be present.

There was no introduction of susceptible species, or animal products within the high risk source window.

Spread investigations

Assessment of potential and likelihood of spread

After consideration of all risk pathways, it was considered that there was a very low likelihood of spread with low uncertainty.

A small number of eggs were the only animal product that has left the holding, these were all retrieved and destroyed by the farmer.

No susceptible domestic birds were identified contiguous to the infected premises.

No spread tracings were identified within the high risk spread window.

All regulatory surveillance visits were completed with no evidence of spread identified.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2021/03, Glenrothes

Description of the infected premises

Overview of the premises and the wider business

AIV 2021/03 was an independent, private business with one linked premises 12 miles away from the infected premises, where no birds were kept at the time of the disease report. The infected premises was owned by a local arable farmer and rented out to the bird keeper. The keeper and one employee were the only people to have contact with the flock on a routine basis. The keeper kept no other livestock besides the gamebirds and had no arable land.

The pheasants and guineafowl were all homebred and hatched on the premises. The partridges were imported through an agent from France, as day-old chicks (DOCs).

The business was set up to supply local farms with gamebird poults for the purpose of release into the wild for shooting. Covid-19 restrictions had impacted the business, resulting in more stock being retained than had been normal in previous years.

Birds were initially all held in two houses mixed with together with pheasants, partridges, and guineafowl, but were split into three separate houses a month prior to suspicion of disease being reported, in order to provide them with more space. Approximately 20 - 30 guineafowl were spread through the three sheds. There were no other recent management changes reported.

Birds were fed commercial pheasant pellets, with the last delivery being on 17/12/2020 and water was provided from a mains supply, through automatic nipple drinkers.

There had been no other movement of birds onto the premises since these birds were hatched in May and July 2020, and no moves off since the sale of poults in September 2020. The keeper had no contact with any other birds, and neither did his employee. No records were kept, and these birds were not laying, so no production records were available.

The keeper reported that the fields around the houses, and between the houses, were flooded a week previously following a period of heavy rain.

Description of the housing

There were six buildings on site, including five ex-broiler poultry sheds, numbered 1 to 5 (see Figure 7):

Shed 1 was retained as a store by the owner of the premises, but was not in use at the time of the disease report.
Sheds 2, 4 and 5 were occupied by gamebirds.
Shed 3 was used as store and hatchery.

Species and number of each present

Shed 2: 6000 pheasants
Shed 4: 3000 partridges
Shed 5: 5000 pheasants

Approximately 30 guineafowl spread throughout the three sheds.

Description of the surrounding area

The area where the suspect IP was located was a high-density poultry area; however, the immediate surroundings were open arable farmland.

There was a stream running through the premises between sheds 1 and 2, along the front of the poultry sheds and across the concrete farm road. Trees run alongside the stream at the front. There was a water filled ditch running from shed 5 to the adjacent shed 4, where the gas pipe was laid, but the excavations were not filled in.

The IP birds were all housed, and there were no contiguous premises with poultry, or other livestock.

The access road to the farm from the main road, continues past the farm entrance to a row of cottages. There were no known backyard flocks.

Wild pheasants and partridges were being encouraged with supplementary feeding at a nearby premises, approximately 700-800m away, at the end of the road past the farm entrance. This had increased the number of local wild pheasants and many were seen on grassy banks surrounding the IP.

The nearest known registered gamebirds (pheasants, partridge, and ducks) were within the SZ. This premise was also registered for poultry (6,000 free-range hens).

Surveillance activity

PZ (0-3km)

40 premises with poultry holding between 1-100 birds (4 premises with 50 or more birds)

(0 premises with 50 or more birds)

SZ (3-10km)

25 premises with poultry holding between 1-32,000 birds

(9 premises with 50 or more birds)

For all HPAI IPs confirmed after 01 January 2021, enhanced surveillance was implemented within 0-10km for a period of 90 days following effective preliminary C&D on the relevant IPs.

Ornithological assessment

A desktop ornithological assessment was completed. It concluded that wild birds were a possible source of infection pressure for this site, given that this coastal location was in a largely agricultural setting, although close enough to littoral, urban and some semi-natural habitats to support a diverse range of bird species. The immediate situation of the IP does not make it clear why wildfowl or waders might ordinarily choose to regularly visit the site and cause a focal infection, though flooding from a nearby stream might change this. The paucity of similar businesses nearby might increase the relative attractiveness of this site to bridging species, (e.g. gulls and corvids) likely to exploit farms for forage.

The IP sits away from any permanent waterbodies, and whilst some within 2 km probably host moderate collections of wildfowl through the winter, these features were not large enough to support substantial aggregations. However, at only slightly greater distances, several fresh waterbodies can be found that host a diverse and abundant community of water birds. Also significant in this area was the mix of fresh and coastal waters used by migratory pink-footed geese, also known to frequently graze on the pasture, or autumn-sown crops which surround the IP.

Few natural, or semi-natural, inland habitats favoured by other water bird species (e.g. waders and herons) were found close to the IP, and whilst pasture does occur close by, the use of these by unusual numbers of waders appears unlikely.

Gulls were likely to be very abundant and ubiquitous in this landscape. Substantial counts were recorded from coastal birding sites, as well as at inland fresh waterbodies nearby. It seems likely that gulls of all species will move between the coastal, urban, and agricultural components of the local landscape, as they roost, forage and loaf.

Other bridging species, such as corvids and starlings, were also likely to be common. The mixed land-use provides a multitude of food sources, combined with the woodland that permits aggregations of these species at roosts.

Location in GB

Figure 6: Location of AIV 2021/03 in Great Britain

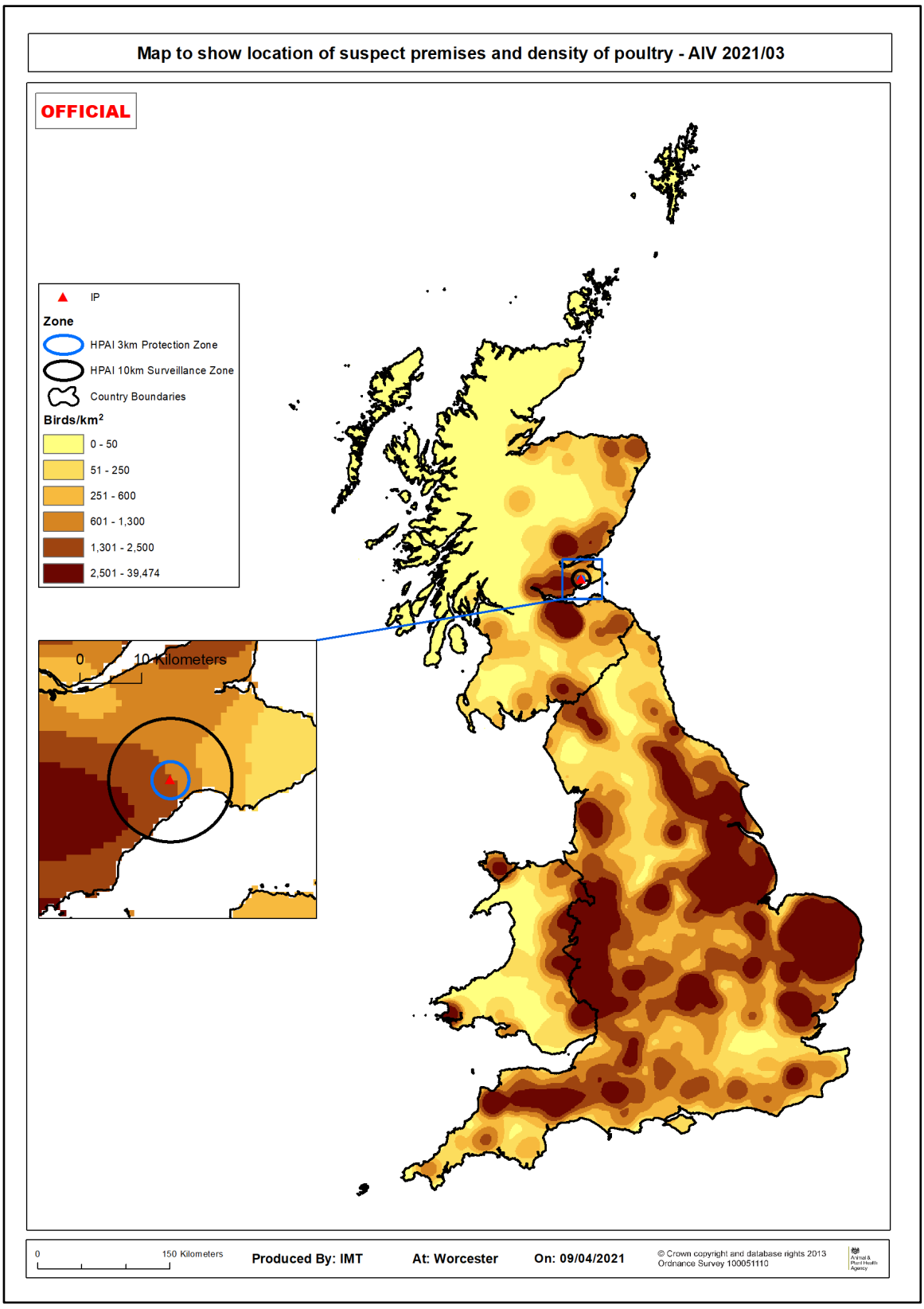
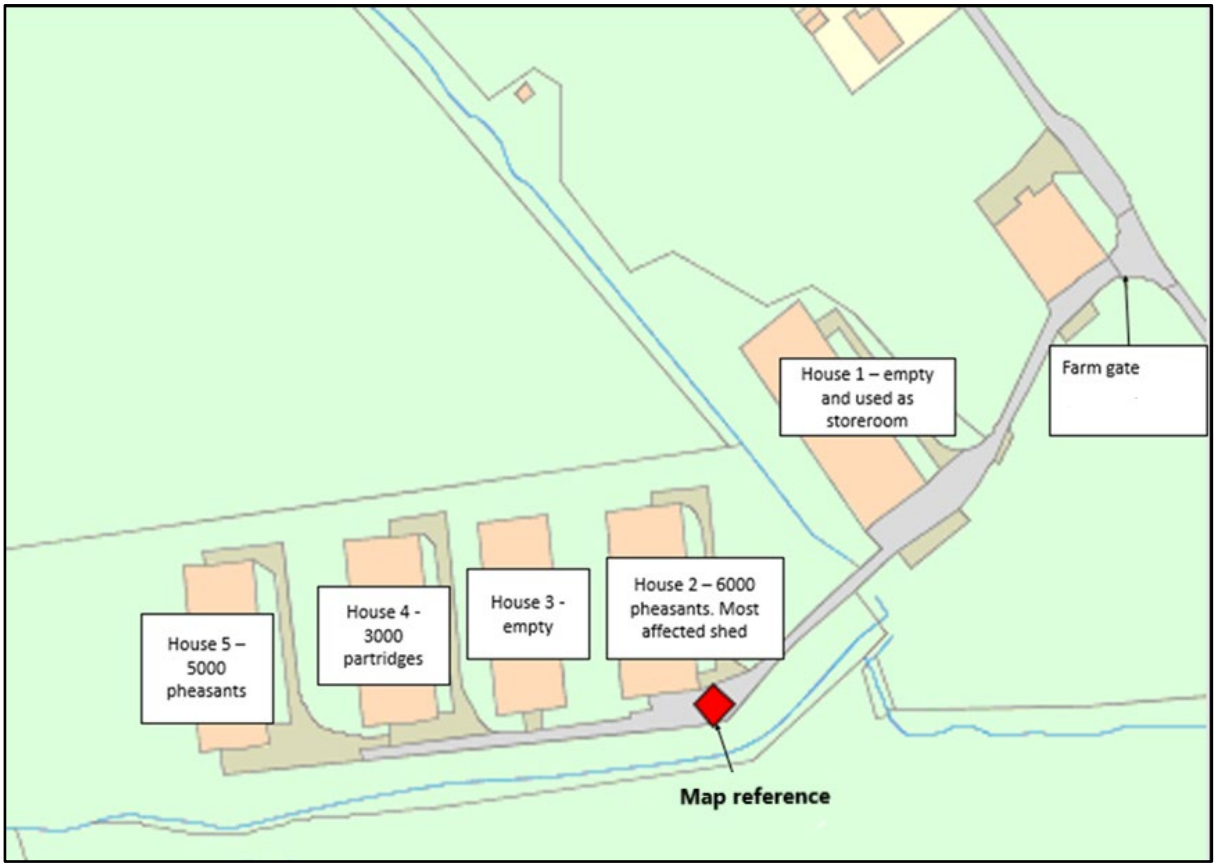


Figure 7: Plan of the infected premises AIV 2021/03



CLINICAL PICTURE

Clinical signs were first noticed on 06/02/2021 with a decrease in feed consumption, followed on 07/02/2021 by 50 dead pheasants in house 2. This then progressed to 150 dead in shed 2 on 08/02/2021 and 1500 on 09/02/2021.

The subsequent APHA disease investigation revealed lethargy, depression, nervous signs and confirmed the high level of mortality.

House 2: (6,000 ring neck pheasants) 75-80% mortality by the time of inspection with birds dying in front of the inspectors. All other birds in that shed appeared to be affected to varying degrees and were showing nervous signs including ataxia, torticollis and recumbency. Birds were very lethargic and would flap their wings, fall over and die. On close inspection birds were pyrexic (40-42^{o}C) dyspnoeic and mouth breathing, and clear fluid poured out of their beaks when handled. Several birds died when being handled for sampling.

House 4: (3,000 partridges) had approximately 5% mortality with another 5% birds clinically affected. Birds were much less affected in this shed, but those were not obviously affected were starting to show clinical signs of depression and puffing up of feathers.

There were a significant number of old carcases in the shed, which made it difficult to determine the recent mortality rate.

House 5: (5,000 pheasants) had approximately 5% mortality and another 5% clinically affected. Birds were showing signs of depression, ataxia, torticollis, recumbency and dyspnoea, although to a lesser extent than house 2. One bird examined in this house had a temperature of 40.4 ^{o}C.

No reported disease in Guinea fowl at this point; however, the following day approximately 10 were seen dead, including one in shed 5.

On the afternoon of 11/02/2021 shed 2 had approximately only 100 birds left alive. In shed 5, 90% of the birds remained alive, and in shed 4, the clinical picture was the same as the previous day.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	16/01/2020 – 22/01/2020
Likely:	23/01/2020 – 02/02/2020
High risk:	03/02/2020 – 05/02/2020

Spread tracings window:

Precautionary:	17/01/2020 – 23/01/2020
Likely:	24/01/2020 – 03/02/2020
High risk:	04/02/2020 – 10/02/2020

Most likely date of infection (Start of high risk source tracing window)**:** 03/02/2020

Table 2: Timeline for AIV 2021/03

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**16/01/21**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**17/01/21**	Start of precautionary spread tracing window (source + 24h).
Day 19		18/01/21	
Day 18		19/01/21	
Day 17		20/01/21	
Day 16		21/01/21	
Day 15		22/01/21	
Day 14		**23/01/21**	Start of likely source tracing window (-14d).
Day 13	Day 1	**24/01/21**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	25/01/21	
Day 11	Day 3	26/01/21	
Day 10	Day 4	27/01/21	
Day 9	Day 5	28/01/21	
Day 8	Day 6	29/01/21	
Day 7	Day 7	30/01/21	
Day 6	Day 8	31/01/21	
Day 5	Day 9	01/02/21	
Day 4	Day 10	02/02/21	
Day 3	Day 11	**03/02/21**	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak.**
Day 2	Day 12	04/02/21	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	05/02/21	Birds inspected and all normal.
	Day 14	**06/02/21**	**Onset of first clinical signs. Decrease in appetite and depression.**
	Day 15	07/02/21	50 dead birds in shed 2.
	Day 16	08/02/21	Increase in mortality. 150 birds died shed 2.
	Day 17	**09/02/21**	Report case at 22:40hrs. Verbal restrictions 1500 birds died in shed 2.
	Day 18	**10/02/21**	Disease investigation initiated (**DPR 2021/11**). Written restrictions in place. Further 1500 birds died shed 2. clinical signs noted in sheds 4 and 5. Samples taken.
	Day 19	**11/02/21**	Only 100 birds alive in shed 2. Lab results: Pheasants PCR +ve for H5N1, serology negative. Single partridge sample PCR -ve. **H5N1 confirmed (AIV 2021/03**).
	Day 20	12/02/21	Culling of some birds on welfare grounds initiated. **High Pathogenicity confirmed**
	Day 21	**13/02/21**	Deterioration in the clinical picture in house 5. Main cull started. Pre cull samples (60/60/60) collected from partridges in house 4, all negative on PCR and serology. Four partridge carcase (died on handling) gave weak PCR +ve signals.
	Day 22	14/02/21	
	Day 23	15/02/21	
	Day 24	16/02/21	
	Day 25	17/02/21	Preliminary C and D at 11:53
	Day 26	18/02/21	**Preliminary C and D considered complete at 11:53**
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

The owner reported that strict biosecurity measures existed between houses, including foot baths and separate boots, overalls, and gloves.

However, the impression on site was that, while the intention may be there, the biosecurity practices as described, were not consistently practised. At the time of the epidemiological investigation, boots were seen in the entrance vestibule in only one shed, and a new white, disposable overall was also seen in only one shed vestibule; although the owner reported that both boots and overalls were available in all sheds. The farm helper had his own protective clothing; however, he did not usually work inside the bird sheds.

Disinfectant foot dips, with an instruction notice, were in place in vestibule areas at the entrance door for the bird area. A Defra approved disinfectant at an appropriate dilution was used and reported as being routinely changed twice weekly.

The foot dips were contaminated at the time the Field Epidemiology Investigator visited on 11/02/2021, although the disinfectant had been replaced the previous day; however, it was noted that this had been an unusually busy day, and so was a plausible explanation.

There was disinfectant spray for vehicle wheels at the farm entrance; however, there was no facility to wash wheels or wheel arches, therefore disinfection was unlikely to be fully effective when there was any dirt present.

The company's lorry did use the disinfectant, as witnessed (however, as noted no wheel wash was available).

There were occasional rats on site and the farmer reported that he deals effectively with rodents using poisoned bait, this was placed in each shed vestibule and other strategic sites, including store / shed 3; however, a live mouse was seen in shed 4 at the time of the visit. A recent flooding event in surrounding fields and between sheds in the previous couple of weeks, increased the risk of vermin on site.

There was spilled feed observed under the food hopper at Shed 5. Shed 5 uses a feed auger system; however, this hopper was also used to fill feed bags for distribution to shed 4 and shed 2, both of which use mobile bird feeders. The bags were taken to the front end of each shed and feed was transferred to feeders there. There was certainly a risk of feed spillage at this point, as evidenced by the vestibules that were untidy with numerous feed spills, which were attractive to wild birds. The area around the doors were covered with snow and multiple bird tracks were apparent in the snow at these points.

There were many small wild birds seen in the tree line next to the stream, at the front of the sheds. These birds were seen in close proximity to the buildings. Wild birds were reported to perch on the shed guttering and ventilation hoods. There were wild bird tracks in the snow under the hopper at shed 5, and around each shed, including up to the entrance doors. The buildings did have small gaps at the doors, both at the front end of the sheds and at the entrance vestibules - particularly where the base of the door into the vestibule was worn, this was most significant in shed 4. Small birds or rodents could gain

access at these points, given the amount of spilled feed present in the vestibules. The long grass and some stacks of equipment and pallets between the sheds would provide excellent cover for all kinds of wildlife.

The hoods to the ventilation outlets on the side of the buildings had fallen off, apparently due to the weight of snow and were lying next to the buildings; however, there was intact mesh on the gaps, so wild birds should not have been able to gain access there. There was no evidence of wild birds seen inside the sheds.

Although there were the adjacent streams, as well as standing water in the ditches, and there was recent flooding around and between the sheds, the farmer reported that he had not seen any waterfowl on the site. Pigeons had been noted roosting close to shed 5. Seagulls were abundant a couple of weeks previously, when the adjacent field was ploughed, which could have presented a risk to the captive birds on site. However, no dead wild birds were seen.

Overview of tracing activities

Five potential personnel contacts were identified as follows, and were traced - none had other domestic bird contacts and were therefore considered to be low likelihood and closed:

1. Farmworker.
2. Site owner – who visited within the high risk spread window.
3. Tractor driver – cleared snow in high risk spread window.
4. Feed delivery driver and vehicle – outside precautionary window.
5. Bedding supplier – straw stored in open fronted barn, but collected by IP owner.

Source investigations

Hypothesis for the source

The most likely source of infection was considered to be indirect spread via fomite from the wild bird population.

Assessment and evidence base for the likely source

Although the farmer states that strict biosecurity was in place, the impression on site did not allow full confidence in the consistency of this practice. The integrity of the buildings was flawed around the door areas, which certainly would allow rodent access, a potential source of fomite contamination. There were wild bird tracks right up to the building entrances, which could pose a high risk of fomite transfer via personnel, were any personal biosecurity breaches to occur. Such biosecurity breaches appear to be probable.

Feed spills under the storage silo were attractive to wild birds and would result in an increased likelihood of HPAI contamination of the environment, and so an increased likelihood of disease being tracked into the buildings, if biosecurity was compromised at any point.

Recent surface flooding close to the buildings would also increase the risk from vermin and the potential for virus to be carried into the buildings.

The potential contamination of straw, whether prior to, or during storage was considered. However, straw had not recently been added to house 2, which was the worst affected Addition of straw occurred prior to population (four to five weeks prior to disease being reported), a date outside the most precautionary source tracing window.

Spread investigations

Assessment of potential and likelihood of spread

Investigations would suggest that due to poor biosecurity and the poor building fabric, the likelihood for escape of disease from the bird accommodation was medium; however, tracing activity has indicated that there was no valid risk pathway to other captive birds. The potential for spread into the wild bird population was high; however, this must be considered in the context of the level of infection in that population at that time.

There had been no bird movements onto the site since July 2020, and no movements off since the sale of 7 week-old poults, in September 2020. The birds were brought in as day-old chicks and permanently housed. As a closed all-in and all-out flock (since September 2020) the risk of spread was reduced.

There was one associated premises, a poultry breeding site operated by the same owner; however, there were no poultry kept there at the time of the investigation. The group at the IP were due to move there in February, but this was delayed due to bad weather.

Only the keeper and a farmhand have had contact with the birds. Neither had contact with any other birds or bird premises.

Movements of personnel and vehicles on and off the farm were limited at this time due to Covid-19, and recent snow, although such moves were infrequent even in normal times. The private veterinary surgeon had not been on the premises in-person. There had been no movement of equipment off the farm because of the weather (although this would normally have occurred if birds had been moving to the breeding site as planned).

There were no visitor book records kept; however, it was reported that there were no visitors – except the site owner on 08/02/2021. On the following day he sent an employee

to clear snow from the track in front of poultry sheds. These two tracings were completed (on 13/02/2021) with no contact with other poultry or captive birds identified.

Feed deliveries from the company occurred on 17/12/2020, which was outside even the OIE precautionary source tracing window. Feed was delivered mainly to the silo at shed 5, with any excess added the silo outside shed 4, as occurred at the latest delivery.

Bedding was collected by the business owner from a local supplier. The latest top up to sheds 4 & 5 was approximately three weeks previously. Shed 2 was newly populated with fresh straw 4-5 weeks previously, when birds were transferred from two other sheds – no top-ups have occurred since then. Telephone tracing to the local supplier confirmed that the straw was stored in an open-sided barn that could be accessed by wild birds.

Fallen stock was reported as being removed by the business owner, and then delivered to an approved ABP disposal point. No ABP removals occurred in 2021 and bags of dead birds were present outside the bird accommodation.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

HIGH PATHOGENICITY AVIAN INFLUENZA H5N8

IP1 AIV 2020/02 (Frodsham)

IP2 AIV 2020/03 (Leominster)

IP3 AIV 2020/04 (Stroud)

IP4 AIV 2020/05 (Melton Mowbray)

IP5 AIV 2020/06 (Northallerton)

IP6 AIV 2020/07 (Northallerton)

IP7 AIV 2020/08 (Attleborough)

IP8 AIV 2020/09 (King's Lynn)

IP9 AIV 2020/10 (Droitwich)

IP10 AIV 2020/11 (Willington)

IP11 AIV 2020/13 (Orkney)

IP12 AIV 2020/14 (Gillingham)

IP13 AIV 2020/15 (Attleborough)

IP14 AIV 2020/16 (Attleborough)

IP15 AIV 2020/17 (Watton)

IP16 AIV 2020/18 (Exmouth)

IP17 AIV 2021/01 (Anglesey)

IP18 AIV 2021/02 (Redcar)

IP19 AIV 2021/05 (Uttoxeter)

IP20 AIV 2021/06 (Skelmersdale)

AIV 2020/02, Frodsham

Description of the premises

Overview of the premises and the wider business

The infected premises (IP AIV2020/02) was a medium size, chicken broiler breeder rearing unit, located in the county of Cheshire, in Northern England, and was part of a large, integrated, broiler poultry company.

Description of the housing

The farm consists of one large, single shed, which was divided into six pens, laid out in a single row. The site building dates from the 1970s, was wood-framed, and concrete-floored, with a small contiguous parcel of land associated with the farm.

The farm operated an "all in- all out" policy, with one day-old chicks brought to the unit and reared until they were 18 weeks old, when they were moved to a laying site.

Species and number of each present

14,000 chicken were distributed over five pens (1, 2, 3, 5 and 6), each of which were initially filled with 2,800 birds each. Pen 4 was left empty.

Description of the surrounding area

The IP was geographically located in an area of Cheshire in the North West of England, five kilometres south of the large River Mersey tidal estuary, which was a well-known over wintering site for migratory birds. There were also numerous ponds and ditches across the local area, including ponds near the farm.

The surrounding area holds a medium-to-high poultry population density, where a large number of poultry were distributed across a small number of premises.

Surveillance activity

PZ (0-3km)

61 premises with poultry holding between 1-140,000 birds (4 premises with 50 or more birds)

SZ (3-10km)

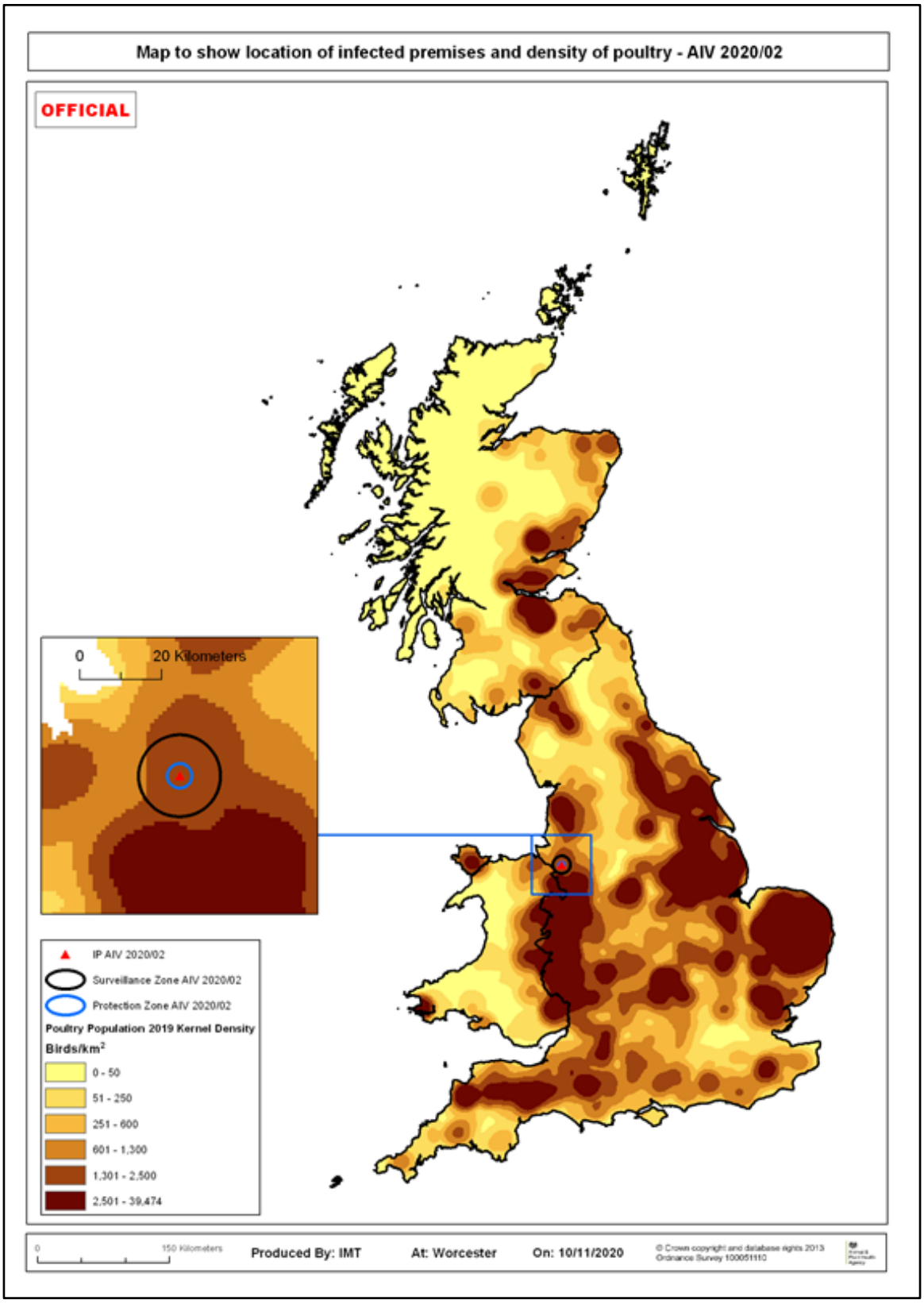
57 premises with poultry holding between 1-20,000 birds

Ornithological assessment

No ornithological assessment was carried out for this premises.

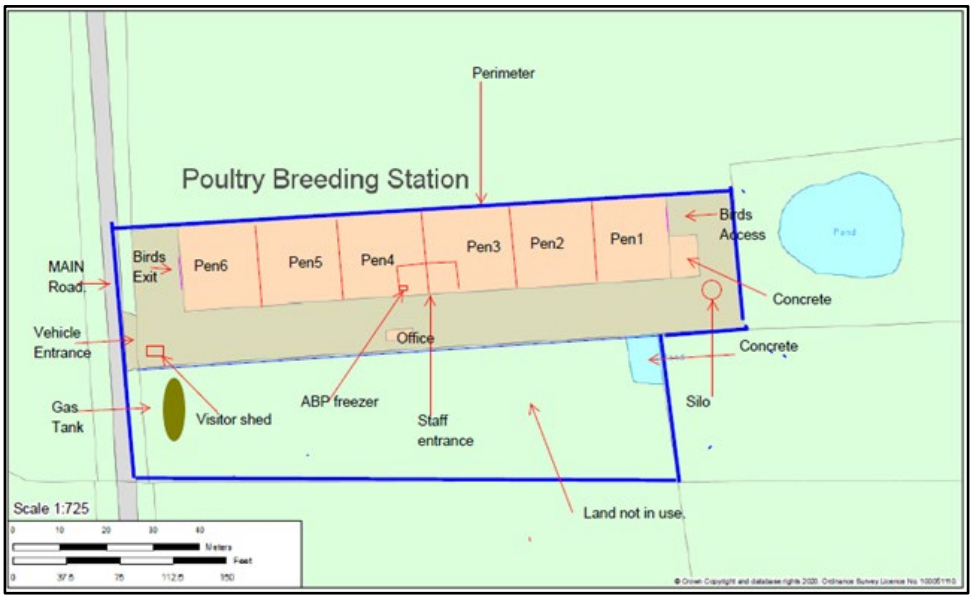
Location in GB

Figure 8: Location of AIV 2020/02 in Great Britain



Plan of the infected premises

Figure 9: Plan of the infected premises AIV 2020/02



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	03/10/2020 – 09/10/2020
Likely:	10/10/2020 – 20/10/2020
High risk:	21/10/2020 – 23/10/2020

Spread tracings window:

Precautionary:	04/10/2020 – 10/10/2020
Likely:	11/10/2020 – 21/10/2020
High risk:	22/10/2020 – 01/11/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 21/10/2020

Clinical picture

24/10/2020: Pen 6: first recorded mortality noted in farm records (two dead).

25/10/2020: Pen 6: first clinical signs observed: swollen haemorrhagic ('bruised') legs on four birds. One of the birds was found dead, and the other three were culled.

In the following days, nervous signs were noticed also in Pen 6, with some birds reluctant to move, with their heads tilted to the side, and cyanosis/discoloration of the combs.

Similar numbers of birds were culled on 26-27th October (3 per day)

28/10/2020: Daily mortality (including culls) increased to 11 birds, another 11 birds on 29/10/2020, and 16 birds on 30/10/2020.

To prevent possible spread of disease, the farm manager moved the birds from Pen 5 to the empty Pen 4.

30/10/2020: The company's private veterinary surgeon (PVS) carried out a post-mortem examination (PME) on five birds, with non-specific findings: liver and joints swabs were taken for bacteriology and skin, brain and eye samples taken for histopathology.

31/10/2020: The number of birds presenting with clinical signs increased in Pen 6: total mortality, including both deaths and culls due to clinical signs, increased to 30. On PVS advice, the birds from Pen 6 were moved into Pen 5.

01/11/2020: The PVS reported suspicion of a notifiable avian disease (NAD) to APHA. A report case investigation took place, the APHA report case vet was unable to rule out suspicion of a NAD, took clinical samples for testing and served movement restrictions. The clinical picture recorded: birds presented with swollen necrotic legs, nervous signs, reluctance to move, tilted head and discolouration of the comb. Water consumption has increased in the last five days as per the information provided by the farmer. A small quantity of nasal mucus has been noticed on some of the dead birds, but not substantial. Pen 5 (birds previously in pen 6) daily mortality including culls due to clinical signs was 53.

The first mortality increase (3 dead) was recorded in Pen 4 (birds previously in Pen 5)

02 and 03/11/2020: In Pen 5 (birds moved from Pen 6): 52 further dead birds, and 61 birds displaying clinical signs were culled.

04/11/2020**:**

Pen 5 (birds moved from Pen 6): 48 further dead birds, and 50 with clinical signs.

Pen 4 (birds moved from Pen 5): one dead bird, and three with clinical signs.

Pen 3: three birds were displaying clinical signs.

Culling was completed.

Overall, it appeared that spread of disease from Pen 6 to the other pens in the building was slow.

Timeline

Table 3: Timeline for AIV 2020/02

Source Tracing Window	Spread Tracing Window	Date	AIV 2020/02 ESTIMATED TIMELINE FOR SOURCE AND SPREAD OF INFECTION
Day 21		**03/10/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**04/10/20**	Start of precautionary spread tracing window (source + 24h).
Day 19		05/10/20	
Day 18		06/10/20	
Day 17		07/10/20	
Day 16		08/10/20	
Day 15		09/10/20	
Day 14		**10/10/20**	Start of likely source tracing window (-14d) .
Day 13	Day 1	**11/10/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	12/10/20	
Day 11	Day 3	13/10/20	
Day 10	Day 4	14/10/20	
Day 9	Day 5	15/10/20	
Day 8	Day 6	16/10/20	
Day 7	Day 7	17/10/20	
Day 6	Day 8	18/10/20	
Day 5	Day 9	19/10/20	
Day 4	Day 10	20/10/20	
Day 3	Day 11	**21/10/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 12	**22/10/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	23/10/20	
	Day 14	**24/10/20**	**2 birds dead - precautionary onset of first clinical signs.**
	Day 15	25/10/20	4 birds with swollen haemorrhagic/necrotic legs reported.
	Day 16	26/10/20	
	Day 17	27/10/20	
	Day 18	28/10/20	
	Day 19	29/10/20	Birds from sister site relocated to premises in Lincolnshire.
	Day 20	30/10/20	
	Day 21	31/10/20	
	Day 22	**01/11/20**	Suspicion of disease report by PVS. APHA investigation and sampling (DPR 2020/21). Restrictions served.
	Day 23	**02/11/20**	Disease confirmed as H5N8 (AIV 2020/02). All birds sampled were PCR positive, sero-negative.
	Day 24	03/11/20	Pathotype confirmed as high pathogenicity.
	Day 25	04/11/20	Culling completed.
	Day 26	05/11/20	Preliminary C&D completed.
	Day 27	**06/11/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possiblity of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possiblity of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Biosecurity measures were considered to be relatively poor for this type of production premises:

PERSONAL PROTECTIVE EQUIPMENT: Basic farm dedicated PPE was utilised (reusable overalls and wellington boots). Additional wellington boots were dedicated for the bird pens, but not colour coded to allow them to be distinguished from outdoor PPE. Staff did not change outdoor overalls when accessing the bird shed.

The staff / visitors' entrance was in the access / hygiene room, which was situated between pens 3 and 4. There was a covered foot dip wash outside this access room. Inside the room there was a low wall before entering the shed where staff change outdoor wellington boots, into the dedicated indoor wellington boots. Before accessing the pens there was a second foot dip wash, but this was not in use at the time of the inspection.

STAFF INSPECTION ROUTINE: The keeper accessed the shed from the empty Pen 4, then fed the birds in Pen 3, followed by Pen 2, and then Pen 1, inspecting the birds on the way back (first Pen 1, then Pen 2, and Pen 3). Then he fed Pen 5, and finally Pen 6, feeding and then inspecting again in reverse order. After finishing the inspection, he exited through Pen 4, washing wellington boots in the access/hygiene room, and changing wellington boots to outdoor wellington boots.

VEHICLES: No biosecurity measures appeared to have been implemented for vehicles entering and leaving the site.

PEST CONTROL: The vermin control plan was the responsibility of the company's area manager (regular monthly inspection of bait boxes and recording of findings and required actions). Records for the previous three months showed rodent activity in August, and a significant increase in September leading to addition of three more bait boxes (12 in total). October's report showed continued rodent activity, although decreased from previous month.

All bait boxes were located outdoors, around the building. Bait box one, located at the main external door of Pen 6, was the only bait box with evidence of constant rodent activity from August to October. The other boxes showing activity were located close to the staff entrance of the building.

Vermin proofing overall appeared to be medium-poor. The building dates from 1970s, with several maintenance issues.

BUILDING MAINTENANCE: The building needed several repairs, particularly noticeable in Pen 6; with a roof leak, and the external doors were not watertight. Dampness was evident in this pen.

The farm reported that due to heavy rains on 03/10/2020 and 27/10/2020, water leaked from the roof in Pen 6, leading to water pooling inside the pen on both occasions. Additionally, water also was believed to have leaked through the double doors accessing Pen 6 at the end of the building, further contributing to water pooling inside Pen 6.

Overview of tracing activities

Source investigations

Hypothesis for the source

The most likely source of the outbreak was considered to be indirect contact with infected wild birds; via ingress of water, or vermin mechanically carrying the virus into the poultry house as fomite.

Assessment and evidence base for the likely source.

This assessment was based on the following key pieces of evidence:

1. The lack of maintenance of roof and door sealant, leading to water ingress into Pen 6 in wet weather (i.e., the pen where clinical signs were first observed, and with the highest number of PCR positive samples from pre-cull sampling).
2. Cases of HPAI H5N8 have been confirmed in several wild birds in geographically diverse parts of England.
3. There was evidence of high vermin activity outside Pen 6. There were cracks in the building through which vermin could have had access into the shed.
4. The onset and progression of clinical signs in the shed suggests introduction of infection into Pen 6, rather than through the pens in order of inspection/feeding, as would be expected should personnel have introduced infection to the shed via fomites.
5. There were no poultry, or eggs, brought onto the IP within the source window.

Spread investigations

Assessment of potential and likelihood of spread

Spread tracings were identified and prioritised on a risk basis as follows:

Spread Tracings 1 and 2 (ST1 and ST2): High risk

During the critical period, the farm manager of the IP routinely looked after a second sister poultry premises (Premises 'LTA': ST1), at 6 km distance from the IP. ST1 was empty when the outbreak took place as all the birds had been sent to a third holding in Lincolnshire (Premises 'R': ST2). A risk of disease spread was identified from the IP through personnel movement into ST1 with a subsequent risk of disease spread from ST1 into ST2.

Based on the dates of the contact and the evidence of poor biosecurity practices in the IP these two tracings were identified as high risk. Both farms were placed under movement restrictions, and the investigations had the following results:

- ST1: Following interview with keeper and inspection of farm records, no evidence of disease spread was identified: low mortality, bird culling level in normal levels ahead of depopulation, average bird weights well over target for all groups and no abnormalities observed in feed/water consumption.
- ST2: A high risk tracing inspection was completed on 03/11/2020 and no evidence of notifiable disease was identified. The inspection included:
    - A full clinical inspection and examination of any sick looking birds
    - Full inspection of production records (mortality and culling data, feed/water consumption and medicine usage)

Movement restrictions on both premises were kept for at least 21 days from the last 'contact' with the IP on 29/10/2020. Regular updates were obtained, confirming no evidence of notifiable disease.

Spread Tracing 3 (ST3): high risk

An occasional staff member worked in the IP (on 21, 23 and 28/10/2020) and in ST1 (28/10/2020) and also looked after a different poultry premises (ST3). Based on the dates of the contact and the evidence of poor biosecurity practices in the IP this tracing was identified as high risk.

An urgent investigation confirmed that ST3 was depopulated in September and no further actions were considered needed at ST3.

Spread Tracing 4 (ST4)

A Private Veterinary Surgeon (PVS) visited and carried out PME on 30/10/2020 on birds at the IP and collected samples. A Tracings Request Form (TRF) was raised on 03/11/2020 to clarify post visit actions.

On 04/11/2020 it was confirmed that, following the IP visit, the PVS attended another poultry premises (Premises 'AH': ST4) on the same day, to investigate high mortality in 2-

day-old chicks, where he entered the shed after satisfactory biosecurity. Based on the dates and the nature of the contact in the IP and the traced premises this tracing was identified as high risk. A tracing inspection was conducted on 06/11/2020, restrictions were served, and the poultry were clinically normal. Following review, no further actions were considered needed at ST4.

Investigation of the samples taken from the IP concluded a very low to negligible risk. No further action was required.

The PVS visited a further premises prior to the IP visit: no further action was deemed necessary.

Spread Tracings 5 (ST5) Feed Deliveries, 6 (ST6) Gas Delivery and 7 (ST7) Bedding Deliveries

Deliveries for ST5, ST6 and ST7 were all outside the high-risk tracing window (Low Risk). tracing request forms were raised and details obtained and evaluated for each delivery and no further action was considered necessary.

Following the precautionary 21-day incubation period there was no evidence of spread of infection from the IP to any other premises.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/03, Leominster

Description of the premises

Overview of the premises and the wider business

The premises comprised a privately owned broiler breeder unit in Herefordshire. It was the only poultry unit within a wider agricultural enterprise, comprising cattle, arable and pheasant businesses. The site was contracted to produce hatching eggs for a large poultry company. Hatching eggs left the site three times per week, destined for any of the company's three local hatcheries.

Description of the housing

The unit was self-contained and comprised four deep litter, poultry sheds (with approximately 11,000 birds per shed), an egg collection corridor, egg sorting area, egg collection room and a series of ancillary rooms including office, showers, kitchen and toilets.

Outside the unit, there was a generator and an incinerator. There was an area of hardcore where there was a tank used for submerging poultry house furniture for cleaning at turnaround, and a covered stack of bales of wood shavings used for bedding. The unit was built five years previously and was of good structural integrity, well-sealed and the surrounding area was clean and tidy.

Species and number of each present

46,000 broiler breeder chickens.

Description of the surrounding area

In the immediate vicinity there were commercial orchards, arable land and woodland and a number of small waterbodies. There were no livestock adjacent to this premises.

The area was not considered to be of particular significance for wild birds although there was a range of species that visited the site on occasion. There was a commercial pheasant shoot nearby.

Surveillance activity

PZ (0-3km)

64 premises with poultry holding between 1-208 birds

(2 premises with 50 or more birds)

SZ (3-10km)

74 premises with poultry holding between 1-401,760 birds

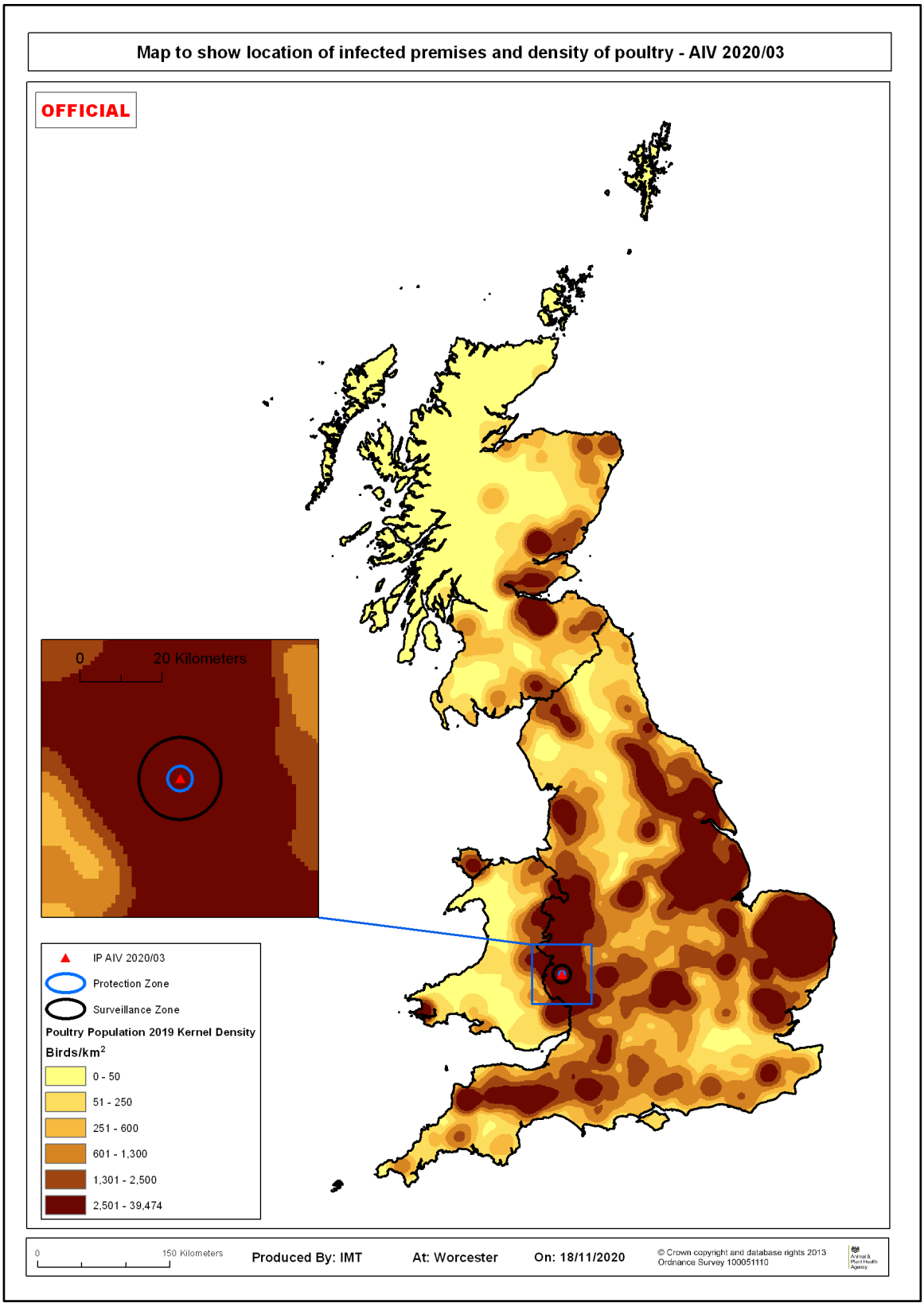
(38 premises holding 50 or more birds)

Ornithological assessment

An ornithological assessment was undertaken for this IP, but was unable to provide any conclusive additional evidence to better understand the role of wild birds and waterfowl.

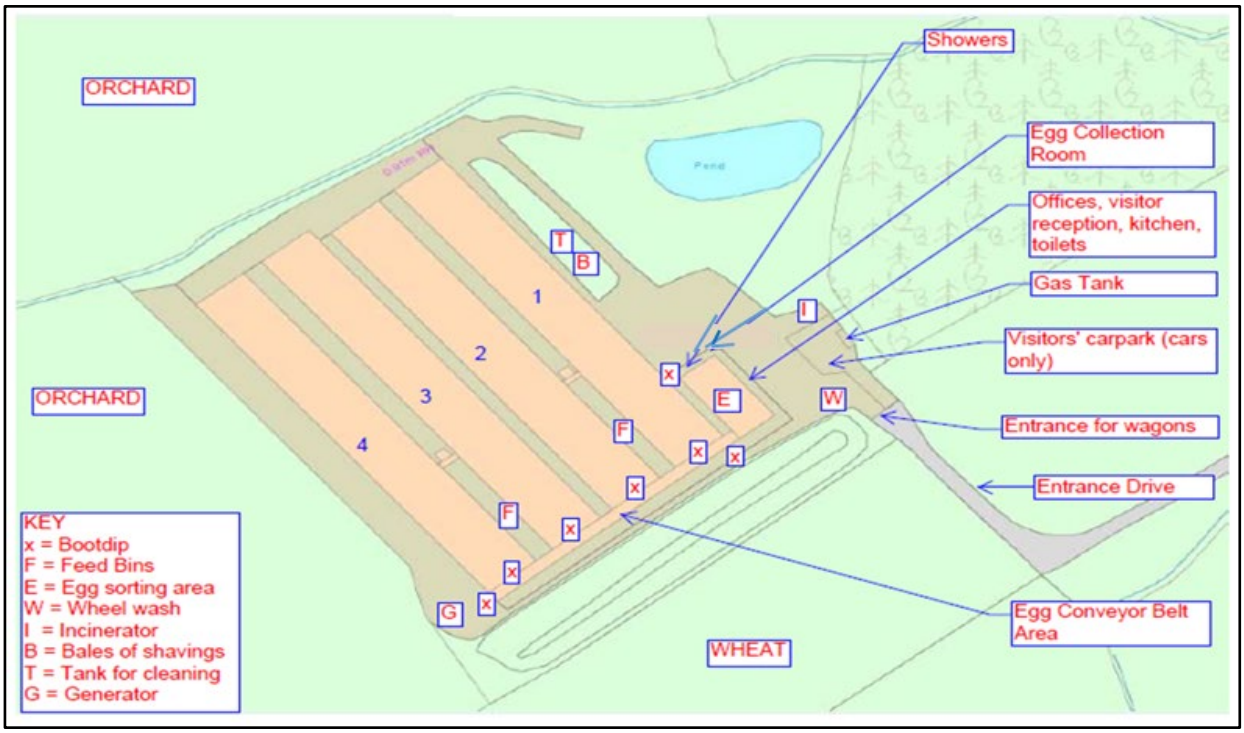
Location in GB

Figure 10: Location of AIV 2020/03



Plan of the infected premises

Figure 11: Plan of AIV 2020/03



Disease Picture

An episode of high mortality (80 – 100 birds died, out of an approximate total of 10,500 birds) occurred late afternoon of 09/11/2020. Mortality had occurred in Shed 4 only. No clinical signs were apparent prior to death, and no significant visible lesions were found at PME of two birds. Egg production, and food and water intake were reported to be normal.

Overnight, there were approximately 250 more mortalities in Shed 4. Overt clinical signs included listlessness, drooping heads, abdominal breathing, occasional snicking, mouth breathing and diarrhoea. There were no signs of swollen heads, cyanosis, coughing or conjunctivitis. It was reported that the other three sheds remained unaffected, and that there were still no signs of egg drop or changes in feed and water consumption in any shed.

Scrutiny of flock data indicated some egg drop and a reduction in water consumption; however, the significance of this was uncertain, as similar reductions had occurred earlier in the course of the flock. It was of particular note that there appeared to be a rise in mortality before clinical signs developed.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	17/10/2020 – 23/10//2020
Likely:	24/10/2020 – 03/11/2020
High risk:	04/11/2020 – 06/11/2020

Spread tracings window:

Precautionary:	18/10/2020 – 24/10/2020
Likely:	25/10/2020 – 04/11/2020
High risk:	05/11/2020 – 09/11/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 04/11/2020

Timeline

Table 4: Timeline for AIV 2020/03

Source Tracing Window	Spread Tracing Window	Date	AIV 2020/03 ESTIMATED TIMELINE FOR SOURCE AND SPREAD OF INFECTION
Day 21		17/10/20	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		18/10/20	Start of precautionary spread tracing window (source + 24h).
Day 19		19/10/20	
Day 18		20/10/20	
Day 17		21/10/20	
Day 16		22/10/20	
Day 15		23/10/20	
Day 14		24/10/20	Start of likely source tracing window (-14d) .
Day 13	Day 1	25/10/20	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	26/10/20	
Day 11	Day 3	27/10/20	
Day 10	Day 4	28/10/20	
Day 9	Day 5	29/10/20	
Day 8	Day 6	30/10/20	
Day 7	Day 7	31/10/20	
Day 6	Day 8	01/11/20	
Day 5	Day 9	02/11/20	
Day 4	Day 10	03/11/20	
Day 3	Day 11	**04/11/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 12	**05/11/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	06/11/20	
	Day 14	**07/11/20**	**Precautionary onset of first clinical signs (based on mortality data)**
	Day 15	08/11/20	
	Day 16	**09/11/20**	Suspicion of disease reported by PVS. APHA investigation and sampling undertaken (**DPR 2020/25**). Restrictions served.
	Day 17	10/11/20	
	Day 18	11/11/20	H5N8 reported by lab. Decision to slaughter on suspicion (**SOS AIV 2020/03**).
	Day 19	12/11/20	Molecular testing confirmed high pathogenicity. Confirmed as **HPAI H5N8** (**AIV 2020/03**).
	Day 20	13/11/20	Culling commenced.
	Day 21	14/11/20	
	Day 22	15/11/20	
	Day 23	16/11/20	Culling completed.
	Day 24	17/11/20	Preliminary C&D completed at 13:30 hours.
	Day 25	**18/11/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possiblity of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possiblity of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Overall, the site was considered to have good biosecurity. The unit was self-contained, well-sealed and in a good state of repair, with no obvious points of entry for wildlife. The outside areas were clean and tidy.

Visitors arriving by car were diverted to an off-site car park. Delivery vehicles accessed the site via a driver-operated wheel wash / disinfection point.

All personnel entering the poultry areas were required to shower on and off, and to use dedicated clothing and footwear. However, there were occasions when staff would be required to exit the poultry sheds during the day. There was uncertainty about the level of compliance with biosecurity procedures applied at those times. Each shed was entered from within the building directly from the egg conveyor belt area. There was no dedicated vestibule for each house, nor a step over barrier. There were dedicated boots, a foot dip, and hand sanitising stations for each shed. Gloves were not worn. Compliance with wearing the dedicated boots may have been variable.

Bedding was placed at the beginning of the flock, with more bales added as necessary. It had been noted that the litter was unusually wet for the affected flock (across all four sheds) and it was estimated that an extra 300 bales were added over the life of the flock compared to normal. Bales were added manually at both ends of the sheds, either placed through the doors, without walking into the shed, or added at the front of the sheds, via the entry door to the unit, and placed on the floor in the egg conveyor belt area. They were then dragged into the sheds via the normal entry doors. It was not known if any cleansing and disinfection (C&D) of bales or their packaging occurred prior to placement.

It was reported that a variety of wild birds (corvids, waterfowl, raptors) were present around the site, although there were no unusual increases over recent previous weeks.

Vermin control had been carried out monthly with little rodent activity reported. There were bait boxes at regular intervals around the unit and these appeared to be well maintained.

Overview of tracing activities

Source investigations

Hypothesis for the source

Most likely source was indirect introduction by wild birds, via personnel footwear or surface contamination of bedding bales.

Assessment and evidence base for the likely source

DIRECT INTRODUCTION BY DOMESTIC BIRDS OR THEIR PRODUCTS - negligible likelihood with low uncertainty. There were no direct introductions of birds or eggs in the source tracing window.

INDIRECT INTRODUCTION BY DOMESTIC BIRDS KNOWN OR UNDISCLOSED INFECTION - very low likelihood, with low uncertainty.

EGG COLLECTING VEHICLE/EQUIPMENT/PERSONNEL - visited this premises first on egg collection days.

FEED DELIVERY VEHICLE/EQUIPMENT/PERSONNEL - came directly from the feed mill.

PEOPLE - site owner, manager and staff, egg cooler engineer (06/11/2020) and pest controller (27/10/2020) all had no other poultry contact.

VERMIN CONTROL – there was evidence of effective vermin control around the site and absence of obvious entry points to the sheds. In addition, there were no other poultry premises adjacent to the premises for rodents to access.

INTRODUCTION FROM CONTAMINATED PRODUCT(S) - negligible likelihood with low uncertainty. Feed was delivered twice weekly directly into covered silos. Bedding was last delivered on 20/07/2020 and stored outside under plastic. Water provided by mains supply into covered header tanks.

INFECTED WILD ANIMAL SOURCE - negligible likelihood with low uncertainty of direct introduction, as wild birds did not have access to poultry buildings. High likelihood with medium uncertainty of indirect introduction. Wild bird carcases have tested positive for HPAI H5N8 in the neighbouring county. Wild bird faecal contamination observed on plastic wrapping of bedding bales stored outside - extra bedding was introduced to poultry sheds during life of flock although dates of bedding additions and biosecurity procedure applied was unclear. Wild bird faeces may have been introduced to poultry sheds by personnel via footwear (possible non-compliances with site biosecurity SOP). Vermin activity outside sheds mitigated by effective vermin control plan in operation.

INFECTION FROM INTERNATIONAL SOURCE - negligible likelihood with low uncertainty. No international trade connections for direct or indirect source.

Spread investigations

Assessment of potential and likelihood of spread

DIRECT CONTACT WITH OTHER SUSCEPTIBLE DOMESTIC SPECIES OR THEIR PRODUCTS - very low likelihood with low uncertainty.

VETERINARY RISK ASSESSMENT FOR SPREAD VIA EGGS - concluded that the likelihood of any hatched chicks in any of the three hatcheries being infected with HPAI H5N8 as a result of receiving eggs from the IP was very low with medium uncertainty. Uncertainty is focused on the very low possibility of internally infected eggs potentially harbouring virus and breaking during transfer into hatcher baskets or during hatching. However, if IP eggs (high risk +/- likely spread window) were removed before they reach the hatcher stage, the risk would be negligible. The company voluntarily destroyed and

disposed of in a biosecure manner IP eggs received from 23/10/207/11/2020. Destruction occurred from 13/11/2020 – 18/11/2020.

INDIRECT CONTACT WITH OTHER DOMESTIC SUSCEPTIBLE SPECIES - low likelihood with medium uncertainty. Vehicle tracings (feed deliveries, egg collections plus their drivers) and people tracings (premises staff, private veterinary surgeon), cooler engineer, pest controller).

ONWARD TRANSMISSION THROUGH WILDLIFE - negligible likelihood with low uncertainty. There was no vermin access to sheds.

ONWARD TRANSMISSION THROUGH INTERNATIONAL TRADE/CONNECTIONS - negligible likelihood with low uncertainty. No international trade connections for spread.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/04, Stroud

Description of the premises

Overview of the premises and the wider business

AIV 2020/04 was situated within a complex site – comprising a zoo, visitor centre and a nature reserve of 300 hectares, near the River Severn Estuary in a low-density poultry area of Great Britain (GB) as illustrated in Figure 12

The wider site provides a home to many resident waterbirds. Numbers increase markedly during winter, with the arrival of migratory waterbirds, which arrive from September through to December-January, and have mostly departed by the middle of March.

The zoo has a valuable collection of captive waterbirds kept for conservation/breeding and educational purposes, including some endangered species. Parts of the centre were normally open to the public for leisure and educational purposes, although the site was closed to the public due to Covid restrictions for much of the outbreak.

This collection of captive birds can be broken down into distinct areas, one of which was designated AIV 2020/04 by means of its separation from the remainder of the site and the effective biosecurity process that were in place prior to and during the disease incursion.

Description of the housing

AIV 2020/04 is composed of a series of interlinked ponds arranged in a horseshoe configuration and divided into a total of eight individual open enclosures (Figure 13) situated to the south east corner of the reserve.

The enclosures were each surrounded by a single fence on all sides and the captive birds were pinioned preventing escape. There were small wooden shelters in each enclosure, but the only housing available is in Pen 4, where 37 Lesser Flamingos were kept (permanently housed since 071/11/2020).

The enclosures were surrounded by a walkway, which allows feeding without staff needing to enter the pens.

Water enters the pond system at pen eight, and flows clockwise into pen one, and on via the remaining pens before leaving the system at pen 7, where it is pumped to a water treatment plant prior to discharge into the River Severn. This is illustrated in the plan of the affected premises at Figure 13 below.

Species and number of each present

Within the designated infected premises, the individual enclosures as detailed in Figure 13 contained:

1. **Loopside**:
   Mandarin duck x 9
   Ferruginous Duck x 7
   Marbled Teal x 1
   Lesser Whistling Duck x 5
   White-headed duck x 3

2. **Australian side**:
   Maned Duck (Australian Wood duck) x 8
   Plumed Whistling duck x 10 (plus dead one 11)

3. **African side**:
   Abyssinian Blue-winged Goose x 2
   Southern Pochard x 4

4. **Lesser Flamingos**:
   Lesser Flamingos x 37
   Red Billed Pintail x 10
   African Comb duck x 2

5. **Empty**

6. **Hybrid4**:
   Magellan Goose x 2

7. **Hybrid3**:
   Andean Goose x 2

8. **Empty**

Description of the surrounding area

AIV 2020/04 was situated near the River Severn estuary a renowned area that receives large numbers of migratory waterbirds on an annual basis and that supports a large population of resident wildfowl.

Due to the nature of this special category of premises, a 3 km captive bird monitoring zone (CBMZ) was declared, and it contained 3 small poultry premises to the east of the establishment, away from water sources and the estuary.

In the wider 10km area there were over 100 poultry premises, of which only seven were large commercial holdings.

The risk to these populations from this specific infected premises was assessed as being very low in comparison to the wider risk from the surrounding wild bird population in which the virus was clearly shown to be circulating.

Surveillance activity

CBMZ (0-3km)

38 premises with poultry holding between 1-1600 birds

(4 premises with 50 or more birds);

1 premises within the CBMZ holding both pigs and poultry

Ornithological assessment

At the time of the investigation many migratory birds had been identified in the immediate vicinity of the infected premise along with native populations.

There were about 8,000 waterbirds on site shortly after the outbreak (based on a site-wide count of the Reserve and Grounds on 17 November). These included

- 4,000 ducks (mostly of five species, mainly migrants)
- 1,000 geese (including 80 migrants, the remainder residents)
- 90 Mute Swans (residents) and 2 Bewick's Swans (migrants)
- 3,000 waders (mainly migrants)
- 300 other waterbirds (rails, herons etc)

The majority of the migrant waterbirds would have arrived over the preceding 4-5 weeks. At this time of year, it is likely that most migrants will have been from within the UK or the near continental mainland.

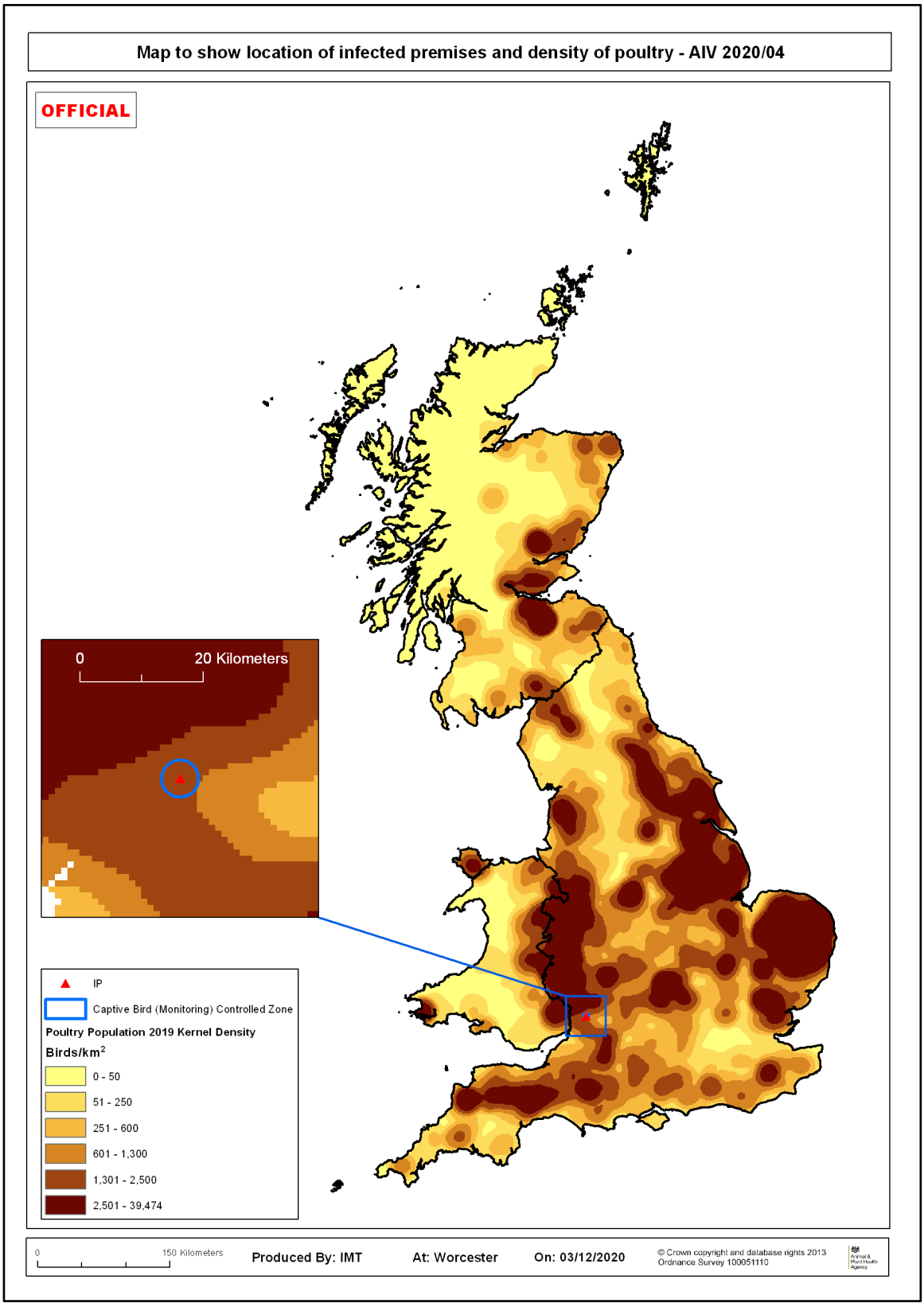
There were also around 100 gulls (mainly Black-headed) on site during the day in November. There is a large overnight roost of many thousands of gulls, which mainly use the channel of the estuary itself, but these are not counted regularly."

90,000 waterbirds use the wider Severn Estuary over the course of a year. This definition of the Severn Estuary stretches from Gloucester to Cardiff on the Welsh shore, and to Bridgwater Bay on the English shore, of which the Slimbridge site is a part. Around 30,000 waterbirds use the Slimbridge site, the great majority occurring only within the Reserve area.

Up to the time of the investigation the site operators had submitted several found dead wild wildfowl from the surrounding area 12 of which were confirmed positive by PCR for H5N8 avian influenza, indicating the presence of active infection in the local wildfowl population. The location of the found carcases indicates the infection pressure on the captive birds present in the reserve (Figure 14).

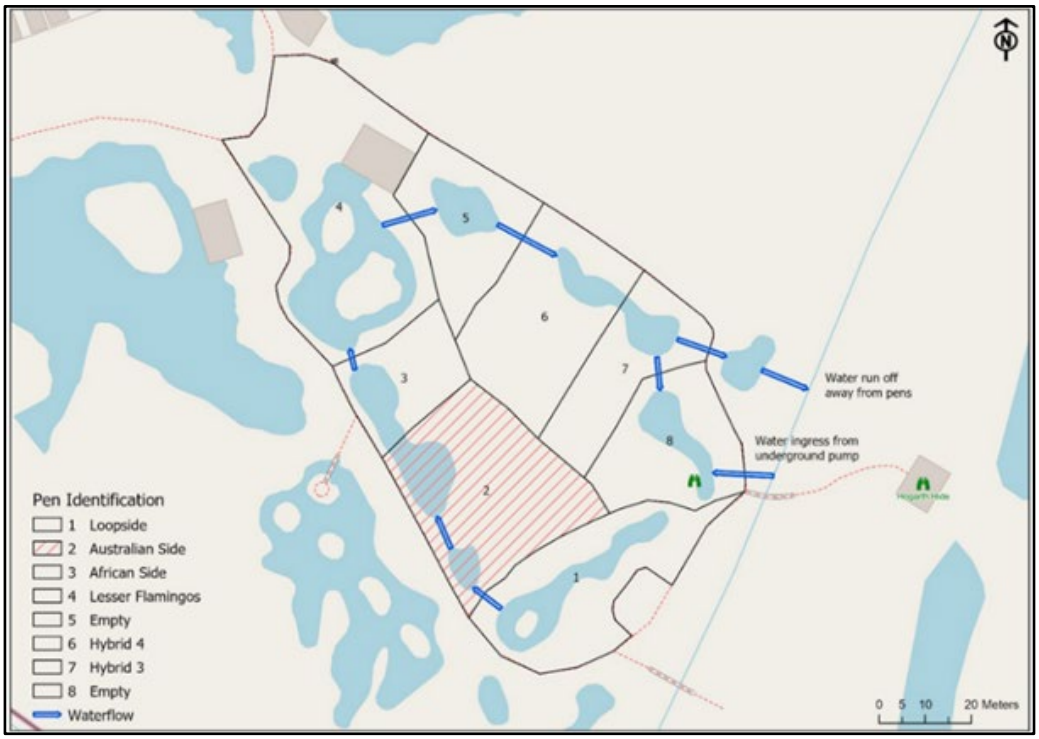
Location in GB

Figure 12: Location of 2020/04



Plan of the infected premises

Figure 13: Plan of the infected premises.



CLINICAL PICTURE

Suspicion of Notifiable Avian Disease (NAD) was first reported at these premises on 18/11/2020, following the sudden death of a captive Plumed (Eyton's) Whistling Duck and subsequent post-mortem findings. HPAI H5N8 was subsequently diagnosed by laboratory testing and no other mortalities or clinical signs attributed to H5N8 were identified in the captive bird collection.

The dead positive duck was from the Australian Side pen. The other 18 birds in that group were tested – laboratory testing revealed H5 antibodies in four of the Australian Wood Ducks. One Eyton's Whistling Duck was also PCR positive for influenza A (M gene), H5 and N8. All of those birds were subsequently culled.

All other captive birds in the Loopway IP were tested/sampled twice – no other mortalities or clinical signs attributed to H5N8 were observed in those birds.

Likewise, the approximately 1,800 other captive birds on site were surveyed as part of the CBMZ on 17/12/2020 – no mortality or clinical signs were observed in those birds.

TIMELINE

Tracings windows

Source tracings window:

Precautionary: 08/10/2020 – 14/10/2020

Likely: 15/10/2020 – 28/10/2020

High risk: 29/10/2020 – 17/11/2020

Spread tracings window:

Precautionary: 09/10/2020 – 15/10/2020

Likely: 16/10/2020 – 29/10/2020

High risk: 30/10/2020 – 18/11/2020

Most likely date of infection

(Start of high-risk source tracing window)**:** 29/10/2020

Timeline

Table 5: Timeline for AIV 2020/04

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**08/10/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d from earliest infection date from lab results but 40 days prior to latest infection date of index case.)
Day 20		**09/10/20**	Start of precautionary spread tracing window (source + 24h)
Day 19		**10/10/20**	
Day 18		**11/10/20**	
Day 17		**12/10/20**	
Day 16		**13/10/20**	
Day 15		**14/10/20**	
Day 14		**15/10/20**	Start of likely source tracing window (-14d)
Day 13	Day 1	**16/10/20**	Start of likely spread tracing window (source tracing window +24h)
Day 12	Day 2	**17/10/20**	
Day 11	Day 3	**18/10/20**	
Day 10	Day 4	**19/10/20**	
Day 9	Day 5	**20/10/20**	
Day 8	Day 6	**21/10/20**	
Day 7	Day 7	**22/10/20**	
Day 6	Day 8	**23/10/20**	
Day 5	Day 9	**24/10/20**	
Day 4	Day 10	**25/10/20**	
Day 3	Day 11	**26/10/20**	
Day 2	Day 12	**27/10/20**	
Day 1	Day 13	**28/10/20**	
Day 0	Day 14	**29/10/20**	**Earliest infection date from lab results: Start of high risk source tracing window** (Based on two strongly antibody positive ducks. High uncertainty as a result of possible prior immunity of the ducks, and the infection dynamics of this strain of HPAI H5N8 in these species)
	Day 15	**30/10/20**	Start of high risk spread tracing window (source +24h)
	Day 16	**31/10/20**	
	Day 17	**01/11/20**	
	Day 18	**02/11/20**	
	Day 19	**03/11/20**	
	Day 20	**04/11/20**	
	Day 21	**05/11/20**	Most likely date range for infection
	Day 22	**06/11/20**	Most likely date range for infection
	Day 23	**07/11/20**	Most likely date range for infection
	Day 24	**08/11/20**	Most likely date range for infection
	Day 25	**09/11/20**	Most likely date range for infection
	Day 26	**10/11/20**	Most likely date range for infection
	Day 27	**11/11/20**	Most likely date range for infection
	Day 28	**12/11/20**	Most likely date range for infection
	Day 29	**13/11/20**	
	Day 30	**14/11/20**	
	Day 31	**15/11/20**	
	Day 32	**16/11/20**	
	Day 33	**17/11/20**	latest infection date of index case
	Day 34	**18/11/20**	Index case found dead: PCR positive along with one other duck in the pen. Two ducks strong antibody positives. Restrictions served
	Day 35	**19/11/20**	
	Day 36	**20/11/20**	
	Day 37	**21/11/20**	
	Day 38	**22/11/20**	
	Day 39	**23/11/20**	Cull
	Day 40	**24/11/20**	
	Day 41	**25/11/20**	
	Day 42	**26/11/20**	Preliminary C and D of affected enclosure completed 13:00
	Day 43	**27/11/20**	Preliminary C and D of affected enclosure effective as of 13:00.
	Day 44	**28/11/20**	
	Day 45	**29/11/20**	
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these dates.		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Biosecurity on the site was stepped up at the beginning of November 2020, following confirmation of avian influenza in GB, and even more so following confirmation of H5N8 in the local wild bird population. COVID 19 restrictions have meant that the visitors' centre was closed to the public on 05/11/2020, therefore no visitors had been allowed on site since then, and the total numbers of people working on site in the Centre and the HQ Offices was considerably reduced, but the number of staff managing the grounds was largely maintained.

Disinfectant mats had been placed at all entrances to bird areas (disinfectant used was "Safe4" at 1:10, Defra approved) and staff used dedicated footwear and clothing.

Feeding of captive birds was done from the path, without accessing enclosures. This was the case for all the birds in the "infected area," except for the lesser flamingos, which have been continuously housed since 01/11/2020. For these, the keepers use a special changing area, and he/she puts on dedicated clothing and footwear which were specific for this task.

Even with good biosecurity, there was an ongoing risk of contact between wild and captive birds, with the consequent risk of disease transmission.

Post disclosure of disease all birds in the group of enclosures within the IP were housed in temporary constructed aviaries to prevent contact with wild birds. Following sampling for surveillance purposes the captive birds were housed in specially constructed isolation facilities until negative PCR test results were received from all samples taken as part of a second round of surveillance at least 21 days after the initial surveillance had also given negative results.

Overview of tracing activities

Ten personnel who worked at the site were identified as tracings. These included three veterinarians who had access to all parts of the reserve. Other staff were restricted to specific areas.

Within the high-risk period, only one of the ten had other bird contact through an aviary at their home. Restrictions were served and an inspection visit instructed. Following a revisit 21 days after the last potential contact, the aviary birds (all were susceptible indicator species) were inspected and found to be healthy. Restrictions were lifted.

Feed deliveries were made to a location outside the IP boundaries and delivered by wheelbarrow to the restricted area. No further enquiries were made, and this tracing was closed.

Source investigations

Hypothesis for the source

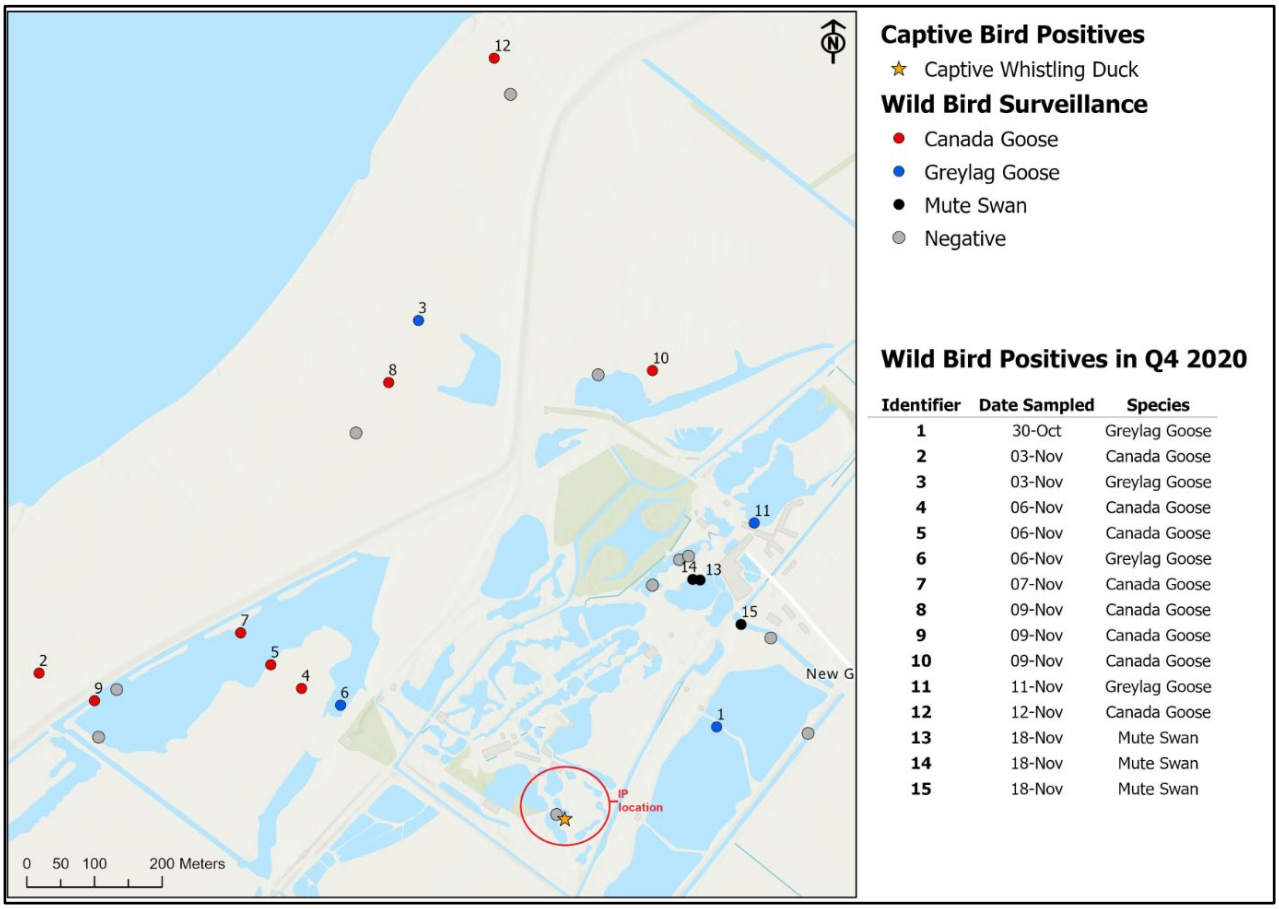
The current assessment was that infection entered the infected premises by either direct or indirect contact with an infected wild bird.

Assessment and evidence base for the likely source

The affected enclosures were not fully enclosed and wild birds were able to land and mingle with the captive birds. Similarly, the site was routinely overflown by wild birds and that can result in faecal contamination of the pens.

The surrounding area has provided several found dead wild waterfowl and up to the time of the investigation twelve wild geese (Canada and Greylag) had been shown to be positive by PCR to H5N8 AIV (see Figure 14).

Figure 14: Map showing the location of found dead waterfowl submitted for AIV testing and test results.



Spread investigations

Assessment of potential and likelihood of spread

The possibility of spread from this infected group of enclosures, designated as AIV2020/04, to further captive birds in other captive bird enclosures on the wider site was assessed via a veterinary risk assessment process to be very low, due to: the lack of visitors to the site as a result of Covid-19 restrictions, the presence of an isolated water source and post use treatment at a water treatment works prior to discharge into the Severn Estuary, and the standard practice that limited staff contact with the birds and / or their environment without strict biosecurity procedures being followed. Staff were dedicated to specific groups of birds to reduce the risk of any disease spread.

In the same way the risk of spread to populations of captive birds/poultry in the wider geographic area was also assessed. The outcome was that 'there is no increase in the risk level to poultry farms present in the surrounding 1km, 3km or 10km areas resulting from

the presence of HPAI H5N8 in the captive bird premises. There was already a substantial risk associated with the proximity to the wild bird assemblages where infection has already been detected.'

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is the direct introduction of an infected wild bird, or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/05, Melton Mowbray

Description of the premises

Overview of the premises and the wider business

The infected premise (IP) was a farm/theme park tourist destination, situated near Melton Mowbray in Leicestershire. It had been closed to the public since 05/11/2020, due to Covid-19 restrictions.

The site contained multiple species, including birds such as turkeys, chicken, waterfowl, birds of prey, emus, parrots, and other exotic birds. The site also had llamas, donkeys, horses, sheep, reindeer, goats and most significantly, pigs.

There was a birds of prey centre on the southern side of the park, this was managed as a separate private business. It was isolated from the affected group of birds in terms of distance, staff and management, and was excluded from the IP on the basis of a veterinary risk assessment.

The livestock on the site were part of a tourist experience and were not part of a 'normal' farming enterprise.

Description of the housing

The unit has the following areas:

FARM PARK AREA: With poultry, aviaries and livestock (see Figure 16) and avian stock list (Figure 16). There was no biosecurity between the different livestock areas.

OUTDOOR POULTRY ENCLOSURE (y in Figure 16): Two chicken sheds with access to an outside range. All the poultry mixed with the domestic waterfowl and there was a small pond within the enclosure. Chickens, geese, ducks, turkeys and one swan.

AVIARY AREA (v in Figure 16): Four round enclosures approximately 2m in diameter. See Figure 4. Made of wood and tight heavy-duty wire mesh, solid roof and approximately 45 cm of solid wood at bottom of wire. Mix of budgies, finches, canaries and cockatoos with partridges on the floor.

SMALL HATCHERY: Situated inside the building that surrounds the courtyard (x I in Figure 16). Inside the hatchery room there were two small chicken pens with four Silkie chickens in one pen and four chickens and three ducks in the other pen. Three chickens were also kept in a rabbit hutch in the hatchery area. An elderly pig, euthanised on 16/11/2020, was housed next to these Silkies.

COVERED BARN: With camelids and commercial-breed pig (w in Figure 16). This pig had not been outside since early summer.

FOUR KUNE KUNE PIGS: Kept outdoors at a distance of 3 metres from duck enclosure (z in Figure 16).

EMU ENCLOSURE: Situated at southern tip of park beyond the birds of prey (u in Figure 16). Two birds outside with small field shelter.

Nine free-ranging peacocks. By the end of the cull eight had been culled and one was missing and classed as a wild bird. (This individual had been reported as known to disappear for weeks at a time and then reappear.)

BIRDS OF PREY CENTRE (BOPC): Was situated within the premise enclosure (Figure 16), under the same CPH. There was clear separation between farm park and the birds of prey centre. The 13 birds of prey were owned and managed by a separate company. No cross over of staff occurred. The site was fenced off, birds were under a solid roof and were protected from wildlife by a double barrier system. It was a separate bio-secure site. All birds of prey had been housed and since the beginning of the AI season had not been exercised. As a result, this unit was not considered part of the infected premises.

Species and number of each present

Species	Input Ratios: 1.2.3 = 1 male, 2 female, 3 unknown		
Black Swan	1.0.0	Geese	2.3.3
Blue and Gold Macaw	1.0.0	Guinea Fowl	0.0.4
Budgerigar	3.2.7	Hahn's Macaw	1.0.0
Canary	0.1.6	Parakeet	1.0.0
Chickens	12.17.18	Peacocks	2.1.5
Cockatiels	1.1.0	Silver Pheasant	1.2.0
Ducks, Indian runner	0.0.1	Japanese Painted Quail	0.0.15
Ducks, Muscovy	1.4.12	Bob White Quail	2.3.0
Emu	1.1.0	Turkey	2.3.15
Finch, Zebra	0.0.18		

Description of the surrounding area

The premises was situated at the edge of a poultry dense area (Figure 22). No commercial poultry units were contiguous to the premise's boundaries. Contiguous land was arable, and the closest livestock were beef and dairy cattle.

Local knowledge identified two known commercial units in 10 km zone – a poultry breeder farm south west of IP and a broiler farm at to the north west of IP.

Surveillance activity

PZ (0-3km)

40 premises with poultry holding between 1-100 birds

(1 premises with 50 or more birds)

SZ (3-10km)

77 premises with poultry holding between 2-64,000 birds

(21 premises with 50 or more birds)

Ornithological assessment

No ornithological assessment was undertaken as part of the investigation of this premises.

Location in GB

Figure 15: Location AIV 2020/05.

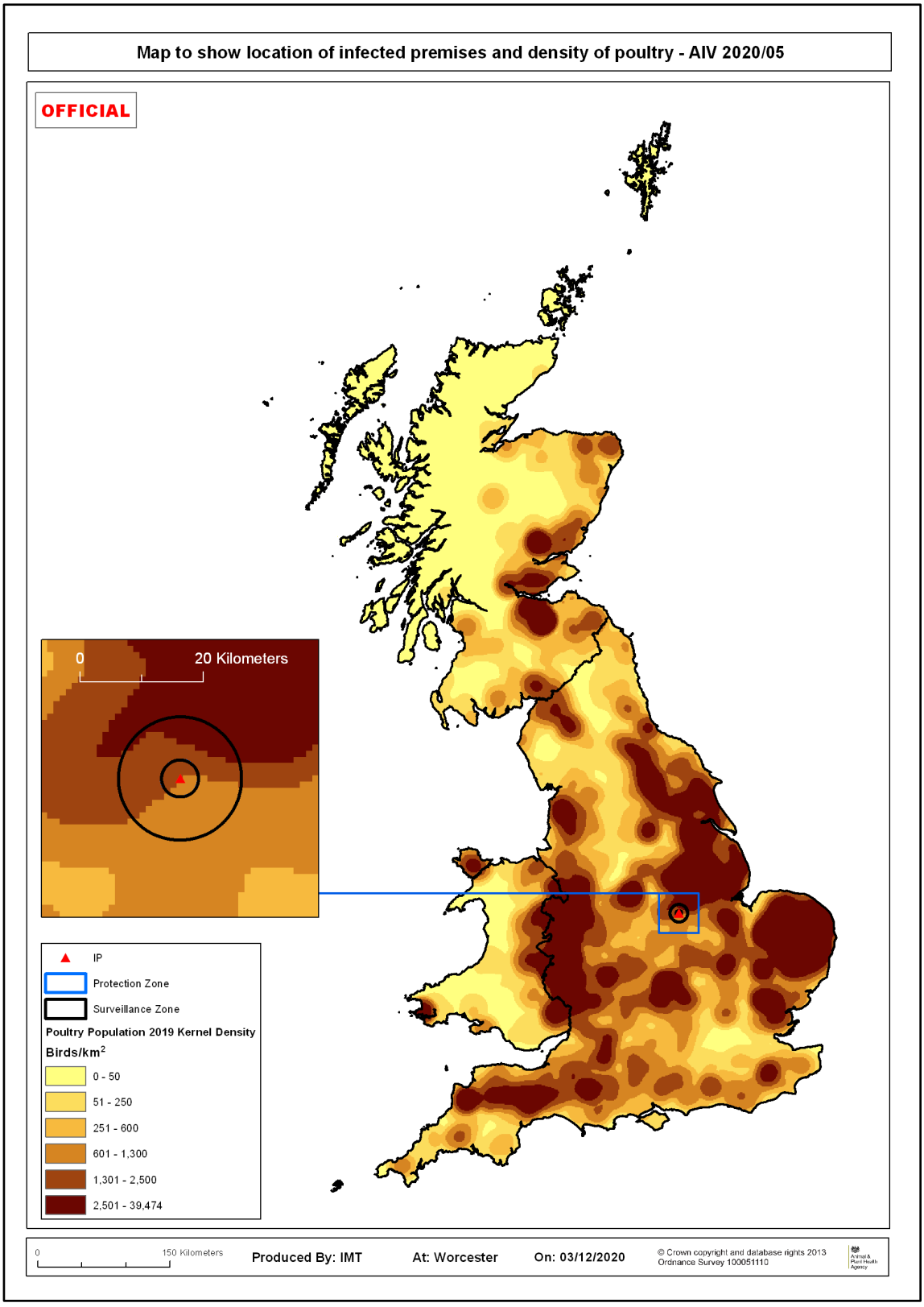
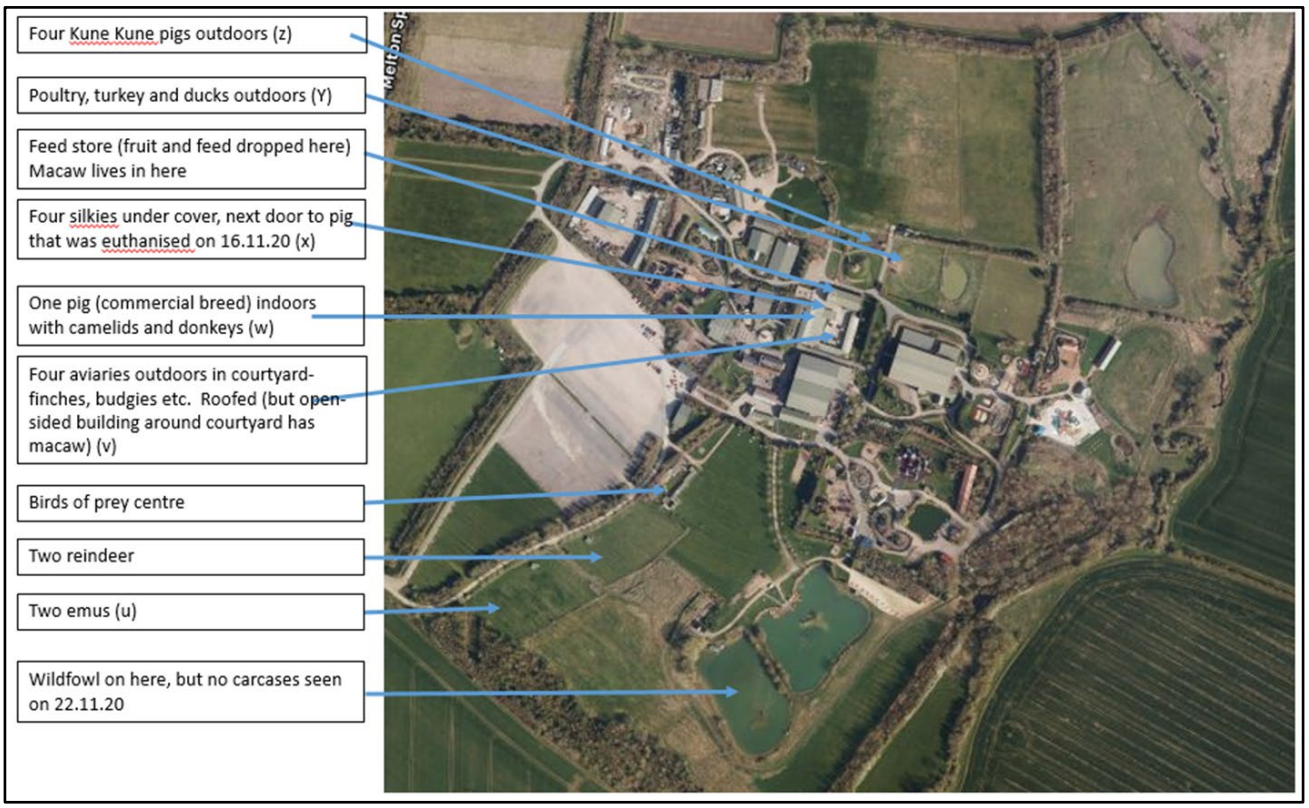


Figure 16: Satellite image of the site with location of poultry and captive birds.



CLINICAL PICTURE

Suspicion of notifiable avian disease (NAD) was reported by the PVS on 09/11/2020, following a steady increase in mortality of domestic fowl at the premises.

At the time of the report case, 14 birds (a mix of domesticated turkeys, chicken and wild waterfowl) were reported as having suddenly died in the previous 48-72 hours. The keeper described the turkeys as having neurological symptoms (circling) and discolouration of the head. All affected birds were from the same group kept in an outdoor enclosure (Y in Figure 16 above). Deaths continued in this enclosure until culling began.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	20/10/2020 – 26/10/2020
Likely:	27/10/2020 – 08/11/2020
High risk:	09/11/2020 –16/11/2020

Spread tracings window:

Precautionary:	21/10/2020 – 27/10/2020
Likely:	28/10/2020 – 09/11/2020
High risk:	10/11/2020 – 20/11/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 09/11/2020

Timeline

Table 6: Timeline for AIV 2020/05

Source Tracing WindowA 1:D36D3	Spread Tracing Window	Date	AIV 2020/05 FOR SOURCE AND SPREAD OF INFECTION — ESTIMATED TIMELINE
Day 21		**20/10/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20	Day 1	**21/10/20**	Start of precautionary spread tracing window (source + 24h).
Day 19	Day 2	22/10/20	
Day 18	Day 3	23/10/20	
Day 17	Day 4	24/10/20	
Day 16	Day 5	25/10/20	
Day 15	Day 6	26/10/20	
Day 14	Day 7	**27/10/20**	Start of likely source tracing window (-14d).
Day 13	Day 8	**28/10/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 9	29/10/20	
Day 11	Day 10	30/10/20	
Day 10	Day 11	31/10/20	
Day 9	Day 12	01/11/20	
Day 8	Day 13	02/11/20	
Day 7	Day 14	03/11/20	
Day 6	Day 15	04/11/20	
Day 5	Day 16	05/11/20	
Day 4	Day 17	06/11/20	
Day 3	Day 18	07/11/20	
Day 2	Day 19	08/11/20	
Day 1	Day 20	**09/11/20**	**Precautionary earliest and most likely infection date for this outbreak based on serology results from a goose sampled on 23/11/20** and allowing up to 14 days to develop antibody titre of 1/2048. **High uncertainty.**
	Day 21	**10/11/20**	Start of high risk spread tracing window (source +24h).
	Day 22	11/11/20	
	Day 23	12/11/20	
	Day 24	13/11/20	
	Day 25	14/11/20	
	Day 26	15/11/20	
	Day 27	**16/11/20**	First deaths in November: (1 chicken (c), 1 duck (d) and 1 turkey (t)). **Latest likely infection date given 7-14 days to seroconvert and develop antibody titre of 1/2048 in a goose sampled on 23/11/20. High uncertainty**
	Day 28	17/11/20	Additional deaths: 3c, 1d and 1t.
	Day 29	18/11/20	10 carcases found: thought to be fox predation 3c, 6t and 2 guinea fowl (gf).
	Day 30	**19/11/20**	Further 11 or 12 deaths. 3c, 2gf and 6t. PVS contacted. Carcase to PVS. Report case initiated **(DPR 2020/31)**. Verbal restrictions served.
	Day 31	**20/11/20**	Written restrictions served. APHA investigation and sampling undertaken.
	Day 32	**21/11/20**	H5N8 reported by lab (Confirmed as **AIV 2020/05**).
	Day 33	22/11/20	Culling commenced.
	Day 34	**23/11/20**	Samples collected at cull on 23rd November demonstrate some high antibody titres so likely infection date 7-14 days previously but high uncertainty (Goose 1/2048 titre). Pathogenicity confirmed as HPAI.
	Day 35	24/11/20	Culling completed. Preliminary C&D completed.
	Day 36	**25/11/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these dates.		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

An onsite assessment at the time of the report case and confirmed by a field epidemiological investigation, identified poor biosecurity between and within the various aviaries, poultry enclosure and emu enclosure. The same staff looked after these three areas and there was no change of clothing or boot dip between groups of birds. These three areas of the park can be considered as the same epidemiological group.

Overview of tracing activities

Source investigations

Hypothesis for the source

Infection was likely to have entered the premises by direct or indirect contact between wild waterfowl and domesticated waterfowl kept on the holding, with subsequent spread to the chickens and turkeys on site.

Assessment and evidence base for the likely source

The first clinical signs suggestive of notifiable avian disease were noted on 16/11/2020, with the sudden death of a chicken and a turkey. Deaths increased in Galliformes until notification occurred on 19/11/2020.

Sampling taken at the time of cull on 23/11/2020 from resident Anseriformes resulted in the disclosure of high antibody titres that were likely to be due to infection occurring approximately 7 to 14 days previously i.e. 09/11/2020 - 16/11/2020.

During the investigation, wild waterfowl were noted on the small pond that was situated within the poultry enclosure, as well as on the larger ponds to the south east of the site.

No evidence was disclosed during the site investigation that would suggest a valid alternative pathway for infection to have entered the site.

Spread investigations

Assessment of potential and likelihood of spread

Given the nature of the site, a theme and farm park, there were potentially many people that visited the site; however, Covid-19 restrictions reduced the likelihood of this risk

pathway. Visitors would not have direct access to the affected birds; however, they would have access to an environment that could be contaminated by faeces from the free-range peacocks; but the peacocks were all tested negative at the time of culling. As a result, the likelihood of spread by visitors was assessed as being very low to negligible.

Disease could be transmitted by park staff to other sites/locations with birds, given the poor biosecurity, and appropriate tracing activity was carried out to ensure disease had not spread.

Spread by feed/bedding delivery was assessed as a low likelihood; however, tracings were carried out to ensure disease had not spread.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/06, Northallerton

Description of the premises

Overview of the premises and the wider business

The infected premises (IP) was an indoor turkey rearing and fattening site in North Yorkshire. The IP was a separate farm within a three-farm complex, with the two other farms located approximately 1 km to the south of the farm; the three premises were considered to be one holding, operating under the same CPH number, and had shared staff and equipment.

Description of the housing

The IP consisted of four sheds, three of them containing between 3100 to 3400 turkeys and a fourth shed that had been depopulated on 15/11/2020, due to an outbreak of blackhead. The IP operated an all-in-all-out, single age system, as a contract rearer site for a large poultry company, and was overseen by an area manager, with day-to-day duties undertaken by a farm manager and an assistant farm worker.

Species and number of each present

10,000 turkeys approximately.

Description of the surrounding area

This was a largely arable area, with a relatively high density of poultry premises.

There were rivers to the East and West, approximately 1 km from the premises; these have associated flood plains, particularly during periods of high rainfall. There was also a pond less than 150m away from House 14 and other bodies of standing water approximately 650m away.

Surveillance activity

PZ (0-3km)

33 premises with poultry holding between 1-7,000 birds

(1 premises with 50 or more birds)

1 premises in the PZ holding both pigs and poultry

SZ (3-10km)

84 premises with poultry holding between 1-180,000 birds

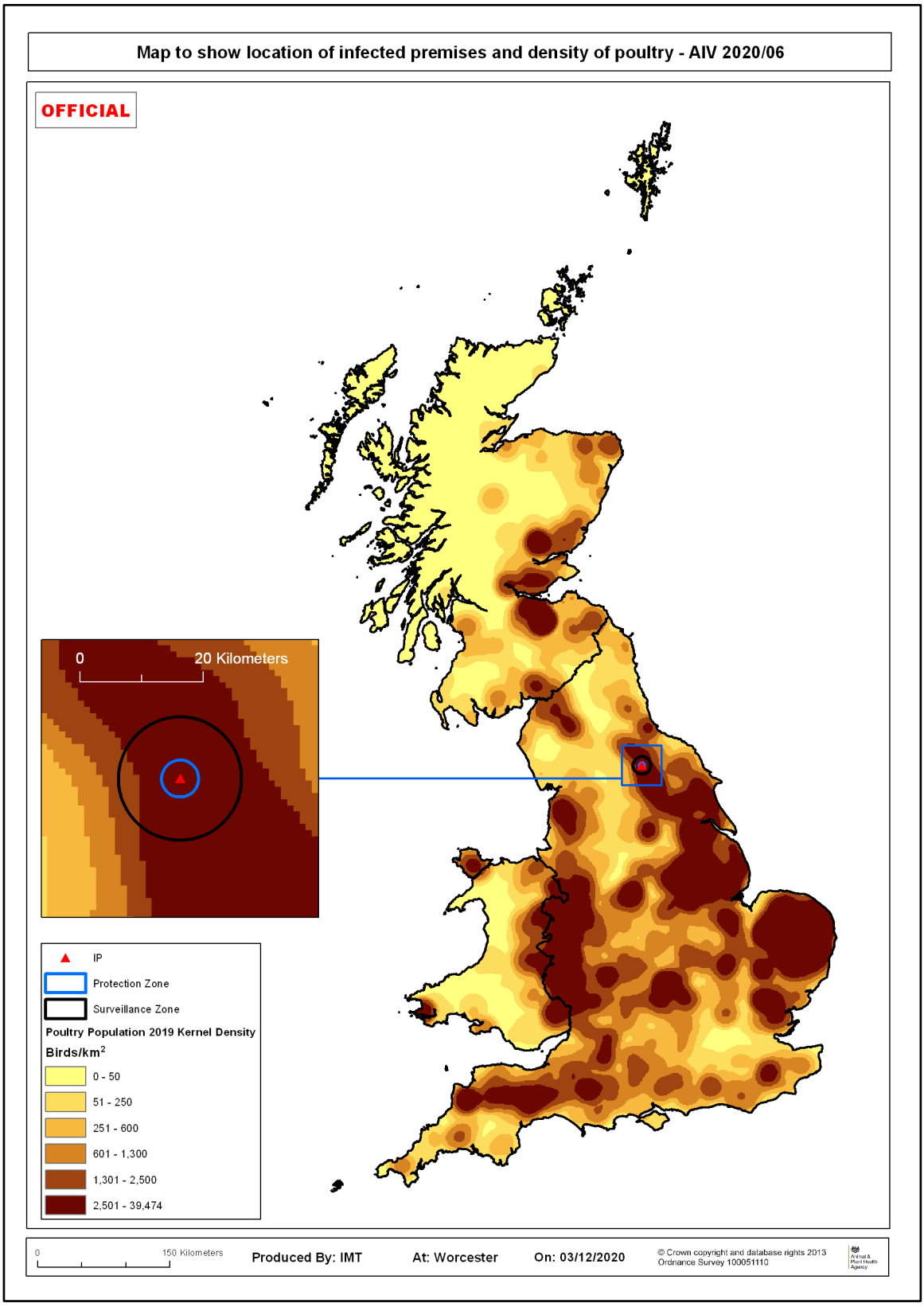
(34 premises with 50 or more birds)

Ornithological assessment

Report dated 30/11/2020 indicated large counts of wildfowl and also waders and gulls present, mainly dominated by resident species common to agricultural landscapes; Greylag goose, Lapwing, Black-headed gull, Canada goose, Mallard. Species which are also winter migrants were present in smaller numbers including Wigeon, Teal and various swans.

Location in GB

Figure 17: Location of AIV 2020/06



Plan of the infected premises

Figure 18: Plan of AIV 2020/06

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	04/11/2020 – 10/11/2020
Likely:	11/11/2020 – 21/11/2020
High risk:	22/11/2020 – 25/11/2020

Spread tracings window:

Precautionary:	05/11/2020 – 11/11/2020
Likely:	12/11/2020 – 22/11/2020
High risk:	23/11/2020 – 27/11/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 22/11/2020

Clinical Picture

This unit had previously had two other (non-notifiable) disease incidents:

- House 12 was sent to slaughter early on 15/11/2020 following an outbreak of blackhead. PME findings were most likely consistent with blackhead (*Histomonas meleagridis*) infection and subsequent secondary infections and were not consistent with HPAI infection.
- Houses 11, 12 & 14 had an *Ornithobacterium rhinotracheale* infection diagnosed around 12/11/2020, and were treated with amoxicillin.

26/11/2020: Clinical signs first observed, with five turkeys found dead in House 14. Five more died in House 14 during the day. PME findings: small amount of air-sacculitis, pericarditis, and mottled spleen. Mild diarrhoea was also seen.

27/11/2020: 87 birds in House 14 had died overnight. The PVS visited in the morning, birds were very quiet. Affected birds retreating to the side of the shed, becoming recumbent and dying. No major respiratory signs.

Many birds were still not showing clinical signs.

Approximately 30 more birds died during the vet visit.

PME FINDINGS: mild peritonitis, mild air-sacculitis, mild-to-minimal proventriculitis, and a mottled spleen with marked splenomegaly. Signs were more severe than those observed on 26/11/2020.

The clinical picture worsened, PVS returned in the afternoon reporting worsened diarrhoea, and birds continuing to die rapidly. At this point, in total approximately 400 turkeys had died (of which 150 had been culled on welfare grounds). Case reported to APHA as suspect notifiable avian disease.

An APHA Veterinary Inspector attended on 27/11/2020, and the clinical signs recorded were diarrhoea, depression, weakness, recumbency and death.

The affected birds were sampled (20 oropharyngeal swab, 20 cloacal swabs, and 20 blood samples were collected from House 14, as well as two fresh carcases). These samples tested positive on PCR for Influenza A (M gene), and H5 and N8, and negative for H7 and APMV-1 (L gene) on 28/11/2020. Serology was negative for both influenza and Newcastle Disease. Sequencing on 29/11/2020 confirmed the virus to be highly pathogenic and was positive on two-day virus isolation on 01/12/2020 and was characterised as Influenza A, subtype H5, further confirming the presence of HPAI H5N8.

Deaths increased in House 14 (700+ on 28/11/2020, and 1000+ on 29/11/2020); however, Houses 11 and 13 remained unaffected. By the morning of 30/11/2020, very few turkeys remained alive in House 14, and mortality increased in the other houses.

Timeline

Table 7: Timeline for AIV 2020/06

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**04/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**05/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19		06/11/20	
Day 18		07/11/20	
Day 17		08/11/20	
Day 16		09/11/20	
Day 15		10/11/20	
Day 14		**11/11/20**	Start of likely source tracing window (-14d).
Day 13	Day 1	**12/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	13/11/20	
Day 11	Day 3	14/11/20	
Day 10	Day 4	15/11/20	
Day 9	Day 5	16/11/20	
Day 8	Day 6	17/11/20	
Day 7	Day 7	18/11/20	
Day 6	Day 8	19/11/20	
Day 5	Day 9	20/11/20	
Day 4	Day 10	21/11/20	
Day 3	Day 11	**22/11/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 12	**23/11/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	24/11/20	
Day 0	Day 14	**25/11/20**	**Precautionary start of clinical signs.**
	Day 15	26/11/20	Onset of first clinical signs - 4-5 deaths in am; 5 more in pm.
	Day 16	**27/11/20**	107 deaths in am; ~300 deaths in pm. Report case initiated (DPR 2020/36) - verbal restrictions served at 18:20. Samples taken.
	Day 17	**28/11/20**	PCR positive H5N8 results, disease confirmed as AIV 2020/06; 850 deaths.
	Day 18	29/11/20	Pathogenicity confirmed as highly pathogenic.
	Day 19	**30/11/20**	Culling commenced.
	Day 20	01/12/20	
	Day 21	**02/12/20**	Culling completed.
	Day 22	03/12/20	
	Day 23	04/12/20	
	Day 24	**05/12/20**	Preliminary C&D completed.
	Day 25	**06/12/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on		

Investigations on the infected premises

Overview of biosecurity

ACCESS, VISITORS AND STAFF BIOSECURITY: The IP had access gates, with signage indicating that visitors must sign in, together with a water butt of disinfectant and a portable hand pump pressure sprayer for disinfection of vehicles. Staff vehicles should not enter the

site. An A4 sign indicated the need to spray wheels with disinfectant upon arrival for “All live bird drivers”. Delivery drivers should wear protective overshoes when on site.

A small port-a-cabin was located by the gates for entry of personnel, with a physical wooden low barrier between clean and dirty side of the cabin. Hooks were provided for staff to hang clothes, with site specific reusable fabric boilersuits on the dirty side of the cabin. Site specific boilersuits for this farm had been introduced following the earlier blackhead outbreak. There were also site-specific wellington boots. The visitors' book was also kept in the cabin. Foot dips (uncovered) with disinfectant (“BioVX” at 1%) were present at the entrance of the cabin and at the external entrance of each of poultry shed.

The site was usually staffed by two staff members caring for all birds in the three-farm complex. They typically would start at the IP, and inspect each house in turn, from House 11 in numerical order up to House 14. They would then usually visit the other two farms. Since the afternoon of 27/11/2020, staff attendance at the different sites was altered to minimising disease spread between farms.

PPE: Within the sheds, there were anterooms with barrier separation between clean and dirty areas, and building-specific wellington boots, but no building-specific boilersuits. Gloves were not usually used, and hand gel was present in the anterooms.

EQUIPMENT: A forklift truck was shared between sites for use when moving pallets of shavings into the sheds. The forklift truck should be pressure washed and disinfected off site; however, no records of this having occurred were present.

FEED DELIVERIES: Feed deliveries (every two to seven days) required the feed vehicle to drive on site. Each house had a separate external feed bin, which delivered feed into the house via an auger.

BEDDING: Bedding was delivered in wrapped bales on wooden pallets, and stored uncovered outside in the yard. Wrapping was observed to be occasionally torn leading to some exposed wood shavings. Bales were used as required (without C&D), moved into a fenced off antechamber of the sheds before unwrapping.

PEST CONTROL: Carried out by a contractor with external rat bait boxes around the edges of the site and several mouse bait boxes present in the antechamber of House 14. The last visit was on 20/10/2020. Records indicated rodent activity observed at the last visit and stations were re-baited; however, there were no outstanding actions recorded.

HOUSING: The sheds were of a relatively old build (approximately 1990s). The roofs had varying degrees of coverage with moss, this was the case in house 14 in particular with evidence of pooling of water in gutters.

The houses were ventilated, with wall mounted extractor fans and the external inlets were potentially accessible to wild birds, although the internal openings would have restricted access.

ABP: Dead stock was collected as part of daily checks, placed into bags which were emptied into sealed bins, where the carcases were sprayed with blue dye. The bins were kept in a communally accessible area on site and were collected by an ABP collector once a week before being sent for rendering.

WATER: Water was sourced from the mains, filling a main tank external to the houses, and then pumped to each of the houses. Water was chlorinated and acidified on site.

Overview of tracing activities

The following tracing events were investigated:

MOVEMENTS OF FARM PERSONNEL:

1. FARM MANAGERS - Two full-time staff members were responsible for the day-to-day running of the IP and the two other associated sites. Both managers were contacted, and they confirmed they did not visit other poultry premises, and they had no other poultry/birds contact outside of the three sites. It was the company policy that staff should not have birds of their own.

2. OTHER STAFF - One other company staff member provided support to the IP on 27/11/2020 (within the high-risk spread window) and the day after only to the other two sites. He confirmed details, biosecurity protocols used and that he kept no poultry/birds at home.

3. COMPANY AREA MANAGER - He moved between the three sites and two other turkey units. He confirmed he was last on the IP on 20/11/2020, which was outside the high-risk window. He followed site specific PPE and C&D protocols.

MOVEMENTS OF OTHER PEOPLE:

4. OWNER OF THE SITE - The owner of the premises resides contiguous to the IP; it was reported that he might have accessed the shared yard and that his dog had been seen on the IP. He owned a small, free-range backyard flock and a tracing visit to this potential contact premises (CP1) was raised.

5. PVS - Carcases from the affected house were submitted to the company veterinary practice for post-mortem examination on 26/11/2020 and a private vet visited the IP on 27/11/2020 – both dates within the high-risk spread window. The practice was contacted and both PVSs (the one who perform the post-mortem examinations and the one who

attended the IP) were spoken to. The information provided about biosecurity arrangements and disposal of carcases were assessed as satisfactory, and no further action requested.

MOVEMENTS OF VEHICLES:

6. FEED DELIVERY - Several deliveries to the IP, including during high-risk source and spread tracing windows. Investigation of transport, delivery routes and biosecurity arrangements informed a full risk assessment concluding that the overall risk for source was very low and for spread low, with low uncertainty in both cases with the recommendation to contact the drivers involved confirming they had no poultry at home, and they did not visit any premises with poultry after the IP.

7. BEDDING DELIVERY – Wood shavings were delivered outside the precautionary source or spread window.

8. FALLEN STOCK COLLECTIONS – There was one collection during high-risk spread tracing window (24/11/2020). Information was sought about the transport, collection route and biosecurity arrangements. This informed a full veterinary risk assessment which concluded that the overall risk for source and spread to be very low with low uncertainty.

9. FORKLIFT DELIVERY – A forklift to be used for depopulation at the IP was delivered on the 27/11/2020(within the high-risk spread window). The driver confirmed biosecurity arrangements, C&D protocols for the vehicle, and that neither he nor the vehicle went to other poultry premises that day and that he did not keep poultry/birds.

MOVEMENT OF LIVESTOCK:

10. MOVEMENT OF TURKEYS TO SLAUGHTER - one house was depopulated on 15/11/2020 (outside the high-risk source and spread window). Investigation of transport arrangements (driver and vehicle) and the catching gang involved in the depopulation confirmed their biosecurity and C&D protocol, and no other poultry visits on the same day as the IP, concluding a very low overall risk for source and spread.

The above investigations resulted in the identification of one potential contact premises (CP1) - it received an immediate tracing visit requiring serving restrictions, veterinary inspection, production record checks and an exposure risk assessment of the likelihood of a valid risk pathway for introduction of H5N8 into the premises. The outcome of the risk assessment was low risk, restriction remained in place until the 21 days post-contact tracing visit and, following the veterinary inspection, restrictions were lifted.

Source investigations

Hypothesis for the source

The most likely hypothesis for source was indirect transmission from infected wildlife, assessed as high likelihood, with low uncertainty. Several possible pathways for introduction were identified, including via the bedding up process, via water leaks from the roof, or via rodent activity.

Assessment and evidence base for the likely source.

The building required maintenance, particularly presenting indications of a leaky roof that was heavily covered in moss and was likely to be used by wild birds as food source. Cracks in the walls were also seen, with evidence of rodent activity.

Biosecurity of the bedding-up procedure was poor, with bedding stored outdoors and used frequently during production.

Cases of HPAI H5N8 have been confirmed in several wild birds in geographically diverse parts of England.

Other potential sources investigated were assessed as being either very low or negligible likelihood, with low uncertainty.

Spread investigations.

Assessment of potential and likelihood of spread

Indirect contact with other domestic susceptible animals was assessed as highly likely with low uncertainty. This was based on the fact that personnel and equipment were shared with the other two farms of this three-farm complex, with relatively poor biosecurity, and the subsequent confirmation of AIV in these two sites (AIV 07), with genomic analysis indicating virtually 100% similarity between isolates from this IP and AIV 07.

Other potential spread pathways investigated were assessed as very low or negligible likelihood with low uncertainty.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/07, Northallerton

Description of the premises

Overview of the premises and the wider business

The infected premises (IP) were two indoor turkey rearing and fattening sites in North Yorkshire. The IPs were separate farms (site 1 and site 2), but within 150 metre distance. They were part of a three-farm complex, with the other farm (site 3) located 1 km to the north of these farms; the three premises operated under the same CPH number and shared staff and equipment. An outbreak of highly pathogenic avian influenza H5N8 (AIV 2020/06) was first confirmed on site 3, following increased mortality seen on 26/11/2020.

Description of the housing

Site 1 consisted of four sheds (numbered 6, 7, 8 and 10), each containing between 3000 to 3600 turkeys.

Site 2 also consisted of four sheds (numbered 1, 2, 3 and 4), each containing between 2900 to 3200 turkeys.

The three sites in this farm complex operated an all-in-all-out single age system as contract rearer sites for a large poultry company, and were overseen by an area manager, with day-to-day duties undertaken by a farm manager and an assistant farm worker.

Species and number of each present

Site 1: 13,200 turkeys approximately

Site 2: 12,500 turkeys approximately

Description of the surrounding area

This was a largely arable area with a high density of poultry premises.

There were rivers to the East and West, 400 m to 1 km from the premises that have associated flood plains, particularly during periods of high rainfall. There was a pond less than 700 m to the North and some standing bodies of water 900 m away from houses 6 and 7.

Surveillance activity

PZ (0-3km)

34 premises with poultry holding between 1-30,000 birds

(3 premises with 50 or more birds)

2 premises holding both pigs and poultry

SZ (3-10km)

76 premises with poultry holding between 1-310,000 birds

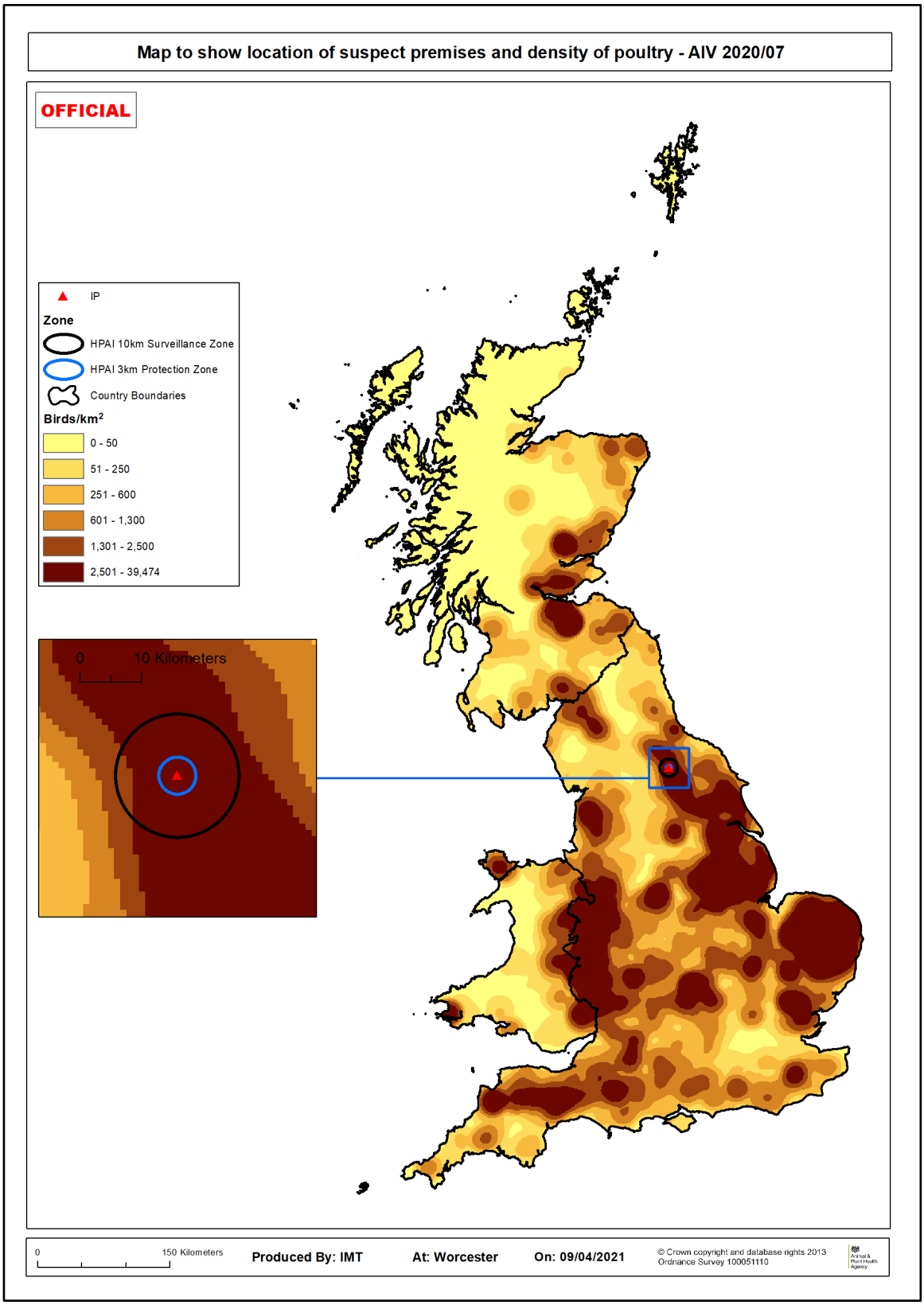
(33 premises holding 50 or more birds)

Ornithological assessment

Report dated 30/11/2020 indicating large counts of wildfowl. Waders and gulls also present, mainly dominated by resident species common to agricultural landscapes; Greylag goose, Lapwing, Black-headed gull, Canada goose, Mallard. Species which were also winter migrants were present in smaller numbers including Wigeon, Teal and various swans.

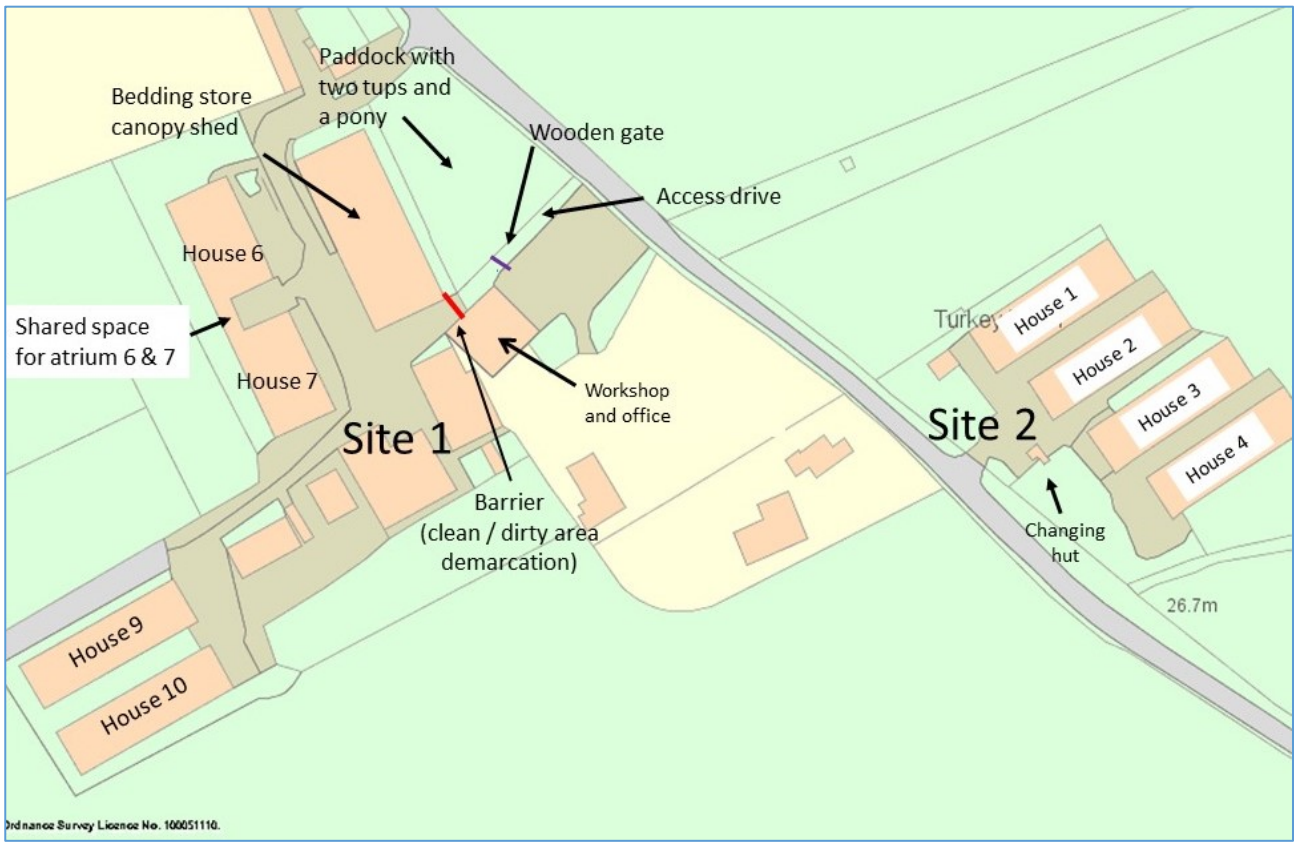
Location in GB

Figure 19: Location of AIV 2020/07



Plan of the infected premises

Figure 20: Plan of AIV 2020/07



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	09/11/2020 – 15/11/2020
Likely:	16/11/2020 – 26/11/2020
High risk:	27/11/2020 – 30/11/2020

Spread tracings window:

Precautionary:	10/11/2020 – 16/11/2020
Likely:	17/11/2020 – 27/11/2020
High risk:	28/11/2020 – 02/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 27/11//2020

Clinical Picture

Site 1 had previously had two other (non-notifiable) disease incidents. Houses 7 & 9 had disease due to *Ornithobacterium rhinotracheale* infection diagnosed on 22/11/2020 and were treated with amoxicillin. All houses were affected with coccidiosis and were prescribed toltrazuril on 15/10/2020.

01/12/2020: Increased overnight mortality in house 6, with 12 birds found dead. Across the shed, approximately 10 birds were noticed to be lethargic, the majority of these had evidence of dyspnoea. Temperatures ranged from 39°C to 42°C. Large discrete volumes of brownish, mucoid voided liquid faeces was observed across the shed, although not with a high frequency. Two birds were observed during sampling to have yellow coloured faecal staining of the whole cloacal area.

The remaining birds were seen eating and drinking, bright and alert, expressing no abnormal behaviour but site worker noted they were slightly quieter than usual.

Post-mortem examination was also carried out on two fresh carcases:

Carcase 1: Slightly congested sinuses, liquid feed in crop, full gizzard, carcase muscle heavily congested throughout, heavily congested lung tissue, marked splenomegaly with congestion, slight hepatomegaly, congested intestines.

Carcase 2: Feed found in both crop and gizzard, significantly congested muscles, heavily congested lungs, marked splenomegaly with congestion, slight hepatomegaly, congested intestines with enteritis, borderline with ulceration.

Increased water consumption was also recorded on 01/12/2020 (10% increase compared to the previous day).

Mortality progressed in House 6: 22 in total on 01/12/2020, 62 on 02/12/2020 and 228 on 03/12/2020.

On 01/12/2020 mortality levels started to rise in House 7 (2 dead on 01/12/2020, 11 on 02/12/2020, 84 on 03/12/2020)

Site 2 had no previous recorded disease issues.

On 02/12/2021, the litter in House 4 was particularly wet, with widespread diarrhoea seen in the birds, and water consumption had risen rapidly to levels that no longer fitted on the water consumption chart.

The visiting vet recorded the following:

House 1: No obvious signs among birds, temperatures 39.2°C to 40.3°C, no respiratory signs, alert response to stimulus (torch light).

House 2: Birds mildly lethargic, some watery faeces present black to brown in colour, litter was wet. There was some mucous around the nares. Temperatures 40.1°C to 40.8°C.

House 3: Similar to House 2, one bird was seen gasping bird after exploration and needed time to recover, some wet litter with foamy liquid foamy faeces. No change to water or feed intake; temperatures 40.5°C to 41.2°C.

House 4: Bedding very wet, having only been re-bedded 3 hours before; some nasal discharge and evidence of cyanosis; birds lethargic and less responsive to stimuli than the birds in the other sheds. Temperatures were 41.1°C to 41.8°C. Only one bird was found dead at the time of inspection. There was a marked increase in water use, but not feed.

No post-mortem examinations were carried out. Based on the strong epidemiological links, and the reported clinical signs, the decision was made to confirm the case on clinical signs and to slaughter the flock on suspicion of notifiable disease.

Timeline

Table 8: Timeline for AIV 2020/07

Source Tracing Window	Spread Tracing Window	Date	AIV 2020/07 ESTIMATED TIMELINE FOR SOURCE AND SPREAD OF INFECTION
Day 21		**09/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20	Day 1	**10/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19	Day 2	11/11/20	
Day 18	Day 3	12/11/20	
Day 17	Day 4	13/11/20	
Day 16	Day 5	14/11/20	
Day 15	Day 6	15/11/20	
Day 14	Day 7	**16/11/20**	Start of likely source tracing window (-14d).
Day 13	Day 8	**17/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 9	18/11/20	
Day 11	Day 10	19/11/20	
Day 10	Day 11	20/11/20	
Day 9	Day 12	21/11/20	
Day 8	Day 13	22/11/20	
Day 7	Day 14	23/11/20	
Day 6	Day 15	24/11/20	
Day 5	Day 16	25/11/20	
Day 4	Day 17	26/11/20	
Day 3	Day 18	**27/11/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 19	**28/11/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 20	29/11/20	
Day 0	Day 21	**30/11/20**	**Precautionary start of clinical signs.**
	Day 22	01/12/20	Onset of first clinical signs - 12 found dead AM; Report case **DPR 2020-40** - link to AIV2020-06 HPAI IP5; based on deteriorating clinical scenario and close epi links, decision made to slaughter on suspicion.
	Day 23	**02/12/20**	51 dead overnight in House 6, 11 dead in House 7, Houses 9 & 10 not affected. DC assessment made of additional premises, some wet litter and diarrhoea reported as well, **DPR 2020-41** report case initiated.
	Day 24	**03/12/20**	Culling commenced - Houses 6 & 7; DPR 2020 41 confirmed on clinical signs - incorporated as part of AIV 2020/07.
	Day 25	04/12/20	
	Day 26	05/12/20	
	Day 27	**06/12/20**	Culling at completed.
	Day 28	**07/12/20**	Preliminary C&D completed on both sites.
	Day 29	**08/12/20**	Preliminary C&D considered effective on both sites.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on		

Investigations on the infected premises

Overview of biosecurity

The following information details the operation of Site 1

Accessed by a single road, controlled with an electronic barrier. Signage indicates that visitors must sign in. The visitor book lists requirements for coming on site, including 72 hours poultry free. A portable hand pump pressure sprayer for disinfection of vehicles was present. The main site office keeps the records from the three farms. Only vehicles that require access should enter the site (feed deliveries etc.). Delivery drivers should wear protective overshoes when on site. The farm manager

lives in a private residence that requires him to drive through the site; however, he follows the procedure of disinfecting the vehicle on and off when doing so.

RECORD KEEPING: The site had two visitor books, one for people visiting site the poultry site, and one for people only visiting the office. The site visitor book was kept in a wooden shed used as changing room between sites.

BIOSECURITY PROCEDURES: A site-specific boilersuit and wellington boots policy was introduced due to the occurrence of blackhead on Site 3, but it was not completely implemented and biosecurity in the changing shed was poor.

Foot dips (not covered) with disinfectant (BioVX -Biolink Limited- a Defra approved disinfectant at a strength of 1%) were present at the external entrance of each of the poultry sheds.

There were anterooms within the sheds with barrier separating clean and dirty areas, and building specific wellington boots, but no building specific boilersuits. Sheds 6 & 7 had a shared anteroom. Gloves not usually used, hand sanitiser present for use in the anterooms.

Compliance with biosecurity procedures for external visitors appeared to be poor.

STRUCTURE AND MAINTENANCE: Large portions of the site were concrete in a moderate state of repair; however, the turkey sheds were bordered with hardcore on three sides.

The sheds were of a relatively old build (estimated 1980s). Houses 9 and 10 had more recent corrugated metal roofs and existed as two standalone structures. Houses 6 and 7 were two separate shed structures, bridged by a shared anteroom. They had corrugated asbestos roofs with a heavy covering of moss.

The internal structures in the sheds were mostly made of wood, some of which was in poor repair, with multiple holes identified along the lower edge of the ceiling. One hole had damp wood present on the other side. The houses were ventilated with wall mounted extractor fans and covered-chimney style air inlets. These were potentially accessible to wild birds, although the internal openings would have restricted full access to the shed.

STAFF: Two staff members cared for all birds in the three-farm complex, with site 3 typically the last site visited on morning checks. Changes were implemented from 27/11/2020 to minimise indirect contact between sites, but these were insufficient to avoid disease spread.

FEED DELIVERIES: Require feed vehicles to drive on site. Delivery drivers arrive and leave vehicles to sign the visitor book in the shed. They should then spray their vehicle tyres at this time. The driver uses a disposable plastic boilersuit and blue polythene/plastic overshoes.

Each house has a separate external feed bin, which delivers feed into an open-top hopper (accessible to rodents) within the sheds or within the personnel anteroom of the shed.

Vehicles leave the premises by the same route they entered and should stop to disinfect the wheels using the disinfectant sprayer.

Compliance with biosecurity procedures for drivers could not be verified.

BEDDING: Was delivered in wrapped bales on wooden pallets and stored in an open sided barn opposite Houses 6 & 7. Bedding was refreshed as required, with pallets moved into a fenced off antechamber of the sheds, where the bales were unwrapped, and the shavings distributed in the sheds. Pallets were moved by a telehandler shared between sites.

There was no C&D of the packaging of the bales before they were moved into the shed and the wrapping and wooden pallet bottom was kept in the antechamber. At the time of the visit, visible faecal contamination was observed on the black wrapping of some of the litter.

ABP: Was collected as part of daily checks and was collected in bags in the shed, later emptied into a sealed bin, where the carcases were then sprayed with blue dye. The sealed bin was in a communally accessible area on site. It was collected by a contractor on an ad hoc basis and sent for rendering. The contractors usually visit each of the three sites on the same day for these collections.

On arrival, the driver leaves the vehicle to sign the visitor book in the shed. They should then spray their vehicle tyres at this time. Once inside by the carcase bin, the forklift from the truck was removed and the ABP collector unlocks the lid of the bin on site. At this point he should be wearing boot protectors (the haulier should provide these themselves). It is not known whether this was adhered to. The forklift was used to empty the bin into the vehicle and the bin was then replaced on the concrete apron. The driver does not stop to disinfect the wheels upon exiting the site and the forklift was not disinfected.

WATER: Was sourced from the mains, filling a single large, covered water tank external to the houses. It was then pumped to each of the houses, and it was supplied to the turkeys in hanging bell drinkers. Water was chlorinated and acidified on site.

RODENT CONTROL: Was mainly external rat bait boxes placed around the edges of the site and several mouse bait boxes present in the antechamber of the houses. It was contracted out and the last visit was on 20/10/2020, recording rodent activity on each site and recurrent corrective actions recommended (sealing holes around doors) but these had not been addressed. Mouse droppings were present in the anteroom to House 7, and a freshly dead mouse under the chest freezer in the anteroom.

The following information details the operation of site 2

Details as in Site 1 except as indicated below:

The sheds were of a similar build to the sheds on Site 1, slightly more recent in construction. The guttering was in variable states of repair. The internal structures in the sheds were mostly covered with a PVC sheet material, with sheeting lining the ceiling. Sheds in a variable state of repair, occasional gaps might have allowed access of vermin.

BEDDING: stored either on the concrete apron or between the houses.

Overview of tracing activities

Tracings enquiries were carried out in tandem with the enquiries for AIV 2020/06 as the two IPs were part of the same three-site farm complex and shared personnel and practices.

The following tracing events were investigated:

MOVEMENTS OF FARM PERSONNEL:

1. FARM MANAGERS - Two full-time staff members were responsible for day to day running of this IP and associated IP (AIV 2020/06). Both managers were contacted and confirmed they did not visit other poultry premises and had no contact with other poultry/birds outside of the three sites. It was the company policy that staff should not have birds of their own.

2. OTHER STAFF -One other company staff member provided support to the IP from 27/11/2020to 29/11/2020 (within the high-risk spread window). He confirmed details, biosecurity protocols and that he kept no poultry/birds at home.

3. COMPANY AREA MANAGER - Moved between the three sites and two other turkey units. He confirmed he was last on the IP on 20/11/2020 which was outside the high-risk window. He followed site specific PPE and C&D protocols.

MOVEMENTS OF VEHICLES:

4. FEED DELIVERY - Several deliveries of feed to the premises including during high-risk source (27/11/2020) and high-risk spread (01/12/2020) tracing window. Information was sought about the transport, delivery routes and biosecurity arrangements. This informed a full risk assessment concluding that the overall risk for source was very low and for spread low, with low uncertainty in both cases, recommending contacting the drivers who confirmed they had no poultry at home, and they did not visit any premises with poultry after the IP.

5. BEDDING DELIVERY – Last wood shaving delivery was during the likely source and spread tracing window (25/11/2020).

6. FALLEN STOCK COLLECTIONS – Last collection was during the likely source and spread tracing window (24/11/2020).

The above investigations did not identify any potential contact premises and all tracing investigations were satisfactorily completed and closed.

Source investigations

Hypothesis for the source

Indirect contact with other susceptible poultry was assessed as highly likely, with low uncertainty.

Assessment and evidence base for the likely source

The assessment was based on:

- the fact that personnel and equipment were shared with Site 3 (AIV 2020/06), the other farm of this three-farm complex, with relatively poor biosecurity, and
- genomic analysis indicating virtually 100% similarity between isolates of AIV 2020/06 and AIV2020/07.

A second hypothesis considered for source was indirect transmission from infected wildlife, assessed as medium likelihood with low uncertainty. Several possible pathways for introduction were identified, including via the bedding up process, via water leak from roof or via rodent activity.

Spread investigations

Assessment of potential and likelihood of spread

Potential spread pathways investigated were assessed as being very low or negligible likelihood, with low uncertainty.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds, or indirect contact with infected poultry on an adjacent premises that is under the same holding number and part of the same business.

AIV 2020/08, Attleborough

Description of the premises

Overview of the premises and the wider business

This premises was a commercial free-range turkey unit located in Norfolk. It was a contracted grower farm for a large UK based integrated poultry company, and was one of only two free-range turkey farms within the organisation.

The farm was stocked as an all-in all-out system, with turkeys aged 45 to 62 days sourced from a rearing farm in Lincolnshire on 12/10/2020. Slaughter was due at the time the suspicion of disease was reported.

The premises was established two years previously, as a temporary site in a field situated at the end of farm track.

Description of the housing

Turkeys were split evenly between two houses, located about 200 metres apart. Each house was constructed from five interconnected poly-tunnels with mesh sides. Houses were divided internally into three pens, using meshed fencing to create two larger pens, each consisting of two polytunnels and a smaller pen of just one polytunnel running in between. There were gaps between the different panels comprising the roofs and sides which were large enough to potentially allow entry of wild birds. Wild birds would also have been able potentially to access houses when the rolling tarpaulin covers were opened at the ends of the polytunnels. Prior to 22/11/2020, the turkeys had access to ranges within fenced boundaries, which for house 2 extended to the edge of adjacent woodland.

One worker ran the site, with a manager visiting every other day.

Species and number of each present

30,000 fattening turkeys (*Meleagris gallopavo domesticus*) – a mixture of bronze and white, with both males and females, aged between 100 to 120 days old.

Description of the surrounding area

The surrounding area was largely arable, with a relatively high density of poultry premises. A small wooded area was situated to the north. Game birds (pheasants and partridges) were abundant in adjacent fields, associated with close-by commercial shoots. Other wild birds, such as gulls and robins, were commonly observed on these fields, although not

many wild birds were reported to have been seen on the farm. The farm manager had observed many geese flying over the IP.

Surveillance activity

PZ (0-3km)

48 premises with poultry holding between 1-75,000 birds

(10 premises with 50 or more birds)

SZ (3-10km)

243 premises with poultry holding between 1-372,000 birds

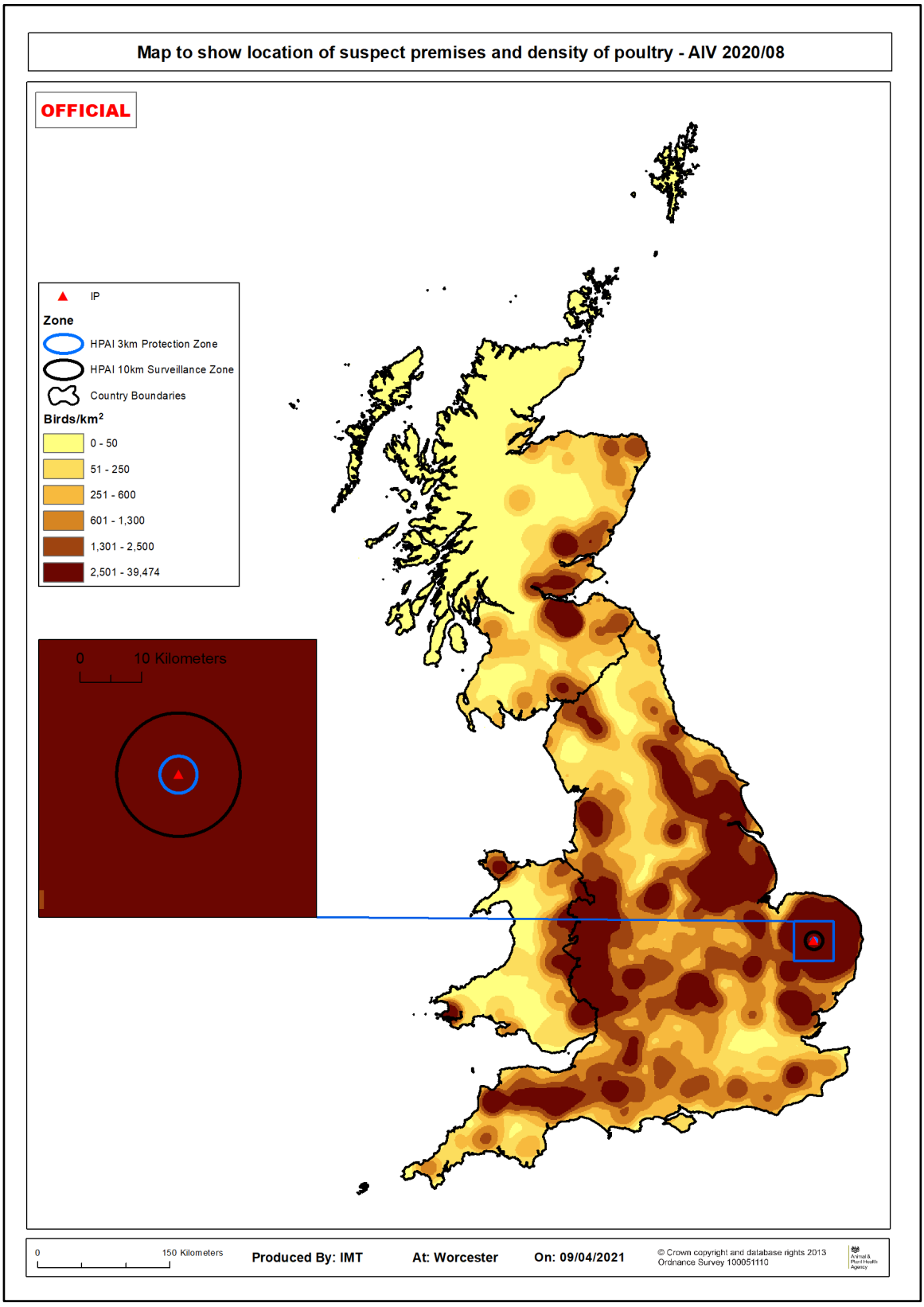
(82 premises holding 50 or more birds)

Ornithological assessment

The IP was an inland site, which whilst distant from known aggregations of waterfowl was situated in a mixed rural landscape rich in small waterbodies, semi-managed land-uses and diverse natural habitats. Wildfowl were likely to be present close to the IP (i.e. < 2 km) although probably not in large numbers. More unusually, other waterbirds were also likely to be abundant in nearby fens, rough pasture and wet woodland, all in a neighbouring conservation site. The local abundance of riparian pasture and outdoor piggeries suggested bridge species (gulls and corvids) would be common and likely to crisscross the landscape between potential foraging sites and roosts. A nearby river, close to the IP might have marked a commuting route for these species.

Location in GB

Figure 21: Location of AIV 2020/08



Plan of the infected premises

Figure 22: Plan of AIV 2020/08

Disease Picture

Clinical signs started in house 1 on 30/11/2020 and spread to house 2 on 03/12/2020. These included lethargy, inappetence, neurological signs (e.g. torticollis, head tremors and flipping over on their backs) and the birds were quiet, and non-responsive. Highest mortalities were reported in pen 1 of house 1, although all three pens were affected from the start of first signs. A stepwise increase of daily mortalities in house 1 occurred from 70 per day on 01/12/2020 to 200 per day on both 02/12/2020 and 03/12/2020, and then increasing to approximately 2,000 on both 04/12/2020 and 05/12/2020.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	09/11/2020 – 15/11/2020
Likely:	16/11/2020 – 26/11/2020
High risk:	27/11/2020 – 30/11/2020

Spread tracings window:

Precautionary:	10/11/2020 – 16/11/2020
Likely:	17/11/2020 – 27/11/2020
High risk:	28/11/2020 – 03/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 27/11/2020

Timeline

Table 9: Timeline for AIV 2020/08

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**09/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20	Day 1	**10/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19	Day 2	11/11/20	
Day 18	Day 3	12/11/20	
Day 17	Day 4	13/11/20	
Day 16	Day 5	14/11/20	
Day 15	Day 6	15/11/20	
Day 14	Day 7	**16/11/20**	Start of likely source tracing window (-14d).
Day 13	Day 8	**17/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 9	18/11/20	
Day 11	Day 10	19/11/20	
Day 10	Day 11	20/11/20	
Day 9	Day 12	21/11/20	
Day 8	Day 13	22/11/20	Moved inside - previously free range outdoors.
Day 7	Day 14	23/11/20	
Day 6	Day 15	24/11/20	
Day 5	Day 16	25/11/20	
Day 4	Day 17	26/11/20	
Day 3	Day 18	**27/11/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 19	**28/11/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 20	29/11/20	
Day 0	Day 21	**30/11/20**	**Precautionary start of clinical signs.**
	Day 22	01/12/20	70 deaths in shed 1 only.
	Day 23	02/12/20	200 deaths in shed 1.
	Day 24	**03/12/20**	1900 deaths in shed 1 & 11 deaths in shed 2; Report case initiated (DPR 2020/42) - restrictions served and sampling undertaken.
	Day 25	**04/12/20**	H5N8 confirmed by PCR (AIV 2020/08).
	Day 26	05/12/20	
	Day 27	06/12/20	
	Day 28	**07/12/20**	Pathogenicity confirmed as highly pathogenic. Culling commenced.
	Day 29	08/12/20	
	Day 30	09/12/20	
	Day 31	**10/12/20**	Culling completed.
	Day 32	11/12/20	
	Day 33	12/12/20	
	Day 34	13/12/20	
	Day 35	14/12/20	
	Day 36	**15/12/20**	Preliminary C&D completed.
	Day 37	**16/12/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Biosecurity on the site was of a moderate standard. At the entrance to the farm there was a hand operated pump for disinfection of vehicle wheels entering or leaving the site, but no hard standing area. Sheds located adjacent to house entrances provided a biosecurity area for changing into farm dedicated wellington boots, and completing a visitors' book.

At the entrance to each pen there was a disinfection foot dip for use before and after entry into bird accommodation. The houses were not wild bird-proof. The area in front of the tunnels was stoned (hard-standing) and reported to be "muddy".

Straw bales used for bedding were stored outside on the hard standing - bales forming the top and bottom layers were discarded as potentially contaminated. Animal by-product bins were transported when full to a location outside the farm entrance for collection; a dedicated farm vehicle was used to avoid the collector entering the premises. Water was extracted from a bore hole that was protected from wild bird contamination.

Overview of tracing activities

The following tracing events were investigated:

MOVEMENTS OF FARM PERSONNEL:

1. FARM MANAGER - attended the IP every other day and every other week he visited a second free-range flock premises. His last visit to this other premises was on 25/11/2020, when the premises was being depopulated – this date was just outside the high-risk tracing window.

2. OTHER FARM STAFF - there was only one permanent member of staff working at the IP. He was contacted and he confirmed his adherence to the biosecurity protocols and that his only contact with poultry/birds was during his work on the IP.

3. DIVISIONAL MANAGER FOR THE COMPANY - visited the IP one day during the high-risk spread tracing window to conduct a routine health check on the birds. He also took from the IP twelve carcasses, which he delivered for post-mortem examination to their associated veterinary practice. He was contacted and confirmed his adherence to the biosecurity protocols, that he did not keep poultry/birds at home and that he did not visit any other poultry premises on the day he visited the IP. He also confirmed handling and transport arrangements of the carcasses.

MOVEMENTS OF OTHER PEOPLE:

4. PVS – a private veterinarian visited the site on the 03/12/2020 following increased mortality being reported on the previous day. In addition, twelve carcases were delivered to the veterinary practice. The information provided about biosecurity arrangements and disposal of carcases were assessed as satisfactory, and no further action requested.

5. PEST CONTROL SERVICE - last routine inspection visit by the contractor responsible for pest control took place outside the high-risk window.

MOVEMENTS OF VEHICLES:

6. FEED DELIVERY - one feed company supplied feed to the IP during the high-risk source tracing window. It also supplied feed to the other poultry premises visited by the farm manager. Information was sought about the transport, delivery routes and biosecurity arrangements. This informed a full veterinary risk assessment, which concluded that the overall risk for source was very low with medium uncertainty, with the recommendation that no further action should be taken.

7. FALLEN STOCK COLLECTIONS - one collection took place within the high-risk spread tracing window. Information was sought about the transport, collection route and biosecurity arrangements. In addition, a visit was carried out to the ABP collection centre to assess hygiene and biosecurity standards. This informed a full veterinary risk assessment, which concluded that the overall risk for spread was very low, with medium uncertainty with the recommendation that no further action should be taken.

The above investigations did not identify any other potential contact premises, and all tracing investigations were satisfactorily completed and closed.

Source investigations

Hypothesis for the source

Wild birds were considered to be the most likely source, with indirect contact more likely than direct contact, as the route for transmission.

Assessment and evidence base for the likely source

No domestic poultry or poultry products had been moved onto the premises during the source tracing window. The sister rearing farm was investigated because of shared management with the infected premises, and feed deliveries occurring on the same round. This sister premises had been depopulated on 25/11/2020 with no signs of disease reported. Feed deliveries and animal by-product collections were risk assessed as a potential source as being very low likelihood, with low uncertainty. Straw bedding was

delivered to the premises months previously, so was not considered to be a likely source of virus onto the premises. However, bales could have been contaminated by wild birds during storage outside on the premises, and prior to use as bedding – either contamination of the top or sides of the stack, or being washed through by rain from the top, and over-riding the precautionary practice of not using bottom and top layers of the stack.

Spread investigations

Assessment of potential and likelihood of spread

No movement of live poultry off the premises occurred during the spread tracing windows. Animal by-product collections, feed deliveries, and the collection of carcases by a private veterinary surgeon for post-mortem examination were assessed as very low likelihood, with low uncertainty for spread of infection to other poultry premises. Staff who worked on the farm had no contact with poultry outside their work on the infected premises.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/09, Kings Lynn

Description of the premises

Overview of the premises and the wider business

The infected premises was a commercial turkey fattening unit, that was part of a large integrated poultry production company. The management procedure for this farm was to rear nine week old male turkeys for about 11 weeks to slaughter, using an all-in all-out system. The flock that became infected was placed over a seven day period from 23 to 29/09/2020 and sourced from two rearing farms, one in Norfolk and one in Lincolnshire.

A contractor was routinely employed to thin-out birds at 19 weeks of age.

Description of the housing

Turkeys were accommodated in twelve poultry houses that were built in the 1970s. These were open span, wooden barns with steel frames. Roofs had been replaced six years previously with galvanised metal sheeting. Side window openings, covered with wire mesh and ducted fans, provided the inlet flow for the ventilation system, with outlets in the roof apexes. Each house had two lines of bell and cup drinkers and a line of automatic feeder pans. A heating system, burning LPG, was rarely used. The drinking water source for the birds was mains supply, with two water tanks on site. Water was chemically treated with hydrogen peroxide. Access to poultry accommodation was via a lobby, with separate doors at entrances and exits.

The houses were situated in two groups of six, separated by a length of farm track. A concrete apron surrounded houses and feed silos.

Species and number of each present

29,000 fattening turkeys (*Meleagris gallopavo domesticus*) – 19 week old males.

Description of the surrounding area

The premises was geographically located within a high poultry density area of East Anglia in the east of England.

The premises was not fenced. To the north it was separated from a large lake by a drainage ditch. It bordered an indoor intensive pig unit to the west, and private dwelling houses to the east. To the south some woodland separated the premises from arable land.

Farm staff reported seeing mostly pheasants on the premises.

Surveillance activity

PZ (0-3km)

43 premises with poultry holding between 1-722 birds

(4 premises with 50 or more birds)

SZ (3-10km)

56 premises with poultry holding between 3-35,200 birds

(19 premises holding 50 or more birds)

Ornithological assessment

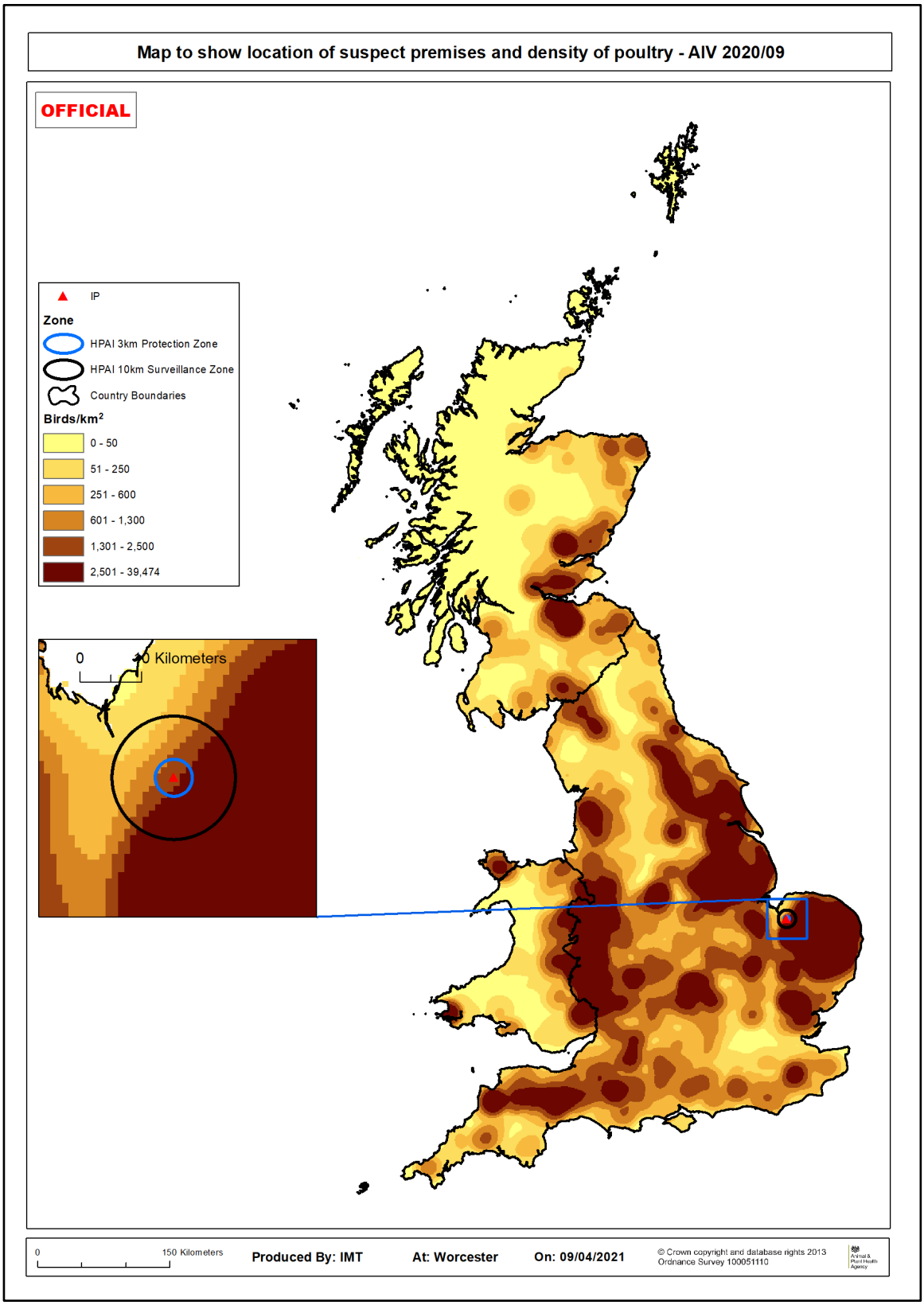
This premises was sufficiently close to the coast and an internationally important overwintering site for wildfowl (the Wash) to be affected by its presence. It was situated in a wet landscape, with abundant permanent freshwater bodies nearby, including a large lake (flooded gravel pit) less than 100m away, which hosted a significant number of birds. An APHA survey of the lake reported more than 900 wildfowl mostly comprised of Greylag geese. Therefore, it was concluded that wildfowl would be abundant within 2 km of the premises.

Bridge species would be abundant and active in this landscape; in part a product of its proximity to the coast (i.e. gulls), as well as potential forage provided by a wet low-lying agricultural landscape and mixed land-uses in a peri-urban setting (i.e. gulls and corvids). Groups of both gulls and corvids were observed close to the IP.

The conclusion was that wild birds would pose a likely source of infection pressure.

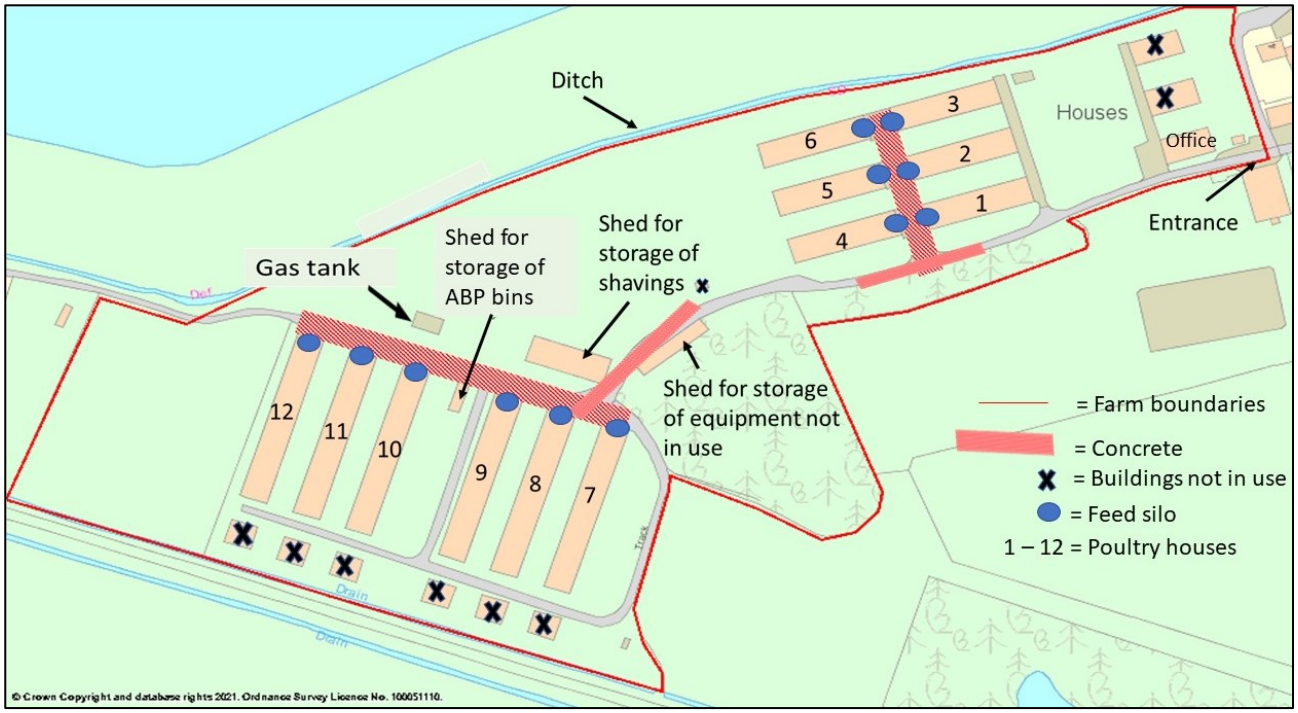
Location in GB

Figure 23: Location of AIV 2020/09



Plan of the infected premises

Figure 24: Plan of AIV 2020/09



Disease Picture

Clinical signs were first observed on 02/12/2020 as increased mortality in houses 1 and 2, in the first group of houses reached from the main road. Later signs included lethargy, depression, paleness, neurological signs (torticollis, incoordination), respiratory distress (open beaks gasping for air), diarrhoea, pyrexia (41.5 ^{o}C to 43.0 ^{o}C) and an exponential increase in daily mortalities.

TIMELINE

Tracings windows

Source tracings window:

Precautionary: 10/11/2020 – 16/11/2020

Likely: 17/11/2020 – 27/11/2020

High risk: 28/11/2020 – 01/12/2020

Spread tracings window:

Precautionary: 11/11/2020 – 17/11/2020

Likely: 18/11/2020 – 28/11/2020

High risk: 29/11/2020 – 05/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 28/11/2020

Timeline

Table 10: Timeline for 2020/09

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**10/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d)
Day 20	Day 1	**11/11/20**	Start of precautionary spread tracing window (source + 24h)
Day 19	Day 2	12/11/20	
Day 18	Day 3	13/11/20	
Day 17	Day 4	14/11/20	
Day 16	Day 5	15/11/20	
Day 15	Day 6	16/11/20	
Day 14	Day 7	**17/11/20**	Start of likely source tracing window (-14d)
Day 13	Day 8	**18/11/20**	Start of likely spread tracing window (source tracing window +24h)
Day 12	Day 9	19/11/20	
Day 11	Day 10	20/11/20	
Day 10	Day 11	21/11/20	
Day 9	Day 12	22/11/20	
Day 8	Day 13	23/11/20	
Day 7	Day 14	24/11/20	
Day 6	Day 15	25/11/20	Farm manager visit to Setchey Farm
Day 5	Day 16	26/11/20	
Day 4	Day 17	27/11/20	
Day 3	Day 18	**28/11/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak**
Day 2	Day 19	**29/11/20**	Start of high risk spread tracing window (source +24h)
Day 1	Day 20	30/11/20	
Day 0	Day 21	**01/12/20**	**Precautionary start of clinical signs** Shed 1 - 1 dead; Shed 2 - 1 dead = normal mortality?
	Day 22	02/12/20	Shed 1 - 5 dead & 4 cull; Shed 2 - 1 dead
	Day 23	03/12/20	Shed 1 - 11 dead & 3 cull; Shed 2 - 2 dead
	Day 24	**04/12/20**	Shed 1 - 315 dead; Shed 2 - 20 dead & 4 cull.Consultation case with PVS at 17:15. Restrictions served (DPR 2020/43) and sampling undertaken.
	Day 25	**05/12/20**	H5N8 confirmed (AIV 2020/09).
	Day 26	06/12/20	
	Day 27	**07/12/20**	Pathogenicity confirmed as highly pathogenic.
	Day 28	08/12/20	Culling commenced.
	Day 29	09/12/20	
	Day 30	10/12/20	
	Day 31	11/12/20	
	Day 32	**12/12/20**	Culling completed.
	Day 33	13/12/20	
	Day 34	14/12/20	
	Day 35	15/12/20	
	Day 36	16/12/20	Preliminary C&D completed.
	Day 37	**17/12/20**	Preliminary C&D effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Biosecurity on this premises was considered to be moderate. Vehicles belonging to staff and visitors remained outside the premises, and for vehicles that had to enter, a pressure washer with disinfectant was available to clean wheels on entry. The entrance gate remained open for access to a pig farm, located adjacent to the western border of the premises. It was reported that vehicular traffic to the pig farm did not use this disinfection point.

Site specific clothing and wellington boots were used by staff. Lobby areas within each poultry house were partitioned into clean (adjacent to poultry accommodation door) and dirty (adjacent to exterior door) areas by a low wooden barrier. However, these were not completely effective because the barriers were not fixed to the floor and several were broken. Regularly maintained disinfectant footbaths were present outside each poultry house entrance and within the clean area of the lobby. Within the lobby, boots were changed to house dedicated footwear and gel disinfectant to sanitise hands. Bales of wood shavings for bedding were taken by hand through the lobby, where they were unwrapped. They were double wrapped in plastic whilst stored outside.

Houses were poorly maintained, creating several potential ingress sites for small wild birds and vermin. Mesh, covering windows and roof ventilation outlets, had large holes and some did not fully cover the gaps. In house 1, an external fan cover was broken. In houses 1 to 6, there were large gaps in the outer walls where new electric cables and water pipes had been installed.

Animal by-products were stored in wheelie bins located in a shed. The bins remained permanently on site and were emptied into a bulk trailer at collection. Monthly pest control was contracted out, and there was no evidence of vermin infestation during the investigation.

Overview of tracing activities

The following tracing events were investigated:

MOVEMENTS OF FARM PERSONNEL:

1. FARM MANAGER – besides managing the IP he also managed two other fattening units. One had been depopulated and the other one was last visited outside the high-risk source and spread window. He was contacted and confirmed his biosecurity protocols, and that he did not keep poultry/birds at home.

2. TWO OTHER STAFF - (excluding the farm manager) worked full-time on the IP. One was contacted and confirmed his biosecurity protocols and that he did not keep poultry/birds at home. The other staff member was unreachable, but the farm manager provided assurances that he did not work in other poultry premises. In addition, he indicated it was the company's policy that staff should not keep birds of their own.

MOVEMENTS OF OTHER PEOPLE:

3. PVS – a private veterinarian performed post-mortem examinations of carcases submitted to the practice during the high-risk spread window. The information provided about biosecurity arrangements and disposal of carcases were assessed as satisfactory, and no further action requested.

4. ELECTRICIAN – one electrician visited the premises during the high-risk spread window to service the alarm device inside the farm's office. He was contacted and confirmed that he only went to the farm office, adhered to biosecurity protocols on/off site, did not visit other poultry premises on the same day and he kept no poultry at home.

5. ENGINEERS – one electrician, employed by the company, and two contractors were reported to have visited the site. However, these works were undertaken outside the high-risk source and spread window.

6. PEST CONTROL PERSON – the last routine inspection visit by the contractor responsible for pest control took place within the precautionary spread window.

MOVEMENTS OF VEHICLES:

7. FEED DELIVERY - one feed company supplied feed to the IP during the high-risk spread window. Information was sought about the transport, delivery routes and biosecurity arrangements. This informed a full veterinary risk assessment that concluded that the overall risk for both source and spread was very low with medium uncertainty, with the recommendation that no further action should be taken.

8. BEDDING – two deliveries of bedding material occurred within the high-risk spread tracing window. Information was sought about the transport, delivery routes and biosecurity arrangements for both vehicles and drivers. On both occasions the IP was last in the delivery route of the day. In addition, on the basis of satisfactory C&D protocols and the lack of other poultry contacts of the drivers, it was concluded overall risk for spread was very low.

9. FALLEN STOCK COLLECTIONS - there were collection reported within the precautionary source and spread window but none during the high-risk ones.

MOVEMENT OF LIVESTOCK:

10. TURKEYS OFF TO SLAUGHTER - a full load of turkeys (thinning of birds from the non-affected sheds) was sent directly for slaughter to an approved slaughterhouse within the high-risk source and spread window. Information was sought about the transport arrangements (driver and vehicle) and the catching gang involved in the depopulation.

a. CATCHING GANG – the catching gang members were individually traced, and they confirmed that none kept poultry at home and that they adhered to biosecurity protocols on/off site. On the same day of the thinning, they visited one other poultry premises prior to the IP. Investigations revealed the premises had been fully depopulated on that day. On that basis no further action was requested.
b. VEHICLES AND DRIVER TRANSPORTING THE TURKEYS – enquiries confirmed the modules, forklifts and lorry were cleaned and disinfected at the slaughterhouse after unloading the birds.

The above tracings investigations did not identify any potential contact premises, and all tracing investigations were satisfactorily completed and closed.

Source investigations

Hypothesis for the source

The most likely source for infection was concluded to be indirect contact with wild birds with low uncertainty.

Assessment and evidence base for the likely source

The ornithological expert conclusion was that there was significant infection pressure posed by wild birds at this location. Biosecurity was assessed as not being an adequate barrier to prevent transmission of environmental virus originating from wild birds into the poultry houses, via personnel movement on site. Additionally, the outer wrapping of additional bedding material was observed to be visibly contaminated during outside storage, and mechanical transfer by vermin could not be ruled out. Direct contact was considered less likely because there had been no recorded incidents of wild birds found or seen in the poultry houses, although this could not be ruled out.

No domestic poultry or poultry products had been moved onto the premises during the source tracing window. Tracing activities concluded that transmission pathways from poultry on other premises involving personnel, vehicles, feed, bedding, and animal by-products were of very low likelihood as source.

Spread investigations

Assessment of potential and likelihood of spread

The only live poultry movements off the premises during the spread tracing windows were direct to slaughter on 25/11/2020 (likely spread window) and 01/12/2020 (high risk spread window). The later thinning was from houses 8, 9, 10, 11, and 12 where clinical signs of disease were not apparent. The Food Standards Agency was informed. Some higher risk personnel contacts with the premises relating to the farm manager and catching gangs were found to be associated with premises that were subsequently depopulated with no recorded clinical problems. Animal by-product collections, feed deliveries, post-mortem examination of carcases by a private veterinary surgeon, and visits by other people (electrician, engineer, and pest-control) were assessed as very low risk with low uncertainty for spread of infection to other poultry premises.

AIV 2020/08, was assessed as not being linked as source or spread to the premises in this report (AIV2020/09).

However, in a wildlife rehabilitation centre within the protection zone, HPAI H5N8 was detected post-mortem in five swans that died between 25/11/2020 and 29/11/2020, and a fox and three seals, which died between 05/11/2020 and 06/12/2020. Virus was isolated in all tissues sampled from the fox, but only in brain tissue from the seals. The swans, fox and seals had all been housed at some point in an isolation facility at the centre. At surveillance visits to this premises, no infection was detected by clinical signs nor from samples taken from the ducks present; the latest sampling visit on 07/01/2021 being three weeks after the last recorded deaths. Risk of spread of infection from the centre was assessed as very low because of the very high standards of biosecurity and delayed release of rehabilitated animals to 28/01/2021.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/10, Droitwich

Description of the premises

Overview of the premises and the wider business

The premises was a small, privately-run, wild and domestic bird (mainly waterfowl) rescue and rehabilitation centre in Worcestershire, co-located with an unrelated retail business. The rescue centre was not open to the public. It was managed by the owner and one main helper, with additional weekend help from three other people. Birds were collected or brought to the premises for treatment and rehabilitation, following which they were released, rehomed, or retained.

Description of the housing

The centre comprised three wooden bird houses with a communal outdoor area containing two concrete pools. The whole area was contained within netted sides and roof. The houses contained communal areas, as well as pens for the segregation of sick/injured birds. Beak-to-beak contact was possible between communal and penned birds.

Species and number of each present

27 swans, 12 ducks, 7 geese.

Description of the surrounding area

The surrounding area included fields belonging to the premises that were grazed by a small number of sheep. A river and small ponds were situated on the boundary of the wider property, but were not frequented by many wild birds. There were no registered poultry premises within 1 km of the premises.

Surveillance activity

No zones were implemented on the basis of a risk assessment which concluded that this represented a special category premises with very low likelihood of spread of disease from the premises over and above the prevailing background risk from wild birds in the area.

Ornithological assessment

This premises was not immediately associated with any landscapes features suggestive of a substantial infection pressure from wild birds, lacking large permanent water bodies adjacent to the site, or locations likely to attract substantial aggregations of bridge species.

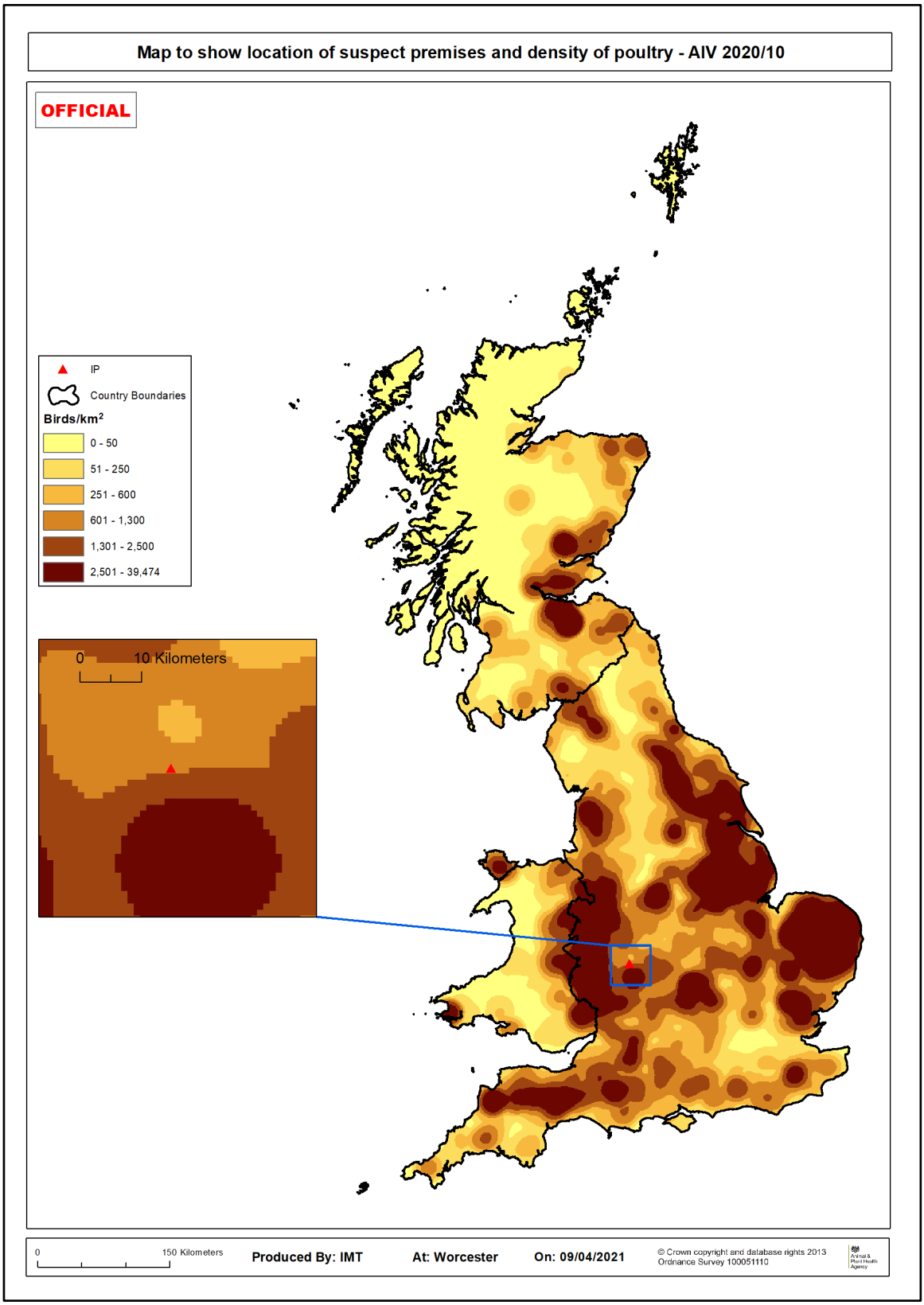
There were aggregations of wildfowl relatively close to the premises (at more than 1.7 km) though these were restricted to larger waterbodies and there were not substantial collections of wild birds. However, it was likely that wildfowl and other waterbirds were present on smaller ponds, or in rivers close to the site, though there appeared to be no reason or possibility for them to have encroached directly onto the premises.

Bridge species would have been abundant and active in this landscape; in part a product of its proximity to some large gull roosts, as well as potential forage provided by a wet low-lying agricultural landscape and mixed land-uses in a peri-urban setting (i.e. gulls and corvids). There was a collection of fast-food restaurants within 250 metres of the site and the premises was immediately adjacent to a motorway.

Therefore, wild birds were considered to be a plausible source of infection pressure.

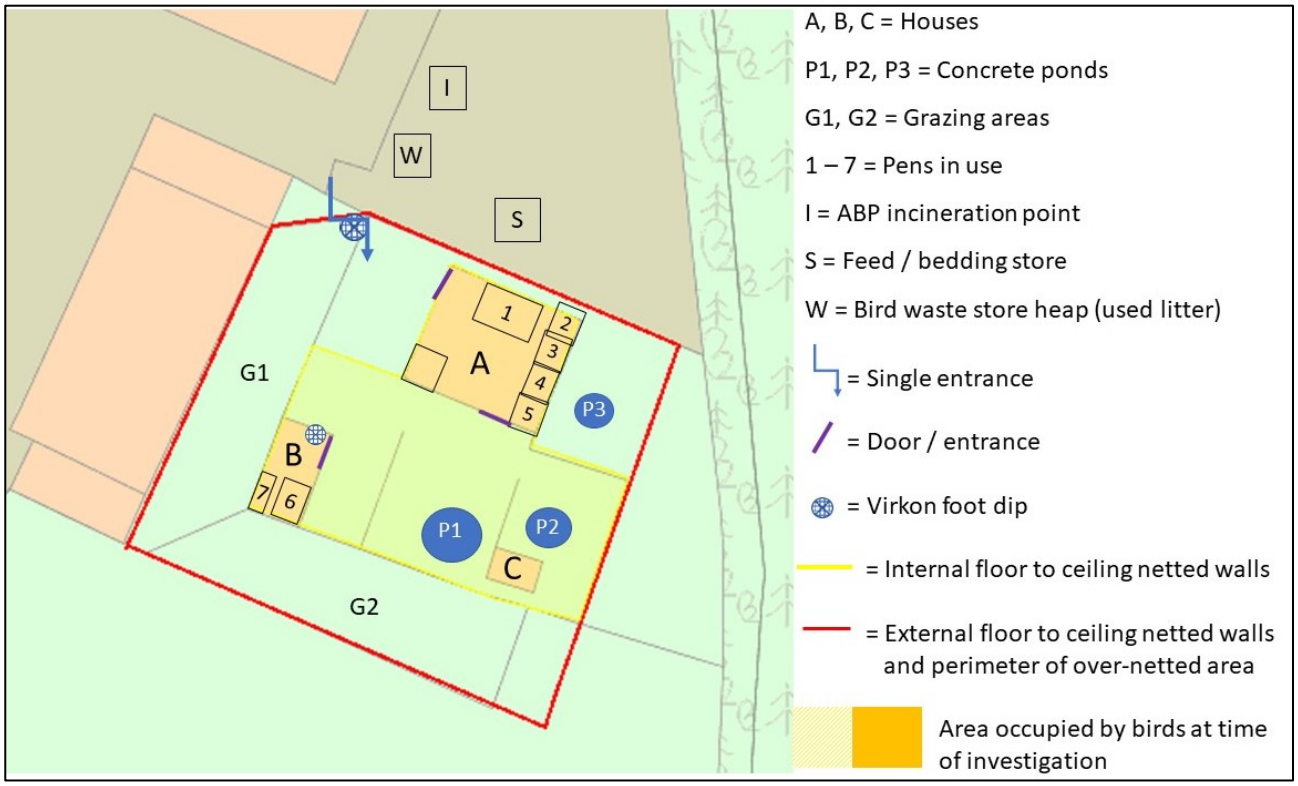
Location in GB

Figure 25: Location of AIV 2020/10



Plan of the infected premises

Figure 26: Site plan of AIV 2020/10



Disease Picture

Mortalities first occurred after the introduction of two sick swans rescued from a nearby river. Both swans reportedly died within 24 hours of collection and six in contact chickens died during the following week. A further seven swans died, with the last death reportedly occurring on 05/12/2020.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	30/10/2020 – 05/11/2020
Likely:	06/11/2020 – 16/11/2020
High risk:	17/11/2020 – 19/11/2020

Spread tracings window:

Precautionary: 31/10/2020 – 06/11/2020

Likely: 07/11/2020 – 17/11/2020

High risk: 18/11/2020 – 10/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 17/11/2020

Timeline

Table 11: Timeline for AIV 2020/10

Source Tracing Window	Spread Tracing Window	Date	
Day 21		30/10/20	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		31/10/20	Start of precautionary spread tracing window (source + 24h).
Day 19		01/11/20	
Day 18		02/11/20	
Day 17		03/11/20	
Day 16		04/11/20	
Day 15		05/11/20	
Day 14		06/11/20	Start of likely source tracing window (-14d) .
Day 13	Day 1	07/11/20	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	08/11/20	
Day 11	Day 3	09/11/20	
Day 10	Day 4	10/11/20	
Day 9	Day 5	11/11/20	
Day 8	Day 6	12/11/20	
Day 7	Day 7	13/11/20	
Day 6	Day 8	14/11/20	
Day 5	Day 9	15/11/20	
Day 4	Day 10	16/11/20	
Day 3	Day 11	**17/11/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 12	**18/11/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	19/11/20	
	Day 14	**20/11/20**	**Precautionary onset of first clinical signs (based on 2 rescued wild swans introduced to premises on this date)**
	Day 15	21/11/20	2 rescued swans (a/a) died
	Day 16	**22/11/20**	
	Day 17	23/11/20	6 chickens died 'a few days' after the 2 swans
	Day 18	24/11/20	7 in-contact swans died over course of days up to 5/12/2020.
	Day 19	25/11/20	
	Day 20	26/11/20	
	Day 21	27/11/20	
	Day 22	28/11/20	
	Day 23	29/11/20	
	Day 24	30/11/20	
	Day 25	01/12/20	
	Day 26	02/12/20	
	Day 27	03/11/20	
	Day 28	04/12/20	
	Day 29	05/12/20	Last reported death (9th swan)
	Day 30	06/12/20	
	Day 31	07/12/20	
	Day 32	08/12/20	
	Day 33	09/12/20	
	Day 34	10/12/20	Suspicion of disease reported by APHA Field Operations (following media story). APHA investigation and sampling undertaken (**DPR2020-48**). Restrictions served.
	Day 35	11/12/20	
	Day 36	12/12/20	Veterinary Field Epidemiology investigation visit
	Day 37	13/12/20	**HPAI H5N8 confirmed AIV2020-10**
	Day 38	14/12/20	Culling completed. Preliminary C&D completed.
	Day 39	15/12/20	Preliminary C&D effective
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possiblity of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possiblity of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

The whole enclosure was contained inside full height perimeter netting and complete overhead netting (which contained some holes through which small birds had been observed to pass).

Routine personnel biosecurity comprised a Virkon foot dip at the single entrance to the site (in the perimeter fence of the bird enclosure). Dilution rates were likely to have been at an ineffective level prior to 20/11/2020. There was no change of clothing or footwear for personnel entering the bird enclosure, and no use of other PPE.

Access to the bird enclosure was limited to specific site staff from 20/11/2020, but prior to that people delivering or collecting birds would have accessed the enclosure.

A significant rodent infestation was noted (rats).

Approximately 150 wild Canada geese often grazed the field immediately next to the bird enclosure, and beak to beak contact through the perimeter netting would have been possible prior to the end of November 2020 (whereupon the enclosure was altered to prevent the rescue centre birds accessing the outermost communal areas).

Overview of tracing activities

Tracings for this premises consisted of four personnel who worked at the swan sanctuary, one RSPCA inspector, two visits to the private vet with injured swans and the feed and bedding deliveries.

All were closed satisfactorily as none had any same day bird contacts within the high-risk tracing window, except for two part-time rescue centre workers, who could not be contacted.

Source investigations

Hypothesis for the source

The most likely source (with medium uncertainty) of infection was the introduction of two sick swans on 20/11/2020.

Assessment and evidence base for the likely source

DIRECT INTRODUCTION BY SUSCEPTIBLE DOMESTIC SPECIES OR THEIR PRODUCTS – negligible likelihood with medium uncertainty. There was no movement of domestic birds during the high-risk window (wild swans only), but record-keeping was incomplete.

INDIRECT INTRODUCTION BY SUSCEPTIBLE DOMESTIC SPECIES WITH KNOWN OR UNDISCLOSED INFECTION – low likelihood with medium uncertainty. Two of the four staff (two staff uncontactable), and other associated personnel had no contact with domestic birds. There was poor biosecurity overall on the premises.

INTRODUCTION FROM PRODUCTS CONTAMINATED AT SOURCE – low likelihood with medium uncertainty. The water supply was a mixture of rainwater collected from the roof of House A and mains water. Feed and bedding were bagged at source and delivered to a secure fully enclosed container on site.

INFECTED WILD ANIMAL SOURCE – high likelihood with medium uncertainty of direct contact. Two wild swans with clinical signs were introduced to the premises on 20/11/2020. Beak-to-beak contact with wild Canada geese grazing regularly in the adjacent field was possible until late November 2020. Medium likelihood with medium uncertainty of indirect contact: wild bird faeces from overflying birds, significant vermin (rat) activity on site, and general lack of site biosecurity.

INFECTION FROM INTERNATIONAL SOURCE - negligible likelihood with low uncertainty. No known international connections.

Spread investigations

Assessment of potential and likelihood of spread

DIRECT CONTACT WITH OTHER SUSCEPTIBLE DOMESTIC SPECIES OR THEIR PRODUCTS – negligible likelihood with low uncertainty. No birds were rehomed during the high-risk window and there was no egg production.

INDIRECT CONTACT WITH OTHER SUSCEPTIBLE DOMESTIC SPECIES – low likelihood with medium uncertainty. Swans were taken to the veterinary surgery, but the attending vets did not carry out any other poultry visits on those days. Personnel did not have contact with other domestic birds (note two part time uncontactable).

ONWARD TRANSMISSION THROUGH WILDLIFE – low likelihood with medium uncertainty. Rescued birds were contained within netted enclosures and sheds; small gaps in netting could have allowed small birds to enter. Used litter was stacked outside the enclosure in an uncovered heap prior to incineration on site. Onward transmission was possible but insignificant given the heavy viral load in the wild bird populations.

ONWARD TRANSMISSION THROUGH INTERNATIONAL CONNECTIONS – negligible likelihood with low uncertainty. No known international connections.

Remaining uncertainty

Two part-time workers were uncontactable. This tracing was closed on the basis that their potential level of contamination would have been no greater than the prevailing background burden of disease within the local wild bird population. In addition, these individuals only worked at the sanctuary for one day per week, thus limiting their exposure even further.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with two sick wild swans introduced to the centre on 20/11/2020.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/11, Willington

Description of the premises

Overview of the premises and the wider business

This premises was a small, hobby, breeding falconry (normally containing between 35-40 birds) together with five domestic poultry situated on a small-holding, where the owner and his family also live. Other domestic species on site were one horse and three dogs. The owner and his wife worked on a local estate, but have had no contact with the estate's pheasant shoot.

Description of the housing

Falcons were kept in four re-purposed buildings (brick stables and wood/metal sheeted barns), they were either fully covered or partly enclosed with metal mesh or netting (both top and sides). The mesh size was large enough have allowed entry of small birds and wild bird faeces from birds that perched on the cages or flew over. The falcons were housed individually, in breeding pairs or in larger communal groups.

Poultry were contained in a stable, which was physically separate from the falcons.

A separate food storage and preparation room was situated adjacent to the falcon accommodation.

Species and number of each present

Approximately 40 peregrine, gyr, saker, lugger falcons and their hybrids.

3 chickens

2 ducks

Description of the surrounding area

Some small waterbodies were situated more than 1.5 km from the infected premises. There were no poultry premises adjacent to this site.

Surveillance activity

PZ (0-3km)

54 premises with poultry holding between 1-77,019 birds

(6 premises with 50 or more birds)

SZ (3-10km)

104 premises with poultry holding between 2-214,001 birds

(43 premises holding 50 or more birds)

Ornithological assessment

This premises appeared isolated, and was situated in an intensively managed landscape, lacking significant waterbodies close to the site, it was disconnected from any habitats which might support waterbirds and relatively distant from likely roosts or forage for bridge species.

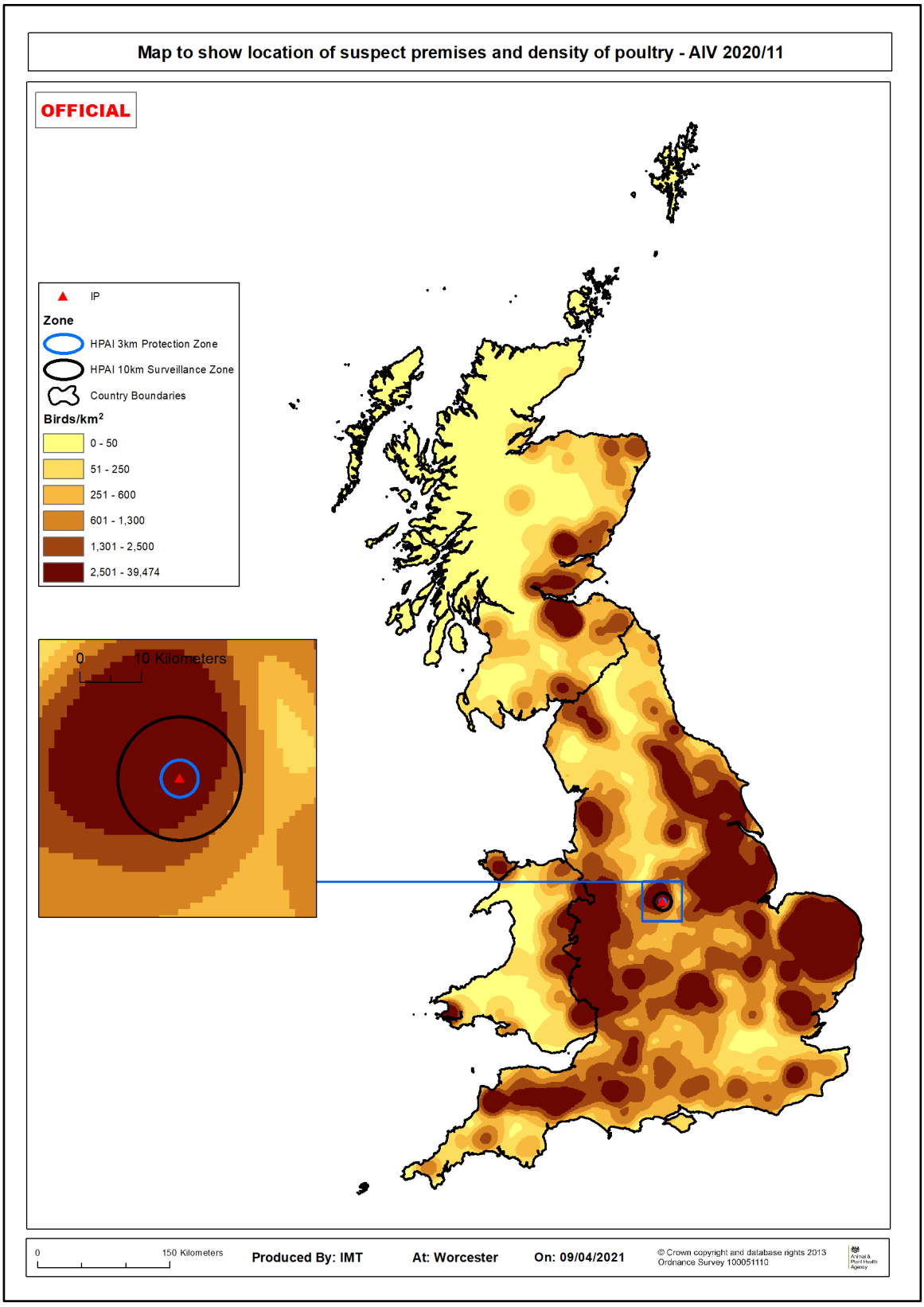
The only permanent waterbodies close to the IP were very small, and unlikely to host aggregations of wildfowl. Even at moderate distances (i.e. > 3 km) the waterbodies were small and held limited numbers of wildfowl. The only significant sites known for wildfowl were more than 10 km distant.

Gulls do not appear to be abundant in this landscape, and appear to have no reason to be attracted to the IP, or its neighbourhood. Similarly, whilst other bridge species (e.g. starlings, corvids) appear potentially well resourced, the isolation of the premises fails to suggest why bird traffic would be attracted to the site, or to fly over the site, en route to other destinations.

Therefore, it was concluded that there was no obvious source of infection pressure from wild birds.

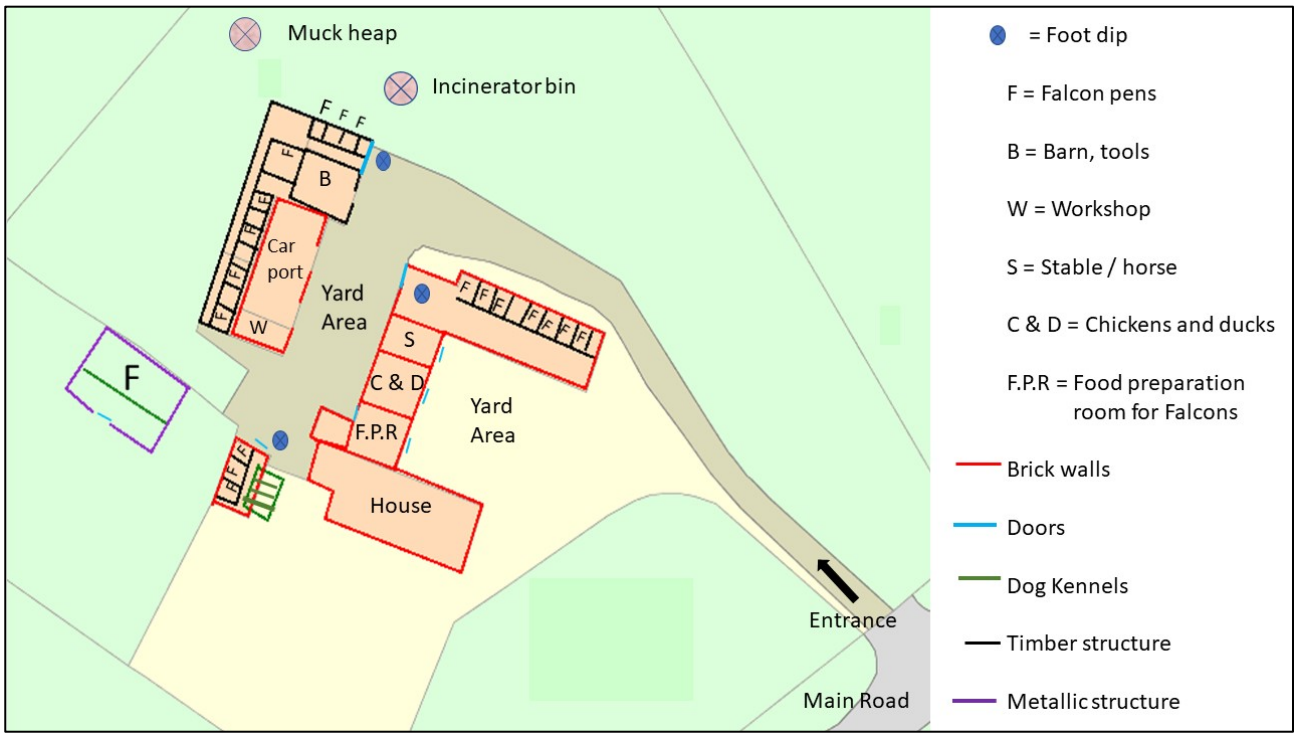
Location in GB

Figure 27: Location of AIV 2020/11



Plan of the infected premises

Figure 28: Plan of AIV 2020/11



Disease Picture

First clinical signs were noted on the evening of 12/12/2020, within the falcon pairs group located in the partially meshed wooden barn. The birds were inappetent and lethargic. The following morning two dead falcons were found in the same building, with a further two dead in the afternoon.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	22/11/2020 – 28/11/2020
Likely:	29/11/2020 – 08/12/2020
High risk:	09/12/2020 – 11/12/2020

Spread tracings window:

Precautionary:	23/11/2020 – 29/11/2020
Likely:	30/11/2020 – 09/12/2020
High risk:	10/12/2020 – 13/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 09/12/2020

Timeline

Table 12: Timeline for AIV 2020/11

Source Tracing Window	Spread Tracing Window	Date	
Day 21		22/11/20	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20	Day 1	23/11/20	Start of precautionary spread tracing window (source + 24h).
Day 19	Day 2	24/11/20	
Day 18	Day 3	25/11/20	
Day 17	Day 4	26/11/20	
Day 16	Day 5	27/11/20	
Day 15	Day 6	28/11/20	
Day 14	Day 7	29/11/20	Start of likely source tracing window (-14d) .
Day 13	Day 8	30/11/20	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 9	01/12/20	
Day 11	Day 10	01/12/20	
Day 10	Day 11	02/12/20	
Day 9	Day 12	03/12/20	
Day 8	Day 13	04/12/20	
Day 7	Day 14	05/12/20	
Day 6	Day 15	06/12/20	
Day 5	Day 16	07/12/20	
Day 4	Day 17	08/12/20	
Day 3	Day 18	**09/12/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 19	**10/12/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 20	11/12/20	
	Day 21	**12/12/20**	**Precautionary onset of first clinical signs.** Owner noted inappetance and lethargy in some falcons.
	Day 22	**13/12/20**	4 falcons died. Suspicion of disease reported by owner. APHA investigation and sampling undertaken (**DPR 2020/53**). **Restrictions served** (late afternoon).
	Day 23	14/12/20	2 dead falcons and 2 falcons sick. Field Epi investigation completed.
	Day 24	**15/12/20**	H5N8 reported by lab. Confirmed as HPAI H5N8 (**AIV2020/11**) by CVO on basis of clinical signs and identification of virus in brain.
	Day 25	16/12/20	Cleavage site analysis confirms highly pathogenic strain of H5N8 avian influenza.
	Day 26	17/12/20	**Culling completed** (all falcons and poultry). **Preliminary C&D completed.**
	Day 27	**18/12/20**	**Preliminary C&D effective.**
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possiblity of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possiblity of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Personnel biosecurity comprised four foot dips containing approved disinfectant, these had been recently placed at the entrances to the falcon accommodation. Dedicated site footwear was used. Occasionally overalls were worn, but no other PPE was used when

attending to the falcons or preparing their food. There were no handwashing facilities in the bird areas or food preparation room.

There was no vermin problem on site.

There were no biosecurity measures applied to vehicles entering the site. However, because of concomitant COVID 19 restrictions, no visitors nor delivery personnel had entered the premises during the high-risk period.

Overview of tracing activities

Since there had been no significant movements or deliveries within the high-risk tracings window, the tracings activities were confined to the investigation of the three suppliers of frozen carcases, used as feed for the birds of prey.

Two had supplied frozen day-old chicks and quails from farmed premises within the UK, Austria, Spain and the Ukraine, whilst the third had supplied shot pigeons from Derbyshire and shot wild waterfowl from Norfolk. The pigeons and waterfowl had been harvested and frozen in September 2020 and were originally intended for human consumption, but were subsequently fed to the falcons.

Source investigations

Hypothesis for the source

The most likely sources of infection were the wild duck meat fed to the falcons, in addition to direct or indirect contact with local wild birds.

Assessment and evidence base for the likely source

DIRECT INTRODUCTION BY SUSCEPTIBLE DOMESTIC SPECIES OR THEIR PRODUCTS – low likelihood with medium uncertainty. Frozen chicks and farmed quail were supplied outside the source window.

INDIRECT INTRODUCTION BY SUSCEPTIBLE DOMESTIC SPECIES WITH KNOWN OR UNDISCLOSED INFECTION – very low likelihood with low uncertainty. Poor premises biosecurity but very few movements of people or equipment due to COVID restrictions. No contact with local pheasant shoot.

INTRODUCTION FROM CONTAMINATED PRODUCTS – very low likelihood with low uncertainty. Mains water supply and sharp sand for bedding.

INFECTED WILD ANIMAL SOURCE - high likelihood of direct introduction with medium uncertainty.

Wild duck carcasses (mallard, teal, and wigeon) shot in Norfolk during September 2020 and frozen prior to delivery to the premises at the end of September 2020. Fed to breeding birds only up until 10/12/2020, very shortly prior to onset of disease. Medium likelihood of indirect introduction with medium uncertainty.

Indirect contact with wild birds via their faeces from overflying the netted/meshed enclosures and by tracking into falcon enclosures on footwear. No rodent problem noted.

INFECTION FROM INTERNATIONAL SOURCE - negligible likelihood with low uncertainty. One falcon imported from UAE, but outside source window.

Either direct or indirect interaction with wild birds or infectious material excreted from wild birds was considered to be the likely source of infection.

Spread investigations

Assessment of potential and likelihood of spread

Direct contact with other susceptible domestic species or their products - negligible likelihood with low uncertainty. The last movement of live birds off premises was one falcon sold in March 2020 (outside the OIE spread window).

INDIRECT CONTACT WITH OTHER SUSCEPTIBLE DOMESTIC SPECIES - very low likelihood with low uncertainty. The premises owner and family had no contact with other birds. Delivery personnel and other visitors did not enter premises (came to gate at end of drive only). Feed deliveries were last made on 05/11/2020 (outside OIE spread window).

ONWARD TRANSMISSION THROUGH WILDLIFE – very low likelihood with medium uncertainty. Occasional exercise events may have occurred when the birds may have been infectious.

ONWARD TRANSMISSION THROUGH INTERNATIONAL TRADE/CONNECTIONS - negligible likelihood with low uncertainty. No known export of birds in the OIE spread window.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is wild shot duck meat fed to the falcons up until shortly before the onset of disease, in addition to direct or indirect contact with local wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/13, Orkney

Description of the premises

Overview of the premises and the wider business

The farm was a small-holding on the island of Sanday in the north of the Orkney islands.

The location and the plan of the site are presented in Figure 37 and Figure 38.

The flock of birds (initially 50) were purchased on 23/09/2020 from a breeding site in Ross-Shire, Scotland where they were extensively vaccinated prior to purchase against Salmonella, coccidiosis, Newcastle disease, infectious bronchitis, Gumboro, infectious laryngotracheitis and turkey rhinotracheitis.

Ewe lambs were kept and sold as gimmers (18 months of age breeding females) the following year. The most recent moves, off and on, being on 09/10/2020 outside the risk period.

The farmer and his wife were retired and due to Covid-19 did not travel far.

Description of the housing

The poultry shed had been recently renovated since the owner bought the holding in 2017 and was described by APHA staff as being of a high quality. Stone built with a new roof and fully lined the birds exit via a pop hole to their range. Feed and water were supplied inside; however, the birds also had a drinker outside and were often see drinking from standing water. They ranged onto the surrounding fields, but seldom further than approximately 200 meters from the poultry shed.

Species and number of each present

There was a small flock of sheep, a horse and a flock of 48 free-range, laying hens supplying the local market, via the island's two village shops.

Description of the surrounding area

The farm was in an area that was famous for migratory birds, indeed within the 10 km radius was North Ronaldsay with its renowned bird observatory. Current information from APHA data indicates that this was a low-density poultry area.

Surveillance activity

PZ (0-3km)

10 premises with poultry holding between 1-42 birds

(1 premises with pigs and poultry)

SZ (3-10km)

8 premises with poultry holding between 7-54 birds

(3 premises holding 50 or more birds)

Ornithological assessment

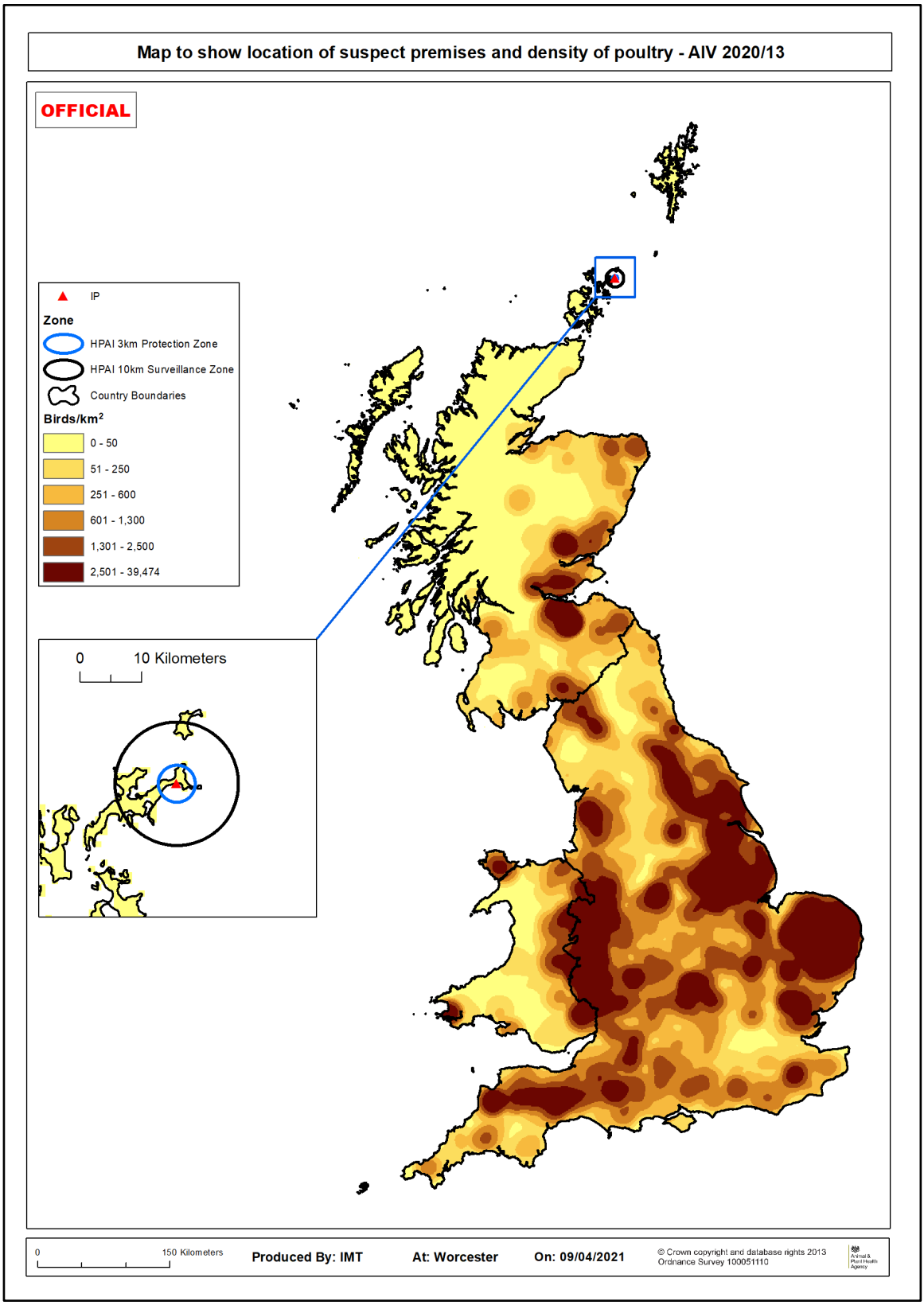
The farm was situated close to both salt and fresh water and was inundated with migratory wild birds.

The owner reported that in 2020 there had been Widgeon (arrived in October / November, which was later than the usual September), Mallard, Teal, Pintail and Shoveler ducks. Geese also frequent the farm, notably Greylag. Also seen in the wider area have been Pink footed and Barnacle geese, but these had not been seen in 2020 on this smallholding. Numerous Snipe, Woodcock and Field Fare had also been seen. In September many Goldfinches were present and after one particularly poor overnight weather event, 10 of these were found dead the next morning.

Additional data sourced from the RSPB Sanday representative suggests that migratory birds arrive from both the north and the east. Greylag geese could be a local breeding population, plus migratory birds from Iceland/Greenland. Mallard and one pair of pintails also breed on Sanday, as do Snipe. Other birds were mainly migratory and will arrive both from the north and east, except for woodcock that do not breed in Iceland, so will only be arriving from the east.

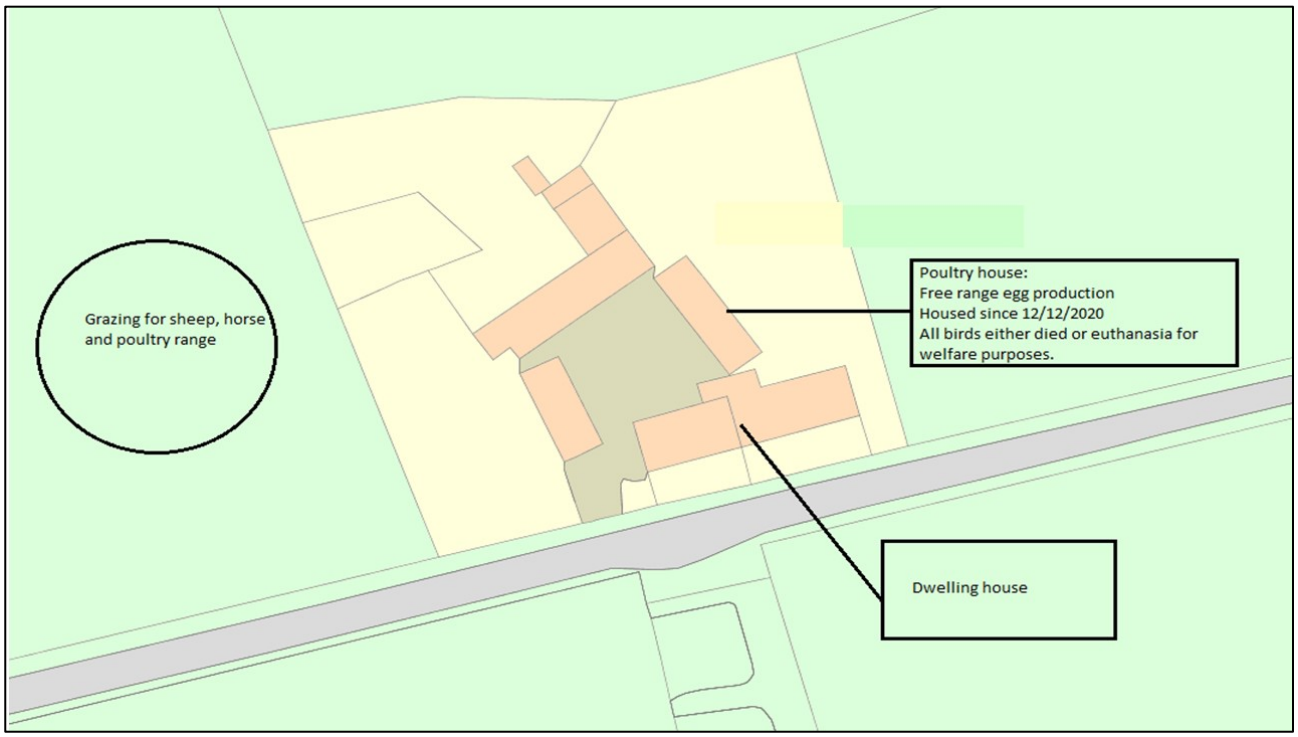
Location in GB

Figure 29: Location of 2020/13



Plan of the infected premises

Figure 30: Plan of 2020/13



CLINICAL PICTURE

A private veterinary surgeon (PVS) reported suspect Notifiable Avian Disease (NAD) in this small commercial 30 week-old, free-range layer flock on 15/12/2020. There had been an increasing mortality since Wednesday 09/12/2020 and a total of 31 birds had died at time of initial report. Post-mortem examinations by the PVS revealed no abnormalities, but the owner had reported discolouration in the combs of the surviving birds, which otherwise appeared bright and alert.

Mortality continued with nine additional deaths, so that at the time of the disease investigation on 16/12/2020, only 14 birds remained alive, three died during examination and the remaining 11 were euthanased on welfare grounds.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	18/11/2020 – 24/11/2020
Likely:	23/11/2020 – 05/12/2020
High risk:	06/12/2020 – 08/12/2020

Spread tracings window:

Precautionary:	19/11/2020 – 25/11/2020
Likely:	26/11/2020 – 06/12/2020
High risk:	07/12/2020 – 16/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 06/12/2020

Timeline

Table 13: Timeline for 2020/13

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**18/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**19/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19		20/11/20	
Day 18		21/11/20	
Day 17		22/11/20	
Day 16		23/11/20	
Day 15		24/11/20	
Day 14		**25/11/20**	Start of likely source tracing window (-14d).
Day 13	Day 1	**26/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	27/11/20	
Day 11	Day 3	28/11/20	
Day 10	Day 4	29/11/20	
Day 9	Day 5	30/11/20	
Day 8	Day 6	01/12/20	
Day 7	Day 7	02/12/20	
Day 6	Day 8	03/12/20	
Day 5	Day 9	04/12/20	
Day 4	Day 10	05/12/20	
Day 3	Day 11	**06/12/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 12	**07/12/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	08/12/20	
	Day 14	**09/12/20**	**Onset of clinical signs: death of a hen.**
	Day 15	10/12/20	
	Day 16	11/12/20	Second dead bird.
	Day 17	12/12/20	Birds housed, 5 more die.
	Day 18	13/12/20	7 birds die.
	Day 19	14/12/20	PVS visit. Sick birds, PME unremarkable. 9 dead birds.
	Day 20	**15/12/20**	Report case initiated (DPR 2020/57). 9 dead birds.
	Day 21	**16/12/20**	APHA Investigation and restrictions. Remaining birds euthanased.
	Day 22	17/12/20	
	Day 23	18/12/20	
	Day 24	19/12/20	
	Day 25	20/12/20	Preliminary C and D completed at 14:15.
	Day 26	**21/12/20**	Preliminary C and D effective as of 14:15.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these dates.		

Assumptions
- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Prior to 12/12/2020 there was no effective biosecurity on this unit. The birds were housed at night and allowed to range during the day on a field where numerous transient waterfowl were known to graze.

On 12/12/2020 the birds were housed in a secure stone-built, lined and fully wildlife/pest proof building with double door entry (outer door solid and inner door wire mesh). On the 14/12/2020 it was reported that a foot dip was introduced, and this was confirmed at the visit on the 16/12/2020.

Overview of tracing activities

Only three lines of inquiry were identified as tracings within the high-risk window:

1. The private vet who examined the chickens and later reported the incident.
2. A neighbour who borrowed the tractor used to shift spent poultry bedding.
3. Eggs delivered to two local shops for retail.

All unsold eggs were recalled, and the other two lines of inquiry were closed satisfactorily following further information and the outcome of one visit.

Source investigations

Hypothesis for the source

The incursion of H5N8 was likely to have occurred due to direct or indirect contact with infected wild waterfowl.

Assessment and evidence base for the likely source

The hens were free-range and ranged on land where numerous transient and local wild birds were known to graze.

There was an absence of any other valid risk pathway for disease incursion in this remote part of Scotland.

Spread investigations

Assessment of potential and likelihood of spread

Eggs were the only animal product that had left the holding for sale at the local shops.

The private veterinary surgeon (PVS) was considered to be a high-risk tracing. He attended the farm as his initial visit on 14/12/2020 and final visit on 15/12/2020.

A local farmer with his own flock of poultry borrowed a tractor that had been used to transport manure from the chicken shed.

The owner's own movements were very limited due to health concerns and Covid-19.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild waterfowl.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/14, Gillingham

Description of the premises

Overview of the premises and the wider business

This was a traditional beef farm with 326 cattle, six ducks, one goose and originally six chickens. There were also three horses (on livery), three farm cats and a dog on the premises. The poultry were kept on an island in the middle of a large garden pond with access to a shelter. This outside pond was regularly visited by wild birds. Pond water was piped from a nearby river, which also hosted wild waterfowl.

The farm was situated in North Dorset and approached by a long access road. A river runs along the west side of the farm buildings.

There were no poultry movements, onto or off the premises, in the previous 21 days.

Eggs laid by the chickens were for personal consumption only.

On 16/12/2020, one of the chickens died suddenly. By the following morning, four more were dead and the owner contacted his PVS.

A report case investigation was initiated on 17/12/2020 and the one remaining chicken was examined. It showed no clinical signs of disease. A visual inspection of the uncatchable six ducks and one goose was completed. All appeared well. Post-mortem examination of one carcass revealed no obvious signs of disease. Samples were submitted. Results were positive and HPAI H5N8 was confirmed on 20/12/2020.

Description of the housing

The ducks and the goose had access to a shelter on the island. The chickens were kept in a separate coop next to the farmhouse at night.

Species and number of each present

6 ducks, 1 goose and 6 chickens.

This was a traditional beef farm with 326 cattle. There were also three horses (on livery), three farm cats and a dog on the premises.

Surveillance activity

PZ (0-3km)

96 premises with poultry holding between 1-189,000 birds

(7 premises with 50 or more birds)

SZ (3-10km)

75 premises with poultry holding between 1-134,000 birds

(35 premises holding 50 or more birds)

Ornithological assessment (where known)

This IP sits in an intensively managed and largely pastoral landscape with few significant waterbodies or watercourses nearby, and the closest substantial permanent waterbodies were relatively distant (2 km).

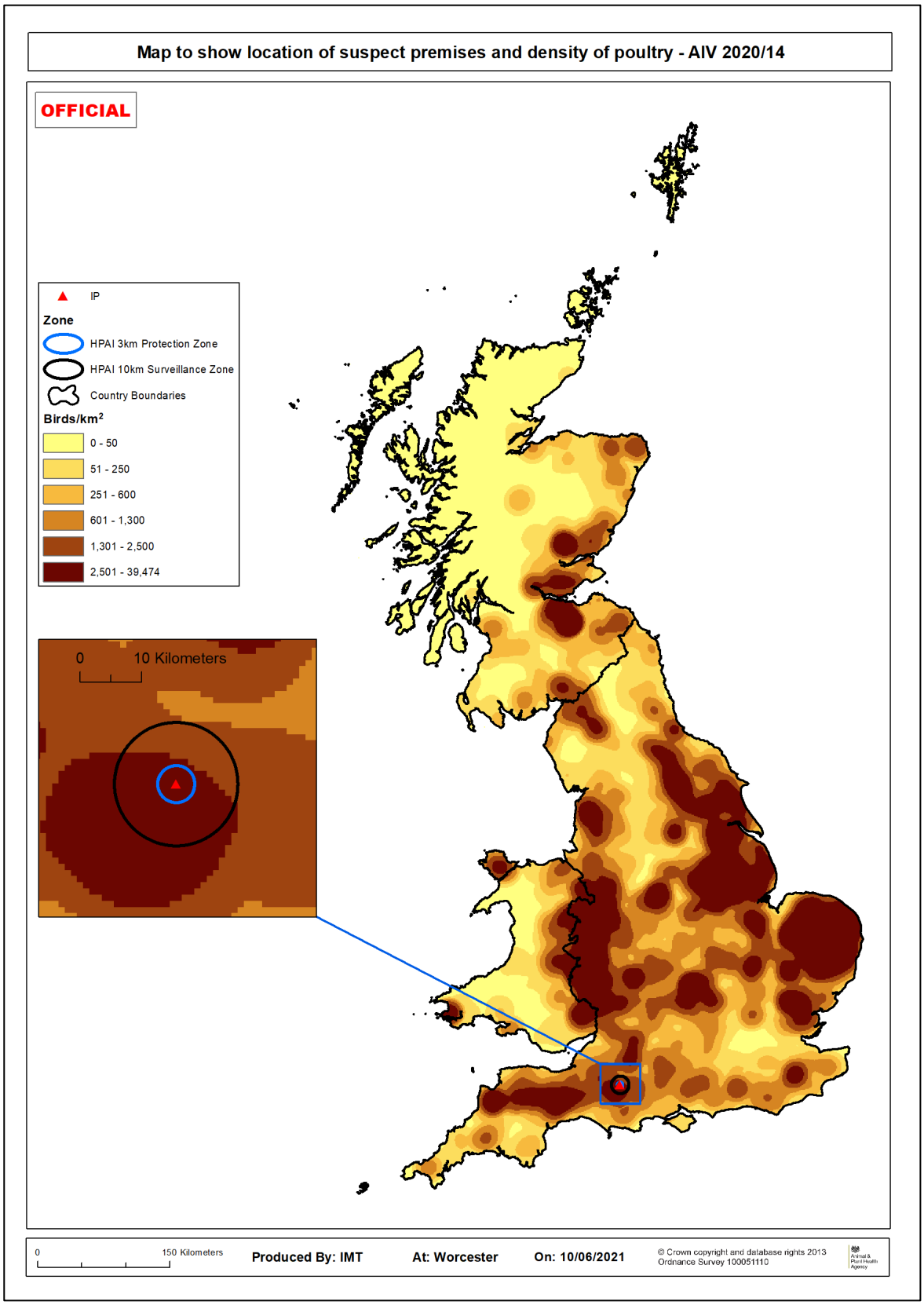
Lack of WeBS (ornithological survey) data for the area suggests wildfowl were not abundant, though they were likely to be widely distributed and mainly of resident species. There do not appear to be any sites locally likely to hold substantial populations of wildfowl. However, the presence of a pond on the IP itself, known to be used by wildfowl, was significant.

Gulls do not appear abundant in this landscape and appear to have no specific reason to be attracted to the IP, or its neighbourhood. Similarly, whilst other bridge species (e.g. Starlings, Corvids) appear potentially well resourced, the isolation of the IP fails to suggest why bird traffic to, or over the site, would be indicated.

It was concluded that wild birds were considered to be a likely source of infection pressure.

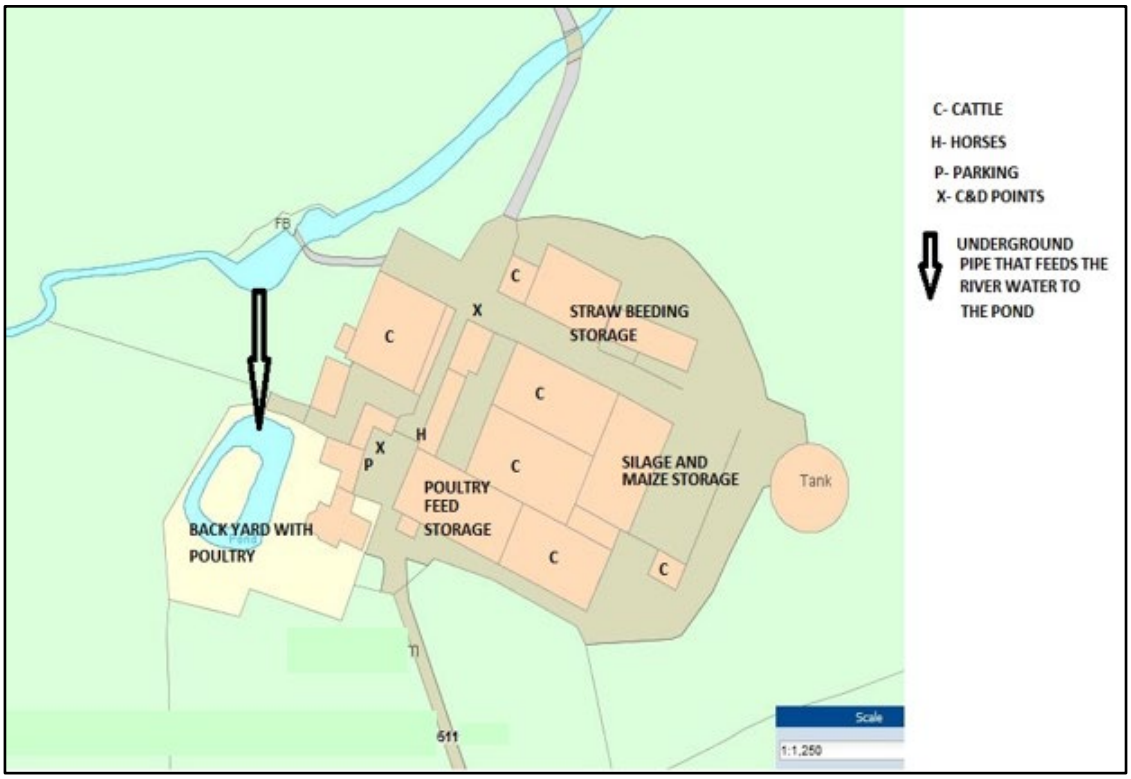
Location in GB

Figure 31: Location of 2020/14



Plan of the infected premises

Figure 32: Plan of 2020/14



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	24/11/2020 – 30/11/2020
Likely:	01/12/2020 – 11/12/2020
High risk:	12/12/2020 – 15/12/2020

Spread tracings window:

Precautionary:	25/11/2020 – 01/12/2020
Likely:	02/12/2020 – 12/12/2020
High risk:	13/12/2020 – 17/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 12/12/2020

Timeline

Table 14: Timeline for 2020/14

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**24/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20	Day 1	**25/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19	Day 2	26/11/20	
Day 18	Day 3	27/11/20	
Day 17	Day 4	28/11/20	
Day 16	Day 5	29/11/20	
Day 15	Day 6	30/11/20	
Day 14	Day 7	**01/12/20**	Start of likely source tracing window (-14d).
Day 13	Day 8	**02/12/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 9	03/12/20	
Day 11	Day 10	04/12/20	
Day 10	Day 11	05/12/20	
Day 9	Day 12	06/12/20	
Day 8	Day 13	07/12/20	
Day 7	Day 14	08/12/20	
Day 6	Day 15	09/12/20	
Day 5	Day 16	10/12/20	
Day 4	Day 17	11/12/20	
Day 3	Day 18	**12/12/20**	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak.**
Day 2	Day 19	**13/12/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 20	14/12/20	
Day 0	Day 21	**15/12/20**	**Precautionary start of clinical signs**
	Day 22	16/12/20	Sudden death of 1 chicken.
	Day 23	**17/12/20**	Deaths of 4 more chickens. Report case visit & sampling. Restrictions served (DPR 2020/58).
	Day 24	18/12/20	Remaining chicken, ducks & goose still alive.
	Day 25	**19/12/20**	H5N8 confirmed (AIV 2020/14). Culling commenced.
	Day 26	**20/12/20**	Pathogenicity confirmed as highly pathogenic. Culling completed. Preliminary C&D completed.
	Day 27	**21/12/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Biosecurity was basic, with two foot-dips containing FAM30 located in the farmyard (see plan). Use of Virkon was also used from 17/12/2020.

There was no vermin control, other than a reliance on farm cats.

There were no visitor, nor poultry movement records kept.

Overview of tracing activities

Tracing investigations were carried out on a part-time farm worker, and a horse owner who both had access to the farmyard only. They had no contact with susceptible species and no further actions were taken.

Two window fitters who did access the back garden area were traced. It transpired that their visit on 11/12/2020 fell outside the high-risk window and neither had any other bird contacts. This too was closed.

Source investigations

Hypothesis for the source

The most likely source was assessed as being direct or indirect contact with wild birds with high likelihood and low uncertainty.

Assessment and evidence base for the likely source

- Wild birds observed in the back garden pond area mixing with poultry.
- Wild birds seen in river supplying pond water.
- Results of tracings activities.

Spread investigations

Assessment of potential and likelihood of spread

The likelihood of spread via wild birds was assessed as medium with low uncertainty, however, this was felt to be negligible in comparison with the likely level of disease burden in the local wildlife population.

All other routes of spread were assessed as negligible likelihood, with low uncertainty.

Remaining uncertainty

As the ducks and geese were not sampled pre-cull, it was not possible to determine if avian influenza virus had entered this flock at an earlier time. However, it would not have made any significant difference to the tracings, the likely hypotheses for source and spread, nor other actions taken.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/15, Attleborough

Description of the premises

Overview of the premises and the wider business

The IP was a commercial, indoor duck breeder layer unit, part of a large integrated poultry production company. The ducks would normally spend approximately 45 weeks in-lay at the site, before being de-populated and sent for slaughter. Hatching eggs were held in an onsite egg store, where they were fumigated daily before twice weekly consignment to a company hatchery.

The company concerned also had another confirmed case of HPAI H5N8 at a different site (AIV 2020/17), although no direct epidemiological links between the two cases could be established, and the two cases appeared to be epidemiologically distinct and independent of each other.

Description of the housing

The ducks were distributed between four reasonably old poultry houses (with approximately 2000 birds per house) which had been converted from their original use, when first built, as housing for battery hens. Each house had a double door entry system, with an intervening lobby area and physical hygiene barrier.

Staff and site visitors would use the lobby area to change into house specific wellington boots, disposable overalls and gloves before entering the bird accommodation. Hand sanitiser was also present in each lobby area for use before and after accessing the bird accommodation areas.

An overhead walkway connected all four houses, although this was only used by the site manager when turning off lights at the end of the day, or if adjustments were needed to the water or feed supply lines, and was not routinely used by other staff.

Ventilation was provided by means of fan inlets in the roofs, and outlets covered by wire mesh, in the walls.

Feed was supplied from individual, enclosed silos attached to each house, and water was mains supplied to a sealed storage tank supplying the drinking lines to each house.

Species and number of each present

Approximately 8000 ducks were present. The site operated an all-in / all-out system with the current flock having been placed in April 2020. Birds were sourced from the company's own pre-breeder units and placed on site aged between 16 and 20 weeks.

Description of the surrounding area

The IP was situated in a highly poultry dense area (see Figure 41) and within the 10 km Surveillance Zone of a previous IP (AIV 2020/08 Attleborough), although the two premises were operated by different poultry companies, and no epidemiological links between the two cases could be established.

AIV 2020/16, a small mixed species backyard flock was located less than 500 metres away across a field, although no epidemiological links, other than by proximity, were uncovered.

AIV 2020/17, Watton (a duck fattening unit belonging to the same poultry company) was located approximately 20 km away, although as above no direct epidemiological links were established between the two IPs.

A further HPAI H5N8 IP (AIV 2020/09, King's Lynn) was some 45 km distant.

The number of IPs in the surrounding area, in the absence of detectable epidemiological links, was suggestive of a relatively high level of background infection in the wild bird population within the area.

The surrounding area was predominantly arable land, but with a relatively high density of poultry premises. A series of fishing lakes, which may offer habitat to wild waterfowl and other species, was located approximately one mile away.

Surveillance activity

PZ (0-3km)

95 premises with poultry holding between 1-80,000 birds

(8 premises with 50 or more birds)

SZ (3-10km)

169 premises with poultry holding between 1-372,000 birds

(57 premises holding 50 or more birds)

Ornithological assessment (where known)

This IP was inland, in a lowland rural landscape dominated by arable and horticultural land uses. Waterbodies close to the IP include lakes in close proximity to a previous outbreak (the IP was located within the Surveillance Zone of AIV 2020/08), though otherwise lakes capable of holding substantial aggregations of birds were limited and relatively distant.

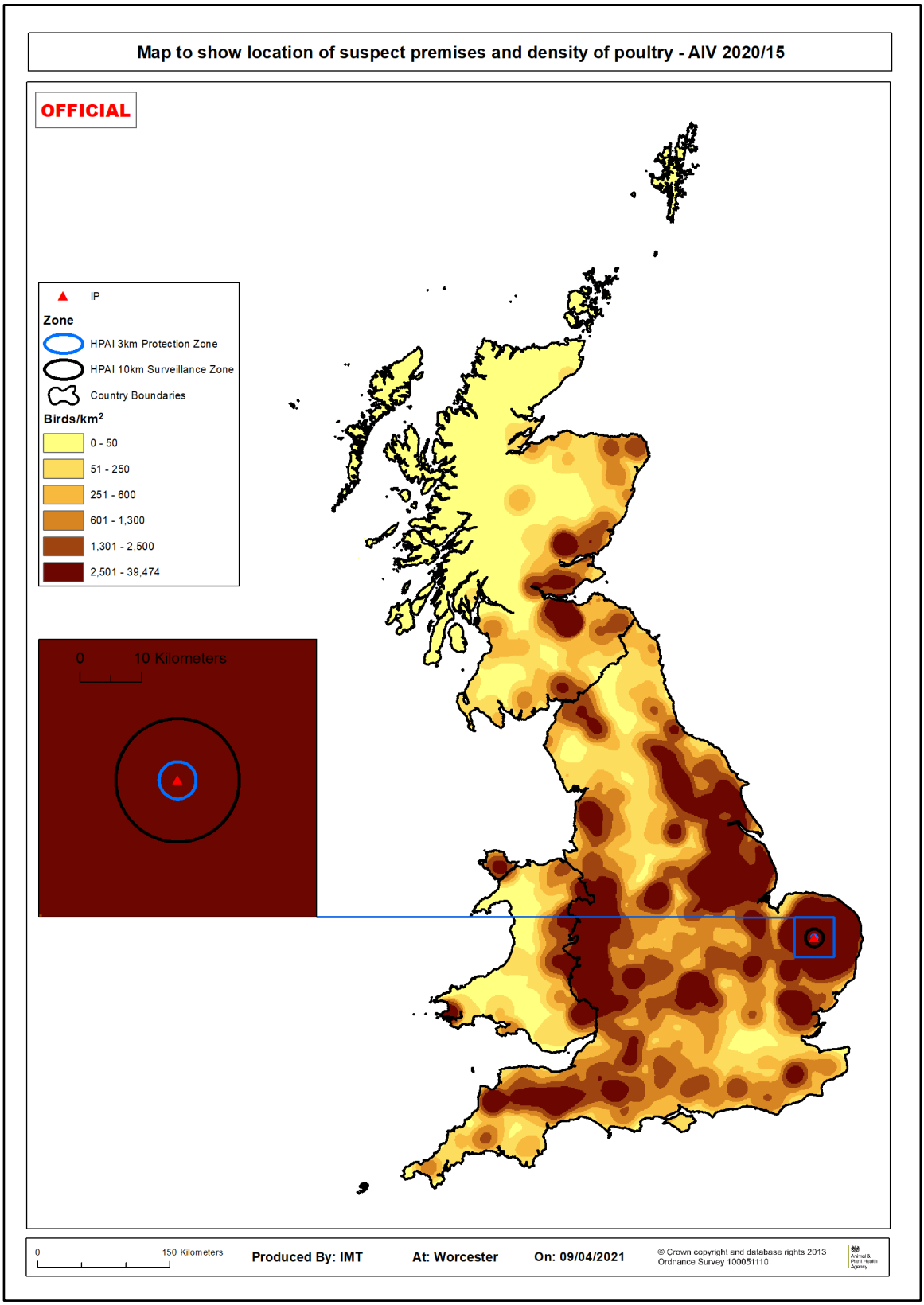
Wildfowl were likely to be present close to the IP (i.e. < 2km) though probably not in large numbers, and more unusually, other water birds such as waders and heron might also be scarce in the immediate neighbourhood of the site

The local abundance of riparian pasture and outdoor livestock (poultry and pigs) suggests bridge species (gulls and corvids) will be common and were likely to crisscross the landscape between potential foraging sites and roosts.

Opinion on potential infection pressure from wild birds indicates these as a possible source of infection.

Location in GB

Figure 33: Location of 2020/15



Plan of the infected premises

Figure 34: Plan of 2020/15

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	01/11/2020 –07/11/2020
Likely:	08/11/2020 – 21/11/2020
High risk:	22/11/2020 – 13/12/2020

Spread tracings window:

Precautionary:	02/11/2020 – 08/11/2020
Likely:	09/11/2020 – 22/11/2020
High risk:	23/11/2020 – 17/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 22/11/2020

N.B. a precautionary range to include the estimated earliest and latest most likely infection dates was provided based on expert opinion from the reference laboratory given uncertainties involved with precise interpretation of serological results, which indicated an earlier introduction of infection onto the site than was suggested by the onset of observed clinical signs.

Clinical Picture

Between 15/12/2020 and 16/12/2020 the farm manager noted a significant reduction in egg production, along with a reduction in feed and water consumption. The mortality rate was slightly higher than normal and the whole flock appeared subdued and less alert. The reduction in feed consumption was initially attributed to delivery of a batch of feed received on 07/12/2020, and a new batch delivered on 14/12/2020 appeared more palatable.

Suspicion of disease was reported to APHA by the company on 17/12/2020, restrictions were served and a veterinary inquiry with collection of diagnostic samples from all four houses was undertaken.

During the clinical inspection by the APHA Veterinary Inspector, ducks in Houses 1 and 2 were observed to be less responsive than would be expected. A single dead duck was found in House 2, two in House 3 and one in House 4. Egg quality appeared normal.

Post-mortem examination of two carcases revealed evidence of egg peritonitis in one and multiple old lesions in the lungs and air sacs of the other, which were attributed to a previous bacterial infection.

Following receipt of positive laboratory results, the presence of H5N8 was confirmed on 19/12/2020 and further testing confirmed this to be of high pathogenicity on 20/12/2020.

Based on analysis of available egg production data, the onset of the reduction in egg production, and hence likely first onset of clinical signs, was established as occurring on 12/12/2020, based on a precautionary approach. However, analysis of egg production data was complicated by the fact that daily production totals were only available from 07/12/2020 onwards, and prior to that only weekly aggregated totals for each house were readily available.

Additional epidemiological sampling from all four houses was undertaken on 20/12/2020, and positive serological results were returned for all birds sampled. Based on the extent of seroconversion and antibody titres detected, expert opinion from the reference laboratory was that virus was most likely to have been introduced into the flock between three to four weeks prior to this sampling being undertaken. The most likely date of first infection was therefore estimated to have been between 22/11/2020 and 29/11/2020, on a precautionary basis, and given the lack of precision associated with interpretation of the serological data.

Timeline

Table 15: Timeline for AIV 2020/15

Source Tracing Window	Spread Tracing Window	Date	
Day - 21		**01/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day - 20	Day 1	**02/11/20**	Start of precautionary spread tracing window (source + 24h).
Day - 19	Day 2	03/11/20	
Day - 18	Day 3	04/11/20	
Day - 17	Day 4	05/11/20	
Day - 16	Day 5	06/11/20	
Day - 15	Day 6	07/11/20	
Day - 14	Day 7	**08/11/20**	Start of likely source tracing window (-14d) .
Day - 13	Day 8	**09/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day - 12	Day 9	10/11/20	
Day - 11	Day 10	11/11/20	
Day - 10	Day 11	12/11/20	
Day - 9	Day 12	13/11/20	
Day - 8	Day 13	14/11/20	
Day - 7	Day 14	15/11/20	
Day - 6	Day 15	16/11/20	
Day - 5	Day 16	17/11/20	
Day - 4	Day 17	18/11/20	
Day - 3	Day 18	19/11/20	
Day - 2	Day 19	20/11/20	
Day - 1	Day 20	21/11/20	
Day 1	Day 21	**22/11/20**	Start of high risk source tracing window (-3d) **Most likely earliest infection date for this outbreak based on serological results of additional epi sampling undertaken on 20/12/2020 - all samples from all sheds seropositive.** This is on a precautionary basis given high levels of uncertainty around interpretation of serology results.
Day 2	Day 22	**23/11/20**	Start of high risk spread tracing window (source +24h).
Day 3	Day 23	24/11/20	
Day 4	Day 24	25/11/20	
Day 5	Day 25	26/11/20	
Day 6	Day 26	27/11/20	
Day 7	Day 27	28/11/20	
Day 8	Day 28	**29/11/20**	**Most likely latest infection date for this outbreak based on serological results of additional epi sampling undertaken on 20/12/2020 - all samples from all sheds seropositive.** Caveat: levels of uncertainty.
Day 9	Day 29	30/11/20	
Day 10	Day 30	01/12/20	
Day 11	Day 31	02/12/20	
Day 12	Day 32	03/12/20	**Last movement of AIV 2020/15 eggs to the hatchery.**
Day 13	Day 33	04/12/20	
Day 14	Day 34	05/12/20	
Day 15	Day 35	06/12/20	
Day 16	Day 36	07/12/20	Feed delivery.
Day 17	Day 37	08/12/20	
Day 18	Day 38	09/12/20	
Day 19	Day 39	10/12/20	
Day 20	Day 40	11/12/20	
Day 22	Day 41	**12/12/20**	**Precautionary onset of first clinical signs observed-** based on analysis of available egg production data.
Day 23	Day 42	13/12/20	
	Day 43	14/12/20	New batch of feed delivered.
	Day 44	15/12/20	
	Day 45	16/12/20	Significant egg drop noted (50%), reduced feed and water consumption reported.
	Day 46	**17/12/20**	Suspicion of disease reported (**DPR 2020/59**). Restrictions served and APHA veterinary inquiry and sampling undertaken: 4 houses 20:20:20.
	Day 47	18/12/20	
	Day 48	**19/12/20**	H5N8 confirmed (**AIV 2020/15**).
	Day 49	20/12/20	Pathogenicity confirmed as HPAI. **Additional epidemiological sampling undertaken** 15:15:15 in all sheds targeting apparently healthy birds: all serology samples positive.
	Day 50	21/12/20	Culling commenced.
	Day 51	**22/12/20**	Culling completed.
	Day 52	23/12/20	Preliminary C&D completed.
	Day 53	**24/12/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Biosecurity on the site initially appeared to be of a good standard for personnel and vehicles. A single road led into / out of the site and the curtilage around the poultry houses was of good quality concrete.

Entrance to the site from the access road was via a gate with signage requiring visitors to sign-in and undertake disinfection of any essential vehicles needing to enter and leave the site (e.g. feed deliveries). A Dosatron disinfectant system with a pressurised hose was available. A car parking area was provided outside the site entrance for non-essential vehicles, including staff vehicles.

A cabin next to the entrance contained the visitor book and a supply of disposable overalls and site-dedicated wellington boots for visitors as well as regularly replenished disinfectant boot dips containing Defra approved disinfectant.

Foot dips were also present at the external entrances to each poultry house.

Staff and any essential visitors would enter each house via a double door system, with a lobby area and physical hygiene barrier, where they would change into house-specific wellingtons, disposable overalls and gloves and use hand sanitiser provided. Disposable protective equipment would be disposed of in bins provided before leaving the site.

Correct personnel biosecurity procedures were observed to be taking place at the time of the APHA epidemiological visit.

However, on further inspection of the site several potential areas where breaches in biosecurity could occur were observed:

1. Whilst there was gated access to the site and concrete hardstanding around the poultry houses, access to the areas around the houses e.g. by wildlife from an adjacent field would be possible and unrestricted.
2. The overhead walkway connecting the four houses had doors between each house, but at the time of the epidemiological investigation not all doors were closed, nor were other biosecurity measures such as disinfectant foot dips available.
3. The roofs of all houses were reported to have been replaced approximately two years ago and were believed to be watertight. However, the internal ceiling surfaces showed evidence of staining indicative of water ingress, although it was uncertain whether this was recent or historic.
4. The fabric of the poultry houses appeared to be generally robust, although some gaps and holes (up to 15cm in diameter) in the structure were observed which could potentially facilitate entry of small wild birds and rodents into the duck

accommodation area, albeit that the presence of intact cobwebs within these defects was suggestive of no recent rodent / wild bird entry.

5. During feed deliveries the pipe delivering feed from the delivery vehicle to the feed silos could touch the ground and was not reported to be disinfected in between deliveries to each house. It was unclear whether it was disinfected before entering or leaving the site. Delivery vehicles had wheels disinfected on entering / leaving the site and the drivers used disposable overalls, but they used their own gloves and it was not clear whether these were disinfected.
6. Bedding straw in unwrapped bales was regularly delivered to the site. Delivery vehicle wheels were disinfected on entry to /exit from the site, but the delivery driver did not use additional personal protective equipment whilst on site (albeit no direct contact with the ducks). Up until a month prior to the onset of first observed clinical signs in the ducks, the straw bales had been stored in a curtain sided trailer. However, subsequent to the sale of this trailer, bales were then stored on the ground in the yard outside the poultry houses and covered by a tarpaulin. This would have a resulted in a significant reduction in the biosecurity of the unit.
7. Bedding was topped up in the houses each day using a total of six bales. A tractor mounted straw chopper was driven into each house daily to distribute fresh bedding. Whilst the wheels of the tractor were reported to be disinfected between each house it was unclear whether the straw chopper itself was, and the straw itself being stored in unwrapped bales on the ground, albeit covered by a tarpaulin in between daily collections, could be subject to contamination by wild birds or other wildlife / vermin.
8. Egg collections were generally (with occasional exceptions) single collections from this site. Collection vehicles would have their wheels disinfected, but the driver would wear their own cotton overalls and leather gloves with no change of footwear, nor any use of disinfectant foot dips prior to entering the egg store (albeit no direct contact with the ducks).

Overview of tracing activities

Evidence based on the clinical picture, laboratory results and expert advice, together with the OIE requirement for a precautionary assumption of a 21-day incubation period prior to clinical signs, gave the source and spread time windows which informed tracing activities.

The investigations and risk assessment carried out on the various hatcheries receiving eggs from the IP are outside the scope of this tracings overview, but are summarised below.

Multiple telephone and email enquiries were generated to confirm information about these potential tracing events and to inform risk assessments.

The following tracing events were investigated:

Movement of IP personnel:

a. FARM MANAGER – he lived onsite in a bungalow next door to the farm. He confirmed he only worked on this premises and had no contact with other poultry or birds during the high-risk window.

b. AREA MANAGER – he visited the IP in three occasions within the high-risk source and spread window two other poultry premises. In one of these dates, he also visited another poultry premises prior to the IP (source). A tracing visit to this potential contact premises (CP1) was raised.

c. FOUR STAFF (EXCLUDING FARM MANAGER) WORKED AT THE IP – satisfactory assurances were received that none worked in other poultry premises and none had any contact with other poultry or birds within the high-risk tracing window. It was the company policy that staff should not have birds of their own.

Movement of other people:

PEST CONTROL TECHNICIAN - there was only one visit during the high-risk source and spread window. There was no contact with poultry during the visit. The pest control services company was contacted for details and they confirmed that on that date they did not visit other poultry premises and that the technician did not keep poultry/birds.

EGG COLLECTIONS - hatching eggs were collected twice weekly from the IP using the company's own vehicles and transported to a company hatchery. Information was sought about the transport, delivery routes and biosecurity arrangements. During the source and spread high-risk window, two collection drivers were involved in the egg collections. As leather gloves (i.e. unlikely to have been disinfected) were used by these drivers when collecting and delivering trollies, the poultry premises that shared the same day egg collections as the IP were considered at risk and tracing visits requested.

Three potential contact premises (CP2, CP3 and CP4) involved in the egg collection route were identified. In addition, hatching eggs from the IP delivered to the hatchery during the high risk spread window were also traced and subject to veterinary risk assessment (see further below). The last delivery of eggs from the site to the hatchery took place on 03/12/2020, after which eggs were disposed of along with other animal by-products.

FEED DELIVERY - one feed company supplied feed to the IP during the high-risk source and spread window. Information was sought about the transport, delivery routes and biosecurity arrangements. This informed a full veterinary risk assessment which concluded that the overall risk for both source and spread was very low, albeit with a degree of uncertainty with the recommendation that no further action be taken.

BEDDING DELIVERY - several deliveries of straw occurred during the high-risk source and spread window. Information was sought about the transport, delivery routes and

biosecurity arrangements. Due to single deliveries to the IP on each occasion, the satisfactory C&D protocols and arrangements, and the lack of other poultry contacts, it was concluded the overall risk for source and spread via deliveries of bedding to the premises was very low (albeit storage and distribution of bedding to the poultry houses once on the site was a potential mechanism for introduction of virus to the ducks as described above).

FALLEN STOCK COLLECTIONS - dead stock and unusable eggs were collected as part of daily checks and placed into a wheelbarrow and then placed in the Animal By-Product (ABP) bins were stored within the farm compound, but moved to the outside gate for collection to prevent the need for the vehicle to enter the site.. Only one collection took place within the high-risk spread window. Information was sought about the transport, collection route and biosecurity arrangements. Due to the single collection on the day, the satisfactory C&D protocols/arrangements, the fact that the bin was collected from the perimeter of the farm, in addition to the no other contact with poultry on the day and the that the driver had no poultry at home, it was concluded that the overall risk for source and spread was very low.

The above investigations resulted in the identification of four potential contact premises (in addition to the hatchery) – all received an immediate tracing visit requiring serving restrictions, veterinary inspection, production record checks and an exposure risk assessment of the likelihood of a valid risk pathway for introduction of H5N8 into the premises.

In three of these premises (CP1, CP2 and CP3) the outcome of the risk assessment was very low and restrictions lifted. In the fourth premises (CP4) the overall risk was considered to be low, but as production records showed a slight increase in daily mortality in some of the sheds a decision was made to take surveillance samples. Once negative results were received, restrictions were then lifted.

Hatchery

Hatching eggs from the IP were delivered to the company hatchery during the high risk spread window up to and including 03/12/2020. The hatchery was ‘designated’ under relevant avian influenza legislation and as such subject to compliance with high standards of biosecurity and traceability. Following confirmation of disease on the IP the hatchery was placed under disease restrictions as a contact premises, and subjected to a thorough veterinary epidemiological investigation considering all aspects of its operation, including the standards of biosecurity and traceability practised.

A detailed veterinary risk assessment (VRA) was undertaken and concluded that given the observed high standards of hatchery operation and other biosecurity mitigations in place the likelihood of HPAI H5N8 spreading from the hatchery, via movement of day-old ducklings hatched from eggs originating from the IP, and other eggs in-contact with IP

eggs within the hatchery to rearing farms was low (and also via other associated routes such as hatchery waste, vehicles, equipment etc.).

Day-old ducklings were permitted to be moved under licence to a small number of rearing farms, where they were placed under movement restrictions and subject to a 21-day period of monitoring by APHA with sampling undertaken towards the end of the monitoring period. Following receipt of negative sample results, restrictions were lifted on these rearing farms.

Following satisfactory additional cleansing and disinfection at the hatchery after the last ducklings hatched from IP eggs/eggs in contact with IP eggs had been licenced out, and all associated hatchery waste securely disposed of, restrictions were lifted from the hatchery itself.

All tracing investigations in relation to this IP were satisfactorily completed and closed.

Source investigations

Hypothesis for the source

The most likely source of infection for this site was considered to be indirect introduction from a wild bird source.

Assessment and evidence base for the likely source

The IP was located within a landscape likely to be attractive to hosting a variety of waterfowl and other potential bridging species.

Direct introduction via movements of live birds or other products derived from susceptible species was considered of negligible likelihood with low uncertainty. There were no recorded movements of live birds, eggs etc. onto the site during the source window. No known direct or indirect international epidemiological links were discovered.

Indirect introduction onto the site from another source with known or undisclosed infection, or from contaminated products such as feed, water and bedding was considered to be of very low likelihood with low uncertainty – tracings assessments and investigations discounted plausible transmission pathways via deliveries of feed (direct from the feed mill into closed feed silos), water (mains supply via a sealed and wild bird/vermin proof delivery system), collections of eggs and animal by-products and movements of personnel.

The most plausible routes of introduction (high likelihood with medium uncertainty) were indirect introductions from a wild bird source via movement of straw bedding (and associated delivery vehicle/straw chopper) into the poultry houses after being stored outside and directly on the ground or via ingress of wild birds or rodents (acting as a fomite

vehicle) into the houses via defects in the building fabric (albeit no evidence of this was observed).

Spread investigations

Assessment of potential and likelihood of spread

Direct contact with other susceptible species or via products was considered of low likelihood (medium uncertainty) – no live birds had left the site since flock placement and hatching eggs that had been moved off during the risk period were traced to the hatchery and subjected to a thorough veterinary risk assessment as previously described.

Indirect contact with other susceptible domestic species was considered to represent a very low likelihood (medium uncertainty) of spread following completion of tracing activities (including veterinary risk assessment where indicated).

Onward transmission via wildlife was considered as being of very low likelihood with low uncertainty as the ducks were permanently housed and the risk would be approaching negligible in comparison to the prevailing background level of infection in wild birds at the time.

No known direct or indirect international epidemiological links were discovered.

Remaining uncertainty

The levels of antibodies detected in the ducks via the additional epidemiological sampling undertaken suggested that the most likely date of infection was between 22/11/2020 and 29/11/2020 - however, there was a high degree of uncertainty associated with the interpretation of these serology results and thus the precision of this estimate.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/16, Attleborough

Description of the premises

Overview of the premises and the wider business

This was a small backyard flock, which originally comprised 22 chickens, 14 ducks and 8 geese. There was a large pond in the garden which attracts wild waterfowl and these were freely co-mingling with the domestic birds up until 13/12/2020 when they were housed in a wildlife-proof barn. There were also two cats, a dog and six horses on site.

This premises was less than 500m across an open field from AIV 2020/15, a large (>8,000) housed commercial laying duck unit – part of an integrated company. However, there were no known contacts between the two premises, although the same wild birds may frequent the area.

This IP has its own farm track which connects to the public road. The two premises were separated by a greater distance by road, and vehicles servicing the intensive duck farm, would not pass close by to this premises.

A report case was initiated in the late afternoon of 24/12/2020 when the sudden death of six chickens was reported with a further three with swollen heads, puffy eyes and purple combs. There were no obvious respiratory symptoms. The in-contact ducks and geese were not displaying any signs of ill health.

As daylight was failing, a decision was taken to visit the following day and verbal restrictions were served.

On 25/12/2020, the APHA vet found that eight more had died, including the three sick chickens. Of the remaining chickens, two more were ill. These were culled and the case vet carried out a PME on one which revealed a heavily congested carcase especially the liver. The crop was full, with a normal gizzard and no obvious tracheitis.

Complete sets of samples were taken from the eight geese, 14 ducks and six remaining chickens and despatched to Weybridge. Results were received on 26/12/2020 and the CVO declared a positive result for H5N8.

The serological results obtained from the domestic ducks and geese give a precautionary earliest infection date of 07/12/2020, well before the birds were housed on 13/12/2020. This strengthens the wild bird hypothesis for source. However, there was a high level of uncertainty around the interpretation of these serology results.

Description of the housing

Prior to housing on 13/12/2020, all the birds had access to the garden and pond, and were in contact with wild waterfowl that visited the premises.

Since that date, they were all housed in a small wildlife-proof stone barn.

Species and number of each present: 22 chickens, 14 ducks and 8 geese.

Description of the surrounding area

This farm lies within an intensive arable landscape in a high poultry density area (Figure 43).

Surveillance activity

PZ (0-3km)

101 premises with poultry holding between 1-80,000 birds

(9 premises with 50 or more birds)

SZ (3-10km)

156 premises with poultry holding between 1-372,000 birds

(55 premises holding 50 or more birds)

Ornithological assessment

This IP was located inland, in a lowland rural landscape dominated by arable and horticultural land uses. Waterbodies close to the IP include lakes proximal to a previous outbreak (AIV 2020/08), although otherwise lakes capable of holding substantial aggregations of birds were limited and relatively distant.

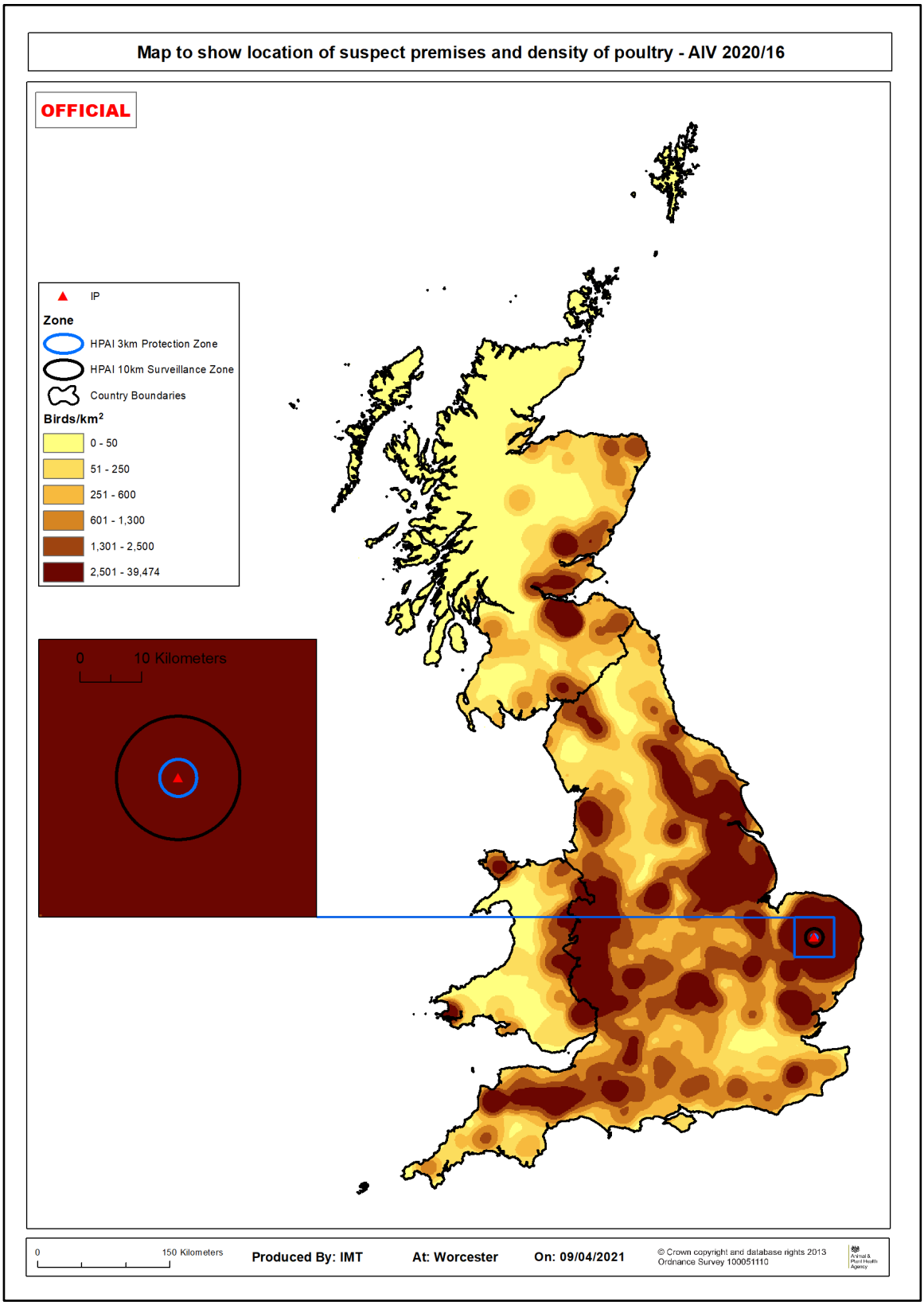
Wildfowl were likely to be present close to the IP (i.e. < 2km) though probably not in large numbers, and more unusually, other waterbirds such as waders and herons might also be considered to be present in the immediate neighbourhood of the site

The local abundance of riparian pasture and outdoor livestock (poultry and pigs) suggests bridge species (gulls and corvids) will be common and were likely to crisscross the landscape between potential foraging sites and roosts.

It was concluded that wild birds would be a possible source of infection pressure on this IP.

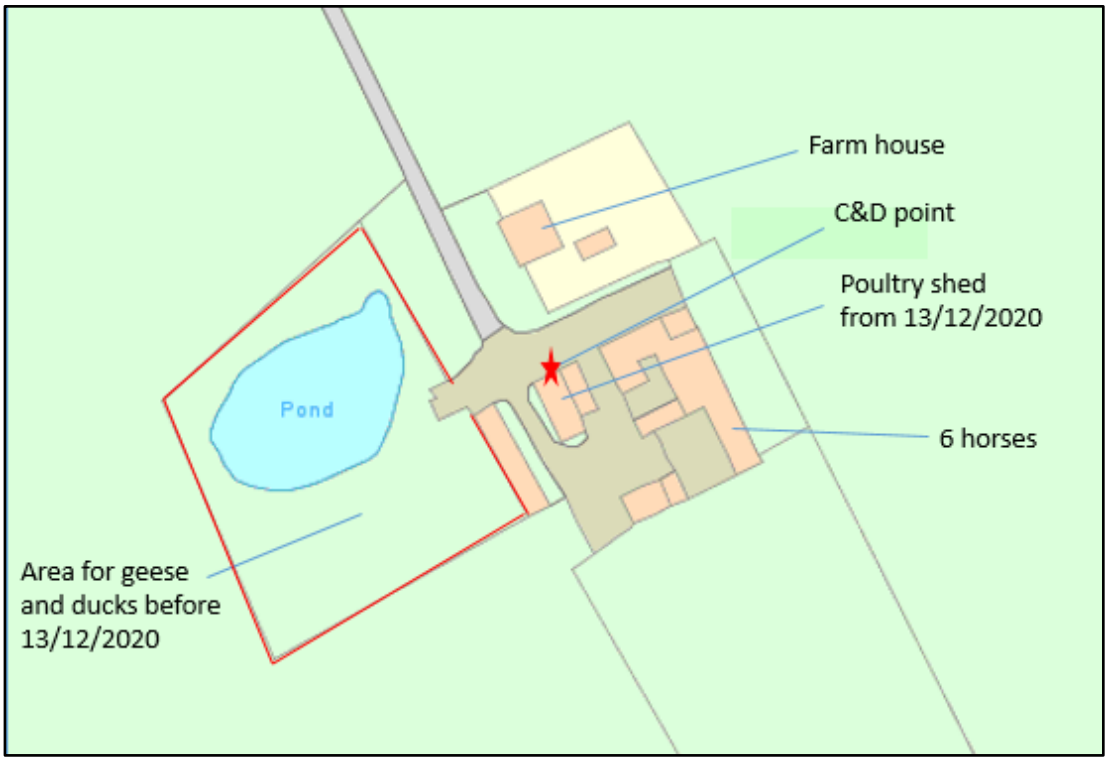
Location in GB

Figure 35: Location of AIV 2020/16



Plan of the infected premises

Figure 36: Plan of 2020/16



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	14/11/2020 – 20/11/2020
Likely:	21/11/2020 – 06/12/2020
High risk:	07/12/2020 – 22/12/2020

Spread tracings window:

Precautionary:	15/11/2020 – 21/11/2020
Likely:	22/11/2020 – 07/12/2020
High risk:	08/12/2020 – 25/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 07/12/2020

Timeline

Table 16: Timeline for 2020/16

Source Tracing Window	Spread Tracing Window	Date	
Day 37		**14/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 36	Day 1	**15/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 35	Day 2	16/11/20	
Day 34	Day 3	17/11/20	
Day 33	Day 4	18/11/20	
Day 32	Day 5	19/11/20	
Day 31	Day 6	20/11/20	
Day 30	Day 7	**21/11/20**	Start of likely source tracing window (-14d).
Day 29	Day 8	**22/11/20**	Start of likely spread tracing window (source tracing window +24h).
Day 28	Day 9	23/11/20	
Day 27	Day 10	24/11/20	
Day 26	Day 11	25/11/20	
Day 25	Day 12	26/11/20	
Day 24	Day 13	27/11/20	
Day 23	Day 14	28/11/20	
Day 22	Day 15	29/11/20	
Day 21	Day 16	30/11/20	
Day 20	Day 17	01/12/20	
Day 19	Day 20	04/12/20	
Day 18	Day 21	05/12/20	
Day 17	Day 22	06/12/20	
Day 16	Day 23	**07/12/20**	Start of high risk source tracing window. **Most likely earliest infection date for this outbreak**. Based on serological results of ducks & geese. This is on a precautionary basis given high levels of uncertainty around interpretation of serology results.
Day 15	Day 24	**08/12/20**	Start of high risk spread tracing window (source +24h).
Day 14	Day 25	09/12/20	
Day 13	Day 26	10/12/20	
Day 12	Day 27	11/12/20	
Day 11	Day 28	12/12/20	
Day 10	Day 29	13/12/20	
Day 9	Day 30	14/12/20	
Day 8	Day 31	15/12/20	
Day 7	Day 32	16/12/20	
Day 6	Day 33	17/12/20	
Day 5	Day 34	18/12/20	
Day 4	Day 35	19/12/20	
Day 3	Day 36	20/12/20	
Day 2	Day 37	21/12/20	
Day 1	Day 38	22/12/20	
	Day 39	**23/12/20**	**Precautionary start of clinical signs.**
	Day 40	24/12/20	Sudden death of 6 chickens. Verbal restrictions served.
	Day 41	**25/12/20**	Deaths of 3 more chickens & 2 culls. APHA report case visit & sampling (DPR 2020/66). Restrictions served.
	Day 42	**26/12/20**	2 chickens die.14 ducks & 8 geese fine. PCR +ves in all spp & serology +ves in ducks and geese. H5N8 confirmed (AIV 2020/16).
	Day 43	**27/12/20**	Culling of remaining birds completed.
	Day 44	28/12/20	Preliminary C&D completed.
	Day 45	**29/12/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.

Investigations on the infected premises

Overview of biosecurity

Prior to housing on 13/12/2020, all the birds were in contact with wild ducks that visited the premises. Since that date, the chickens, geese and domestic ducks had been housed in a small stone barn, with a foot dip outside containing FAM30.

On this basis it was considered that biosecurity had been inadequate prior to housing.

Overview of tracing activities

There have been no movements of live birds on or off the premises in recent years. The only movements were those of the family and two childcare helpers. The owner works on a local cattle farm and as a contractor, with no pig or poultry contact.

No other tracings were identified.

Source investigations

Hypothesis for the source

The most likely source of infection would appear to be direct or indirect contact with the wild ducks that regularly visited the garden pond and mixed with the domestic poultry. This was assessed as high likelihood with low uncertainty.

Some feed and bedding had been collected from a barn accessed by driving down the lane adjacent to the duck farm on three dates in December. However, fomites from the vehicle passing AIV 2020-15 seem to be a far less likely source of infection than the wild ducks. This tracing was assessed as being very low likelihood with medium uncertainty.

Assessment and evidence base for the likely source

- Wild waterfowl seen on the pond and co-mingling.
- No evidence of close links with nearby large, housed duck premises.
- No other source tracings were identified.

Spread investigations

Assessment of potential and likelihood of spread

No spread tracings were identified. The only likely route of spread was via the wild birds in contact with the poultry before 13/12/2020. However, this would have been insignificant in comparison to the likely high level of infection already present in the local wild bird population.

Remaining uncertainty

The levels of antibodies detected in the geese and ducks suggested that the most likely date of infection was 07/12/2020, however, there was a high degree of uncertainty in the interpretation of these serology results.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with the wild ducks that regularly visited the garden pond.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/17, Watton

Description of the premises

Overview of the premises and the wider business

The site affected by AIV2020/17 was part of a large, fully integrated, poultry production company. This location was made up of multiple CPHs and consisted of four indoor fattening units (units 1 to 4), and several seasonal outdoor sites for free-range geese and ducks. At the start of the disease investigation all the free-range poultry had already been slaughtered.

Although made up of different CPHs, the site was managed overall by a single fieldsman, and was effectively one epidemiological group due to the number of viable risk pathways that exist with the level of biosecurity employed.

The indoor units run on an all-in, all-out basis, with day-old ducklings supplied mainly by the company hatchery from eggs produced in their own breeder flocks and finished birds slaughtered in their own slaughter facility. A small number of day-old ducklings were also sourced from a different duck breeding company.

Ducklings were initially fed a starter ration until they were 16 -17 days old, and then were changed to a growing ration until slaughter at either 35 to 45 days (for intensive indoors) or 49 to 54 days (for free-range birds). All day-old ducklings were initially placed indoors, and birds destined for the free-range market were moved to outdoor accommodation at 21 days of age.

The catching gangs were company run. Terminal cleansing and disinfection (C&D) was carried out by a contractor, as was routine pest control.

Feed was supplied by several different companies and straw for bedding was supplied by local farmers.

Access to the site was by two main entrances, one at the north for access to unit 3 and a southern entrance to access units 1, 2 and 4 (see Figure 46).

Unit 4 also has its own side entrance that is restricted to staff only, so that they can enter the site.

A central animal by-products collection unit was situated near the southern entrance and was used by all four production units for the storage of dead birds.

Each of the four units has their own dedicated machinery and staff. Straw was stored and delivered from a central location by the same tractor over shared access tracks, diesel was stored centrally and on occasions some staff moved work location around the site.

Detailed descriptions of chemicals used, and process followed for terminal C&D were available; however, within flock C&D procedures were lacking.

Description of the housing

This specific location consists of:

Unit 1: 6 houses and was considered the main premises linked (20 metres across a road) to

Unit 2: 4 houses.

Unit 3: 6 houses 500 metres to the north, and

Unit 4: 4 houses 700 meters to the south.

The units were set-up in various ways and used different construction types. All sheds, buildings, tanks and silos were on hard standing concrete bases, the tracks and lanes between sites were made of soil and grass, there was a concrete apron at the front and back of all the sheds; however, the space between the sheds was grass. There were places where water can accumulate on the soil during rainy days, but the concrete areas were clean and in good condition.

The temperature, light, feeding and water supply controls were all automated.

Ventilation varies between the sites. Units 1, 2 and 4 have controlled ventilation.

Unit 3 ventilation was more complex:

- Sheds 1 & 6 were controlled for the first 10 days and then go to natural ventilation.
- Sheds 3 was always controlled.
- Sheds 2, 4 & 5 always have natural ventilation.

In units 1 and 2 the top halves of the wall of these sheds were built using wooden panels. The gaps between the panels do not allow wildlife access and the wooden panels were internally covered by black plastic sheets. However, a shed at both sites had some gaps around the door frame that could provide a potential route of exposure to wildlife.

Unit 3 sheds 1, 2, 4, 5 and 6 were not fully walled, as they have extensive lateral netted areas. The bottom half of the sides was solid brick construction while the top half was net. There were blue plastic curtains that were used to cover the netted areas. These curtains covered the netted area when the birds were small and were dropped as the birds grow

older, in order to improve ventilation of the sheds. Curtains were also kept open when straw chopping/bedding was carried out, to allow the dust to blow out, thus further improving ventilation. The netted areas were more exposed to wildlife and in one shed the netting was ripped at one point, allowing further exposure.

BUILDING MAINTENANCE - Unit 4 site consisted of sheds that had been more recently built, brick work was covered with wooden panels with minimal gaps between them, avoiding exposure to wildlife. Overall, this Unit 4 was considered to have the best biosecurity.

Units 2 and 3 showed evidence of moss-covered roofs, which were attractive to various bird species observed searching for food.

WATER - Water was pumped from a borehole at Unit 3 into a nearby water tank. Water was then fed from the tank to all sheds on the four sites, through pipes placed underground. When kept, the free-range birds access water from sheep water troughs.

FEED - Feed was supplied by five commercial feed companies and was stored in silos for each shed.

BEDDING - Straw was stored centrally in open sided barns, prior to moving to each unit where it was stored outside on a trailer before use. The duck sheds were regularly bedded either by hand, or using a straw chopper.

DRAINAGE - Wastewater drainage was internal feeding the dirty water tanks underground at units 1, 2 and 3. At the unit 4 drainage grids were both inside and outside the sheds and both feed underground tanks. The drainage water was collected by suction from the underground tanks using the same shared machine which was not cleaned and disinfected between sites. This wastewater was then spread on nearby land if weather permits or pumped into a slurry tank for storage.

Species and number of each present

Unit 1: 48,000 ducks in 6 houses. Placed 08/12/2020 (Houses 1 and 2), 11/12/2020 (Houses 3, 4 and 5) and 18/12/2020 (House 6).

Unit 2: 16,000 ducks in 4 houses. Placed on 27/11/2020 (Houses 1, 2 and 3) and 01/12/2020 (House 4)

Unit 3: 33,000 ducks in 6 houses. Placed on 01/12/2020 (Houses 1 and 2), 02/12/2020 (House 5), 04/12/2020 (House 6) and 7/12/2020 (House 3 and 4).

Unit 4: 30,000 ducks in 4 houses. Placed on 20/11/2020 (House 4) and 24/11/2020 (Houses 1, 2 and 3).

Description of the surrounding area

This unit was in a poultry dense area of Norfolk (Figure 45). The image at Figure 46 shows woodland around the sites that was easily accessible, as it was not fenced. There were no public footpaths around the premises; however, the site was at the end of a concrete road which gives access to several leisure sites and this road was used by dog walkers.

There were no water courses crossing the farm or around the boundaries, but there was a pond west of the Unit 3 and a reservoir on the east side of a nearby main road.

There was a pig farm with 5200 pigs to the north of the site; however, there was a lane 3 to 4 meters wide, separating the two holdings and contiguous fields were not used for free-range birds.

Surveillance activity

PZ (0-3km)

45 premises with poultry holding between 1-462,661 birds

(10 premises with 50 or more birds)

SZ (3-10km)

42 premises with poultry holding between 1-400,000 birds

(19 premises holding 50 or more birds)

Ornithological assessment

Wild birds have been seen at the farm, mainly seagulls and geese. During the visit only seagulls flying above the premises and sparrows on shed roofs were seen. The farmer stated that the presence of wild birds increased when the ducks were free-range and then decreased when all the birds on site were housed birds.

Situated inland, this lowland IP may be subject to the influence of the coast and two estuaries which are found within 10 km of the site. The neighbourhood of the IP was dominated by managed pasture though this appears relatively ‘dry’, potentially limiting its value as a source of forage to many birds. Despite some small ponds associated with the IP, there were few larger permanent waterbodies, and none close to the IP. Also close to the IP was an extensive area of semi-natural habitats protected by conservation areas and bird reserves.

Wildfowl were likely to be common across the landscape, and whilst abundant at the estuarine sites, might be less so inland. Other than the small group of ducks known to mix with the poultry on the IP before the infection window, it was unclear where visiting wildfowl would have acquired infection, or how wildfowl might have subsequently transmitted it to poultry

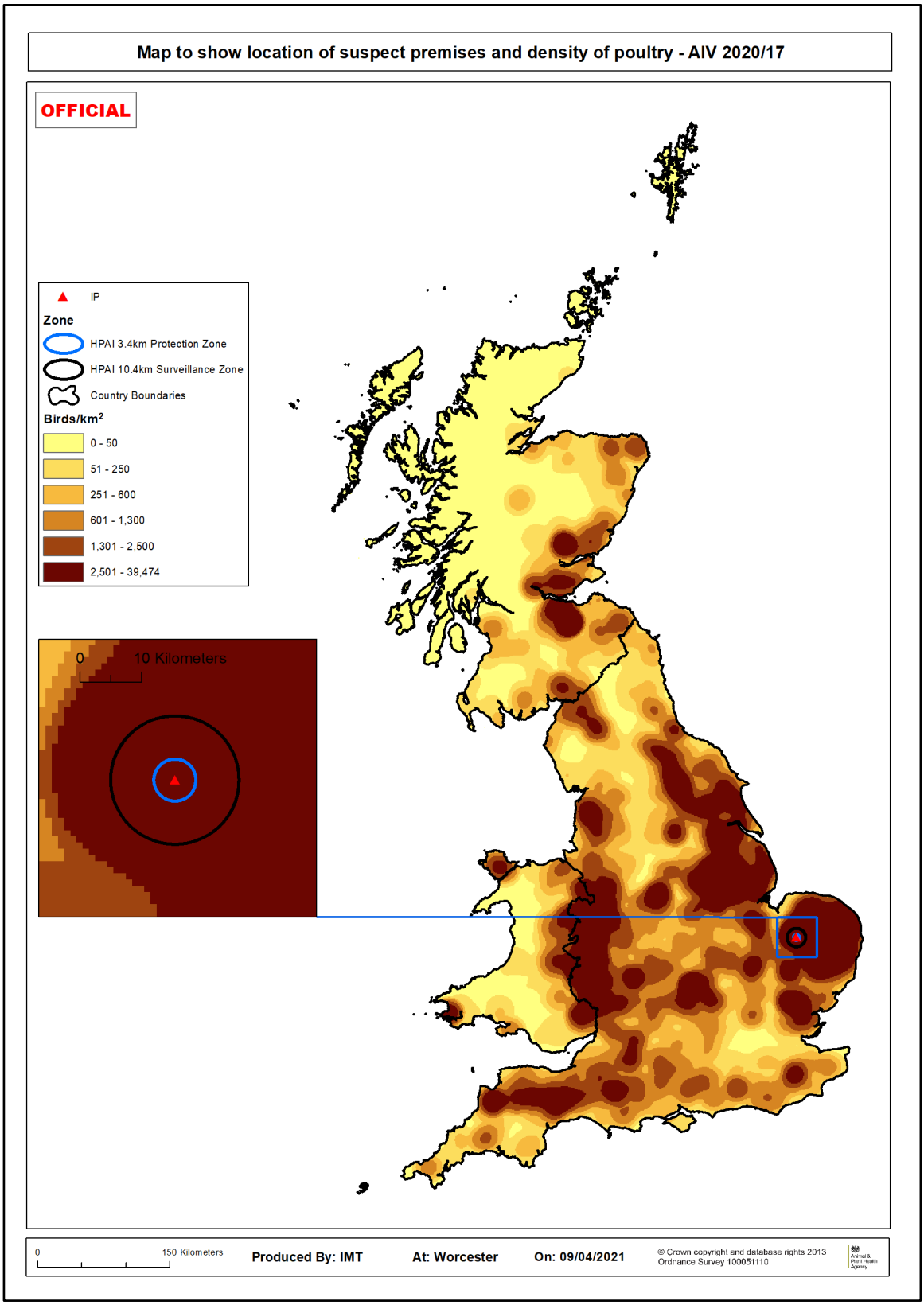
Other water-birds and gulls may all find the nearby estuary sites and coast far more attractive than the IP or its neighbourhood. This combined with the generally limited availability of large waterbodies close to the IP and the character of the pastoral landscape, may limit the abundance and diversity of these birds, and so limit the opportunities for them to support an infection pathway. In this context, the nearby bird reserves might not represent a source of infection. Similarly, the IP appears unattractive to other bridge species such as Corvids.

Small wild birds appear to have had access to the poultry and their feed and housing throughout the potential period of infection, but this pathway presupposes their infection locally.

Wild birds were considered to be a plausible source of infection for this IP.

Location in GB

Figure 37: Location of AIV 2020/17



Plan of the infected premises

Figure 38: AIV2020/17 overview of the wider site

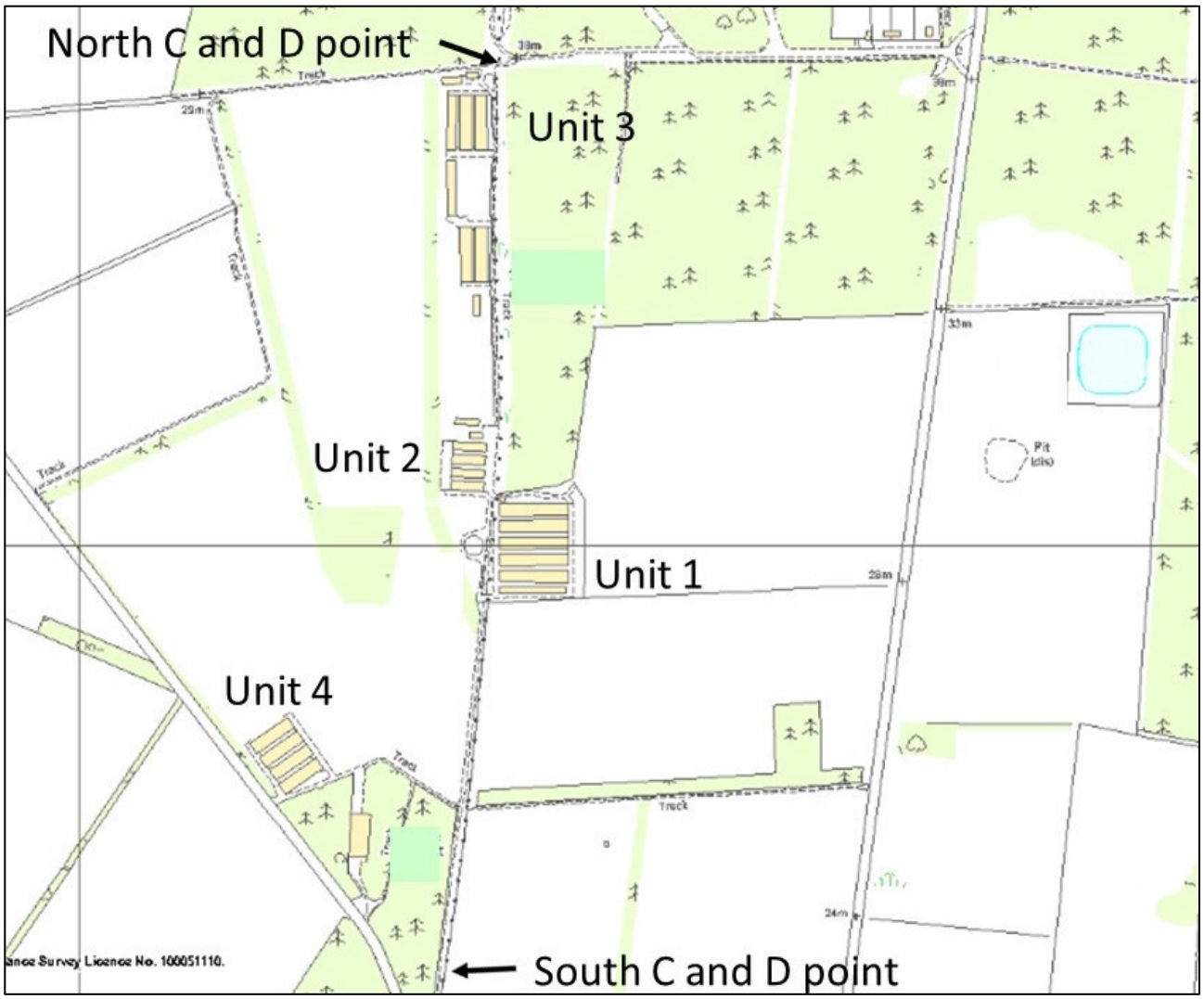


Figure 39: Units 1 and 2 detailing shed numbers and infrastructure.

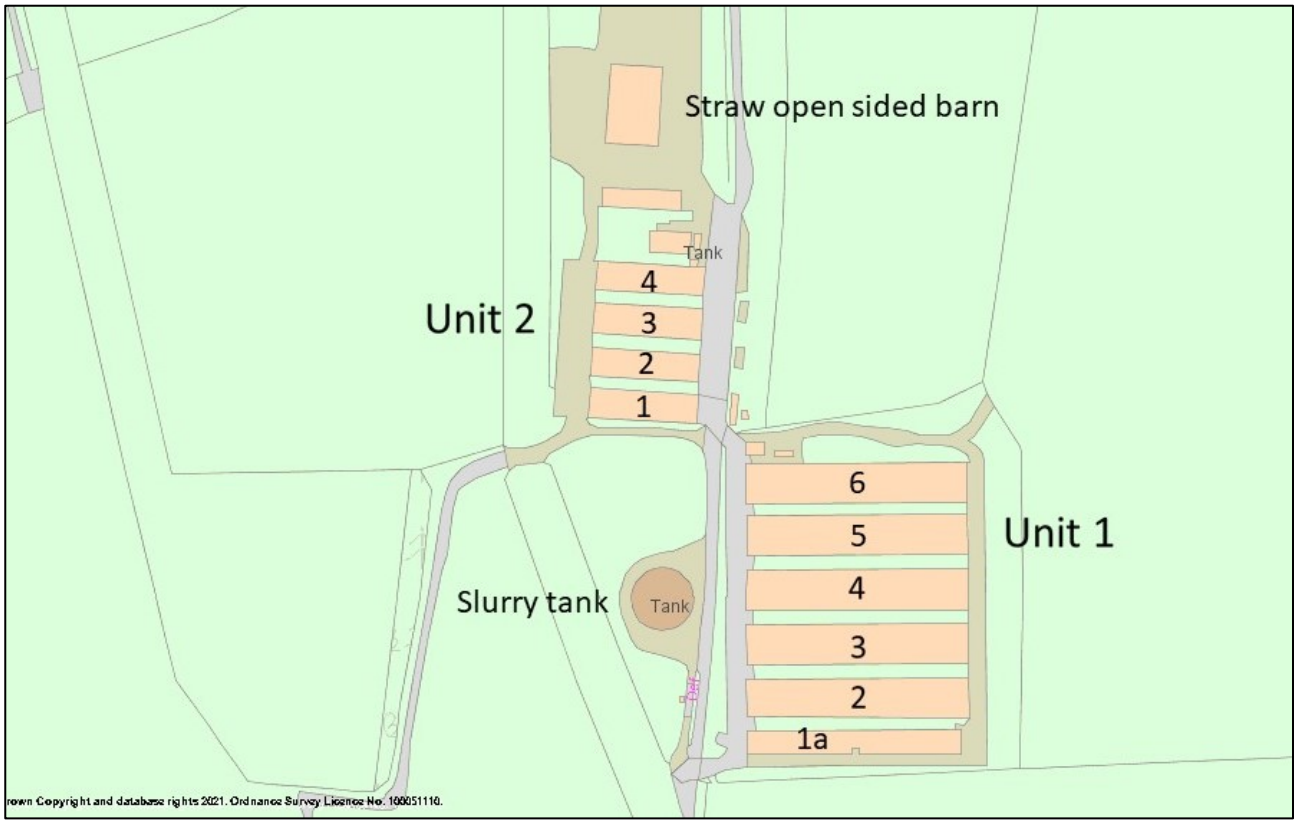


Figure 40: Unit 3 showing shed numbers and significant infrastructure.

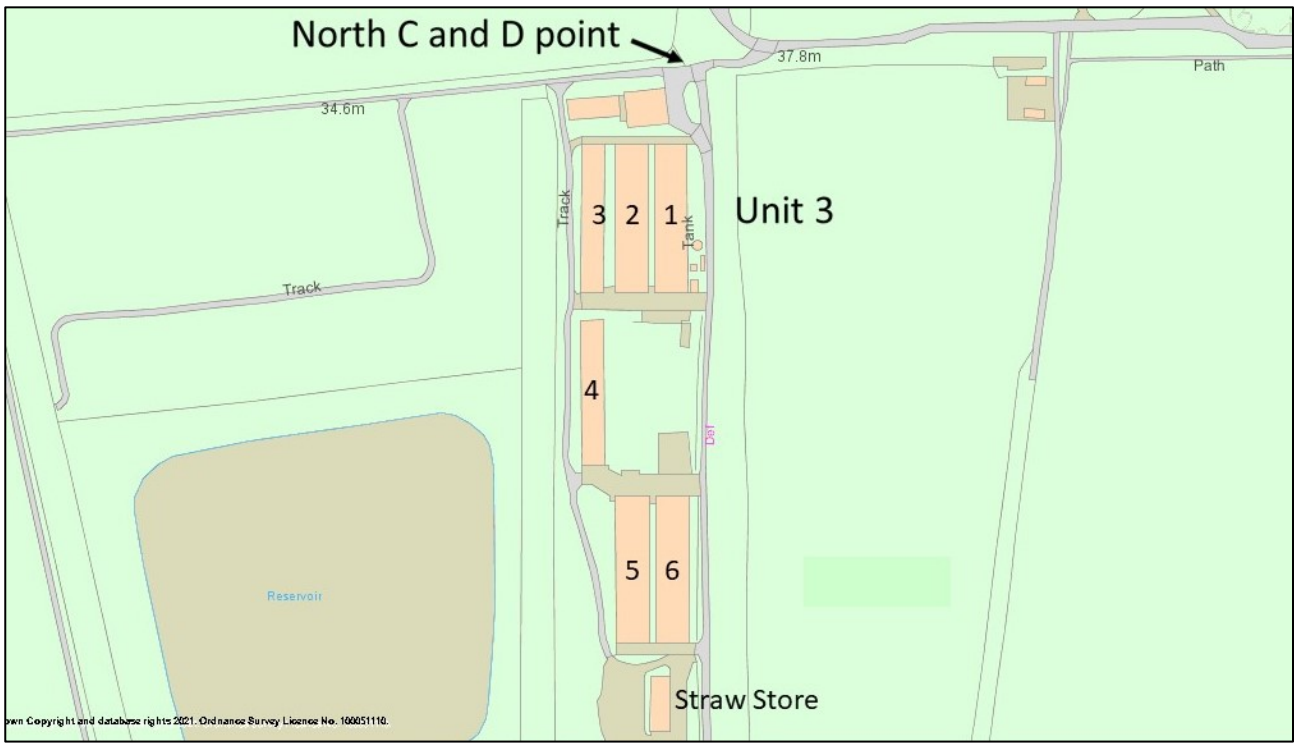
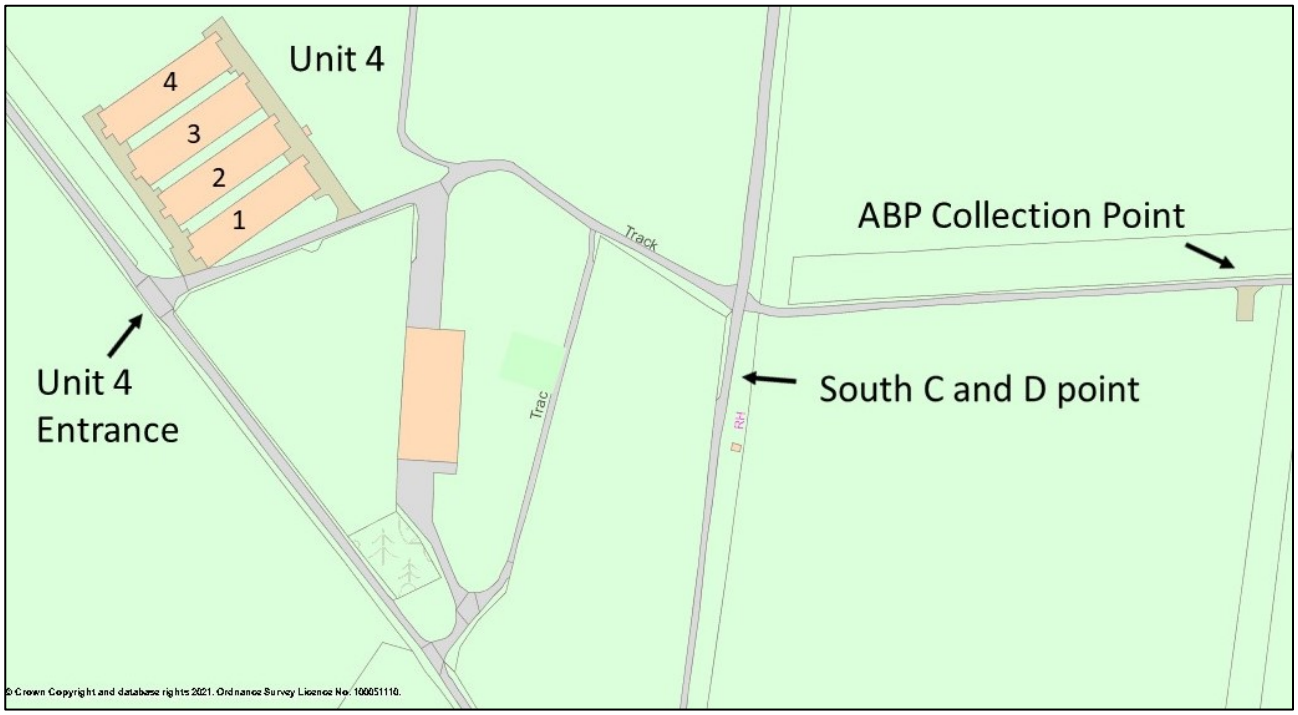


Figure 41: Unit 4 showing shed numbers and significant infrastructure.



CLINICAL PICTURE

Initial suspicion of Notifiable Avian Disease (NAD) was raised on 26/12/2020 as a result of increasing mortality and morbidity in the flock housed at unit 1 that started on 23 or 24/12/2020. At the time of disease investigation an increase in mortality and morbidity was also noted in units 2 and 3.

Further investigation and analysis of the production records on the site indicated that increased mortality started in Unit 4 on 15/12/2020 or 16/12/2020 when post-mortem examinations (PME) by the private vet had indicated a likely diagnosis of aspergillosis.

Sampling at the time of culling on 30/12/2020 in unit 4 produced serological positives to H5N8, plus low-level PCR positives indicating a recovering infection and the likely initial incursion point for the disease.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	24/11/2020 – 30/11/2020
Likely:	1/12/2020 – 11/12/2020
High risk:	12/12/2020 – 15/12/2020

Spread tracings window:

Precautionary:	25/11/2020 – 01/12/2020
Likely:	02/12/2020 – 12/12/2020
High risk:	13/12/2020 – 27/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 12/12/2020

Timeline

Table 17: Timeline for 2020/17

Source Tracing Window	Spread Tracing Window	Date	
		20/11/20	Day olds placed Unit 4: House 4.
		21/11/20	
		22/11/20	
		23/11/20	
Day 21		**24/11/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d). Day olds placed Unit 4: Houses 1, 2 & 3.
Day 20		**25/11/20**	Start of precautionary spread tracing window (source + 24h).
Day 19		26/11/20	
Day 18		27/11/20	Day-olds placed Unit2: Houses 1, 2 & 3.
Day 17		28/11/20	
Day 16		29/11/20	
Day 15		30/11/20	
Day 14		**01/12/20**	Start of likely source tracing window (-14d). Day-olds placed Unit 3: House 2 and Unit 2: House 4.
Day 13	Day 1	**02/12/20**	Start of likely spread tracing window (source tracing window +24h). Day-olds placed Unit 3: House 5 and Unit 2: House 4.
Day 12	Day 2	03/12/20	
Day 11	Day 3	04/12/20	Day-olds placed Unit 3: House 6.
Day 10	Day 4	05/12/20	
Day 9	Day 5	06/12/20	
Day 8	Day 6	07/12/20	Day-olds placed Unit 3: Houses 3 & 4.
Day 7	Day 7	08/12/20	Day-olds placed Unit 1: Houses 1 & 2.
Day 6	Day 8	09/12/20	
Day 5	Day 9	10/12/20	
Day 4	Day 10	11/12/20	Day-olds placed Unit 1: Houses 3, 4 & 5).
Day 3	Day 11	**12/12/20**	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak.**
Day 2	Day 12	**13/12/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	14/12/20	Last of previous free-range flock moved to slaughter.
Day 0	Day 14	**15/12/20**	**Precautionary onset of first clinical signs based on increased morbidity and mortality initially attributed to Aspergillosis infection - precautionary culls started and antibiotic treatment started at Unit 4. Analysis of production records (Unit 4: House 2) and results of further epi sampling supportive of this date.**
	Day 15	16/12/20	
	Day 16	17/12/20	
	Day 17	18/12/20	Day-olds placed Unit 1: House 6
	Day 18	19/12/20	
	Day 19	20/12/20	
	Day 20	21/12/20	
	Day 21	22/12/20	Increasing mortality in Unit 1: House 5.
	Day 22	23/12/20	
	Day 23	24/12/20	Increasing mortality in Unit 1: House 4. Unit 2: Sheds 2 and 3 - antibiotic treatment started after further submissions show evidence of septicaemia.
	Day 24	25/12/20	
	Day 25	**26/12/20**	Suspicion of avian notifiable disease reported to APHA and verbal restrictions served (DPR 2020/68).
	Day 26	**27/12/20**	APHA veterinary inquiry undertaken and samples submitted (20:20:20 from two of the worst affected houses). EXD01 restriction served in writing
	Day 27	**28/12/20**	HPAI H5N8 confirmed (**AIV 2020/17**).
	Day 28	29/12/20	
	Day 29	30/12/20	Culling commenced. Additional epidemiological sampling undertaken at Unit 4. Expert lab opinion is that PCR and serology results indicative of exposure 10-14 days previously.
	Day 30	31/12/20	Additional epidemiological sampling undertaken at Unit 3.
	Day 31	01/01/21	
	Day 32	02/01/21	
	Day 33	03/01/21	Culling completed.
	Day 34	04/01/21	
	Day 35	05/01/21	Preliminary C&D completed.
	Day 36	**06/01/21**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possiblity of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possiblity of spread from the IP on these dates.		

Assumptions

• Detection of viral nucleic acid in birds +A1:D56indicates that infection took place within the last 14 days, after this only antibody is present.

• Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.

• Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.

Investigations on the infected premises

Overview of biosecurity

The farm has a biosecurity protocol with closed gates and disinfection points for vehicles. The gates at both entrances were kept closed and locked most of the time, and always overnight unless vehicles were expected to arrive for live bird collections.

The farm has three entrances. The south entrance was nearby Unit 4, the north entrance was at unit 3. The third entrance was at the unit 4 buildings; however, this was not used for deliveries, but was used by staff to enter the site after parking their cars outside the gates.

The specific unit 4 buildings entrance has a disinfection point consisting of a foot dip, a lidded dust bin containing disinfectant, and a watering can for pouring it.

The north entrance, also called Unit 3 entrance, was used only for deliveries at Unit 3. The entrance was unpaved and at the time of the visit was very muddy and with several muddy water pools. Mixing of water and disinfectant happens inside a small wooden shed at the C&D point, water in supplied through a hose pipe connected to a Dosatron® which adds the right amount from a can of the disinfectant being used. The disinfectant used for vehicles' wheels and wheel arches was Viroshield at 2% rate. There was no information regarding the efficiency of the C&D point water pressure, nor of the amount of disinfectant used. However, considering the poor condition of the ground it was very unlikely that adequate C&D was carried out at this point.

The south entrance, also called unit 1 entrance, mirrors the one at the north and was used for deliveries to units 1, 2 and 4. This entrance was also unpaved and although better maintained compared to the north entrance, it was unlikely that an effective C&D can be carried out.

Neither entrance have records of C&D declaration, hence the uncertainty that C&D was carried out was high. All vehicles that crossed the south entrance C&D point during the critical period were also considered as high-risk tracings.

The company policy was that staff must wear appropriate PPE and the following were supplied.

- Boots.
- Cotton overalls.
- Masks to be worn inside the sheds.
- Gloves (optional).

Staff drive their own cars to the premises. Units 3 and 4 have their car parks outside the gates, while units 1 and 2 has a car park inside the premises. Disinfection of the wheel and wheel arches was carried out at the appropriate C and D point used to enter the site.

There were changing rooms/rest rooms for each specific production site (Units 1 and 2 share the same room). The changing rooms were provided with hand wash basins, warm water, soap, paper towel and hand dryers. Hand sanitizer dispensers were placed at the staff entrance of each shed. Overalls were washed daily.

There were two foot-dips at each bird shed, as well as hand sanitizer. On entry, staff must dip the boots in the exterior foot dip (lidded), then repeat the procedure in the bird shed hall and disinfect their hands. The same procedure should be followed on exit. Virex solution was used at 1% rate on the foot dips. During the visit the foot dips appeared to be used, as they were partly soiled at all sites, unit 4 lidded foot dips appeared clean, as if freshly replenished.

The C&D infrastructure at the ABP 'collection' point was considered poor with a foot dip, a barrel of disinfectant and a watering can. The skip at the time of inspection was leaking and the concrete pad heavily contaminated by soil and organic matter, making effective C&D, difficult if not impossible.

No standard operating procedure were available that detailed the C&D that was expected to be carried out during the routine bedding of the ducks. This was a major risk pathway for the introduction of disease into the flocks, given that the same machinery and staff would be used that visited the ABP collection point.

It was also noted that field staff previously allocated to looking after free-range birds were re-deployed to housed bird locations around the most likely time of infection.

Overview of tracing activities

Evidence based on the clinical picture, laboratory results and expert advice, together with the OIE requirement for a precautionary assumption of a 21 day incubation period prior to clinical signs, gave the source and spread time windows which informed tracing activities.

Multiple telephone and email enquiries were generated to confirm information about these potential tracing events and to inform risk assessments.

The following tracing events were investigated:

Movements of farm personnel

FARM MANAGER – besides managing the IP, within the high-risk spread window he visited two other poultry premises not under his direct management. At one premises he spent one day helping with the depopulation of the site, and at the other he spent several days helping with the placement and initial care of day-old ducklings. A tracing visit to this latter potential contact premises (CP1) was raised.

TWELVE OTHER STAFF (EXCLUDING THE FARM MANAGER) worked on site either as full-time or part-time basis – assurances were received that none worked in other poultry premises and none had any contact with other poultry or birds within the high-risk tracing window. It was the company policy that staff should not have birds of their own.

Movements of other people

PVS – early information provided indicated a private veterinarian performed post-mortem examinations on birds at two sites during the high-risk spread window. The veterinary practice was contacted, and they confirmed the PVS did not visit the sites, but rather carcases were submitted to the practice for PME. The information provided about biosecurity arrangements and disposal of carcases were assessed as satisfactory and no further action requested.

PEST CONTROL PERSON - early information provided indicated the visit frequency was between six to eight weeks. The pest control services company was contacted for details and they confirmed there were no visits to any of the sites during the high-risk window.

Movements of vehicles

FEED DELIVERIES - two feed companies supplied feed to the various sites during the high-risk source and spread window. Information was sought about the transport, delivery routes and biosecurity arrangements. This informed a full veterinary risk assessment, which concluded that the overall risk for both source and spread was very low with medium uncertainty.

FALLEN STOCK COLLECTIONS - one collection took place within the high-risk spread window. Information was sought about the transport, collection route and biosecurity arrangements. Due to the single collection, the satisfactory C&D protocols at the collection yard on vehicle, skip and personnel, in addition to no other contact with poultry on the day and the carcases disposal method (rendering), it was concluded overall risk for spread was very low.

BEDDING DELIVERIES - several deliveries of straw occurred during the high-risk source and spread window. Information was sought about the transport, delivery routes and biosecurity arrangements. Due to the single drop deliveries and the location of the deliveries, the satisfactory C&D protocols, and the lack of other poultry contacts, it was concluded overall risk for spread was very low.

Movements of livestock

MOVEMENT OF FREE-RANGE DUCKS TO SLAUGHTER - three movements of ducks to slaughter to two different slaughterhouses, took place within the high-risk source and

spread window. Information was sought about the transport arrangements (driver and vehicle) and the catching gang involved in the depopulation.

a. CATCHING GANG - assurances were received that none of the catchers worked or went to other poultry premises on the same days as they went to the IP, that they complied with C&D protocols on/off site and they did not keep poultry/birds.

b. VEHICLES TRANSPORTING THE DUCKS - information gathered about the C&D protocol, the depopulation and the drivers with no other poultry contact allowed to conclude an overall risk for source and spread of very low.

DELIVERY OF DAY-OLD DUCKLINGS (DOD) - one delivery of DOD from the hatchery to one of the sites took place within the high-risk spread window and information was sought about the transport arrangements. This revealed that the same driver/vehicle also delivered DOD to another farm just after delivering to the IP. A tracing visit to this potential contact premises (CP2) was raised.

The above investigations resulted in the identification of two potential contact premises (CP1 and CP2) – both received an immediate tracing visit requiring service of restrictions, veterinary inspection, production record checks and an exposure risk assessment of the likelihood of a valid risk pathway for introduction of H5N8 into the premises. In both cases the outcome of the risk assessment was very low, and restrictions were subsequently lifted.

All tracing investigations were satisfactorily completed and closed.

Source investigations

Hypothesis for the source

Most likely source in this infected premise was via indirect contact with infected wild birds that were known to be circulating in the area. The contact was either by (i) contaminated bedding, (ii) contamination of machinery used at the sites, or (iii) by contaminated staff who look after the welfare of the birds. Direct contact with wild birds cannot be excluded, but was considered unlikely, as the sheds initially affected were at unit 4, the most secure of the whole site.

Assessment and evidence base for the likely source

To date all tracing activities have failed to identify infection at premises within the direct supply chain to this site. The company hatchery was associated with AIV 2020/15; however, a VRA carried out at the time of AIV 2020/15 (a duck breeder farm) assessed that the likelihood of infection occurring as a result of DODs placed from the hatchery was

very low and surveillance (clinical inspection and sampling) has failed to show any spread of infection.

The earliest date of likely infection on this site (in unit 4) was 12/12/2020, some 18 days after placement on 24/11/2020. If the DODs had been infected it would be expected that mortalities would have occurred earlier.

Staff that were involved with looking after free-range birds were re-deployed to unit 4 around the time of likely infection. It was likely that these staff routinely working outside, would be doing so in an environment that was being contaminated by infected wild birds.

Biosecurity practices appeared to be somewhat lax. Staff were observed during the report case visit entering sheds of different sites using the same coveralls.

Details regarding C&D procedures followed during the routine bedding of the ducks were lacking, and the staff and machinery that visited the ABP collection site would be involved in the process, providing an effective potential route of disease spread within the site. The straw used was also stored in a central location, in an open sided shed and once delivered to each unit would sit outside uncovered on a trailer before use.

Spread investigations

Assessment of potential and likelihood of spread

Given the apparent poor biosecurity at this site, there was a high likelihood that virus would be able to escape the site on vehicles, people and any equipment used on site.

Tracing activities have demonstrated that within the company and in supply companies (feed, straw,) additional C&D processes at the other sites effectively mitigate the onsite poor biosecurity.

Additional spread by wildlife, specifically bridge species wild birds, that visited the ABP collection point cannot be ruled out; however, the level of additional risk via this route over that already present in the wild bird population was likely to be low.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2020/18, Exmouth

Description of the premises

Overview of the premises and the wider business

This premises was a family farming business of approximately 100 acres, located near Exeter in southeast Devon. The farm owns 125 breeding ewes and has diversified in recent years by renting out three large sheds as non-agricultural storage units.

Initially, the IP owner had a small 'backyard' flock of 17 chickens, producing eggs for personal consumption. These hens were purchased in summer 2018 and roamed freely in the chicken field / pond area of the farm. Whilst there were no chicken-proof boundaries to keep them fenced in, they generally remained within this range. There were two ponds in this area (one dug in 2013 and one larger pond dug in summer 2019).

Since summer 2020, a group of approximately seven wild ducks had regularly visited these ponds, and would have had both direct and indirect contact with the free-range backyard chicken flock.

There was a fox attack in September 2020, which killed eight chickens, leaving nine survivors - these were kept in a temporary enclosure, containing a coop next to the mobile bungalow since 14/12/2020, in compliance with the national housing order. Following stormy weather on 23/12/2020, the birds were moved to shelter in a horse box in one of the sheds.

On 24/12/2020, three birds were found dead with no previous clinical signs of disease, and it was thought that this was due to the stress of movement. The six remaining chickens died over the course of the next five days, with two of them showing clinical signs of avian influenza (depressed, sneezing, swollen head, cyanotic comb) before death. The final two chickens died on 28/12/2020, which was reported to APHA and a report case was initiated, and restrictions served. The last two carcases were sent to Weybridge and HPAI H5N8 was confirmed on 29/12/2020. All previous carcases had been incinerated on site.

Description of the housing

A small chicken coop and fenced run from 14/12/2020 - 23/12/2020. After that a horse box inside an open sided shed.

Species and number of each present

9 chickens

Description of the surrounding area

Extensive pastoral landscape with two man-made ponds.

Surveillance activity

PZ (0-3km)

58 premises with poultry holding between 1-8,100 birds

(7 premises with 50 or more birds)

1 premises with pigs (2) and poultry (260)

SZ (3-10km)

74 premises with poultry holding between 1-90,000 birds

(35 premises holding 50 or more birds)

Ornithological assessment

Situated inland, this lowland IP may be subject to the influence of the coast and two estuaries which are located within 10 km of the site. The neighbourhood of the IP was dominated by managed pasture, although this appears relatively 'dry,' potentially limiting its value as a source of forage to many birds. Despite some small ponds associated with the IP, there were few larger permanent waterbodies, and none close to the IP. Also close to the IP was an extensive area of semi-natural habitats protected by conservation areas and bird reserves.

Wildfowl were likely to be common across the landscape, and whilst abundant at the estuarine sites, might be less so inland. Other than the small group of ducks known to mix with the poultry on the IP before the infection window, it was unclear where visiting wildfowl would have acquired infection or how wildfowl might have subsequently transmitted it to poultry.

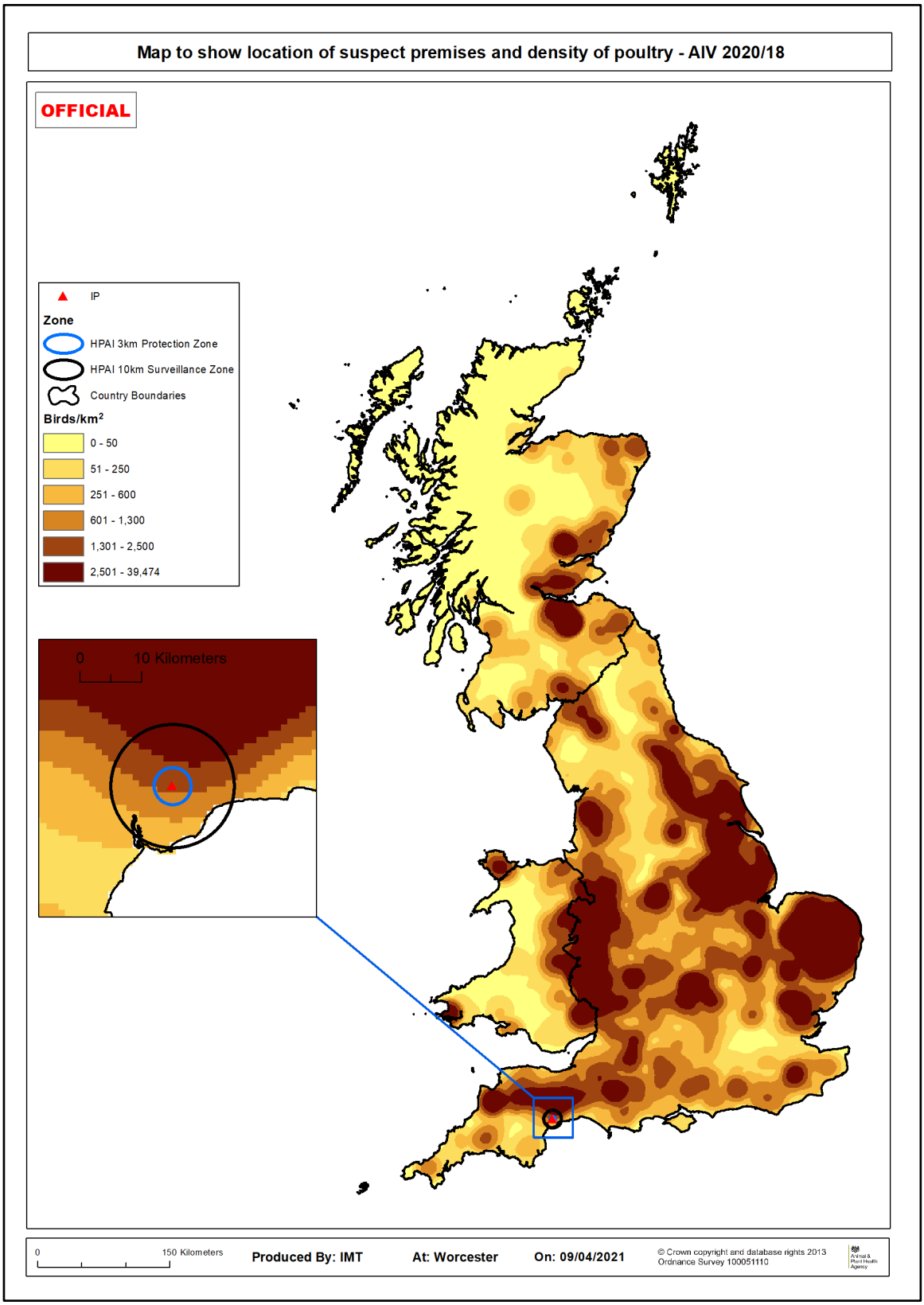
Other waterbirds and gulls may all find the nearby estuary sites and coast far more attractive than the IP or its neighbourhood. This combined with the generally limited availability of large waterbodies close to the IP and the character of the pastoral landscape, may limit the abundance and diversity of these birds, and so limit the opportunities for them to produce an infection pathway. In this context the nearby bird reserves might not represent a source of infection. Similarly, the IP appears unattractive to other bridge species such as Corvids.

Small wild birds appear to have had free access to the poultry and their feed and housing throughout the potential period of infection, but this pathway presupposes their infection locally.

It was concluded that wild birds would be a plausible source of infection pressure on this IP.

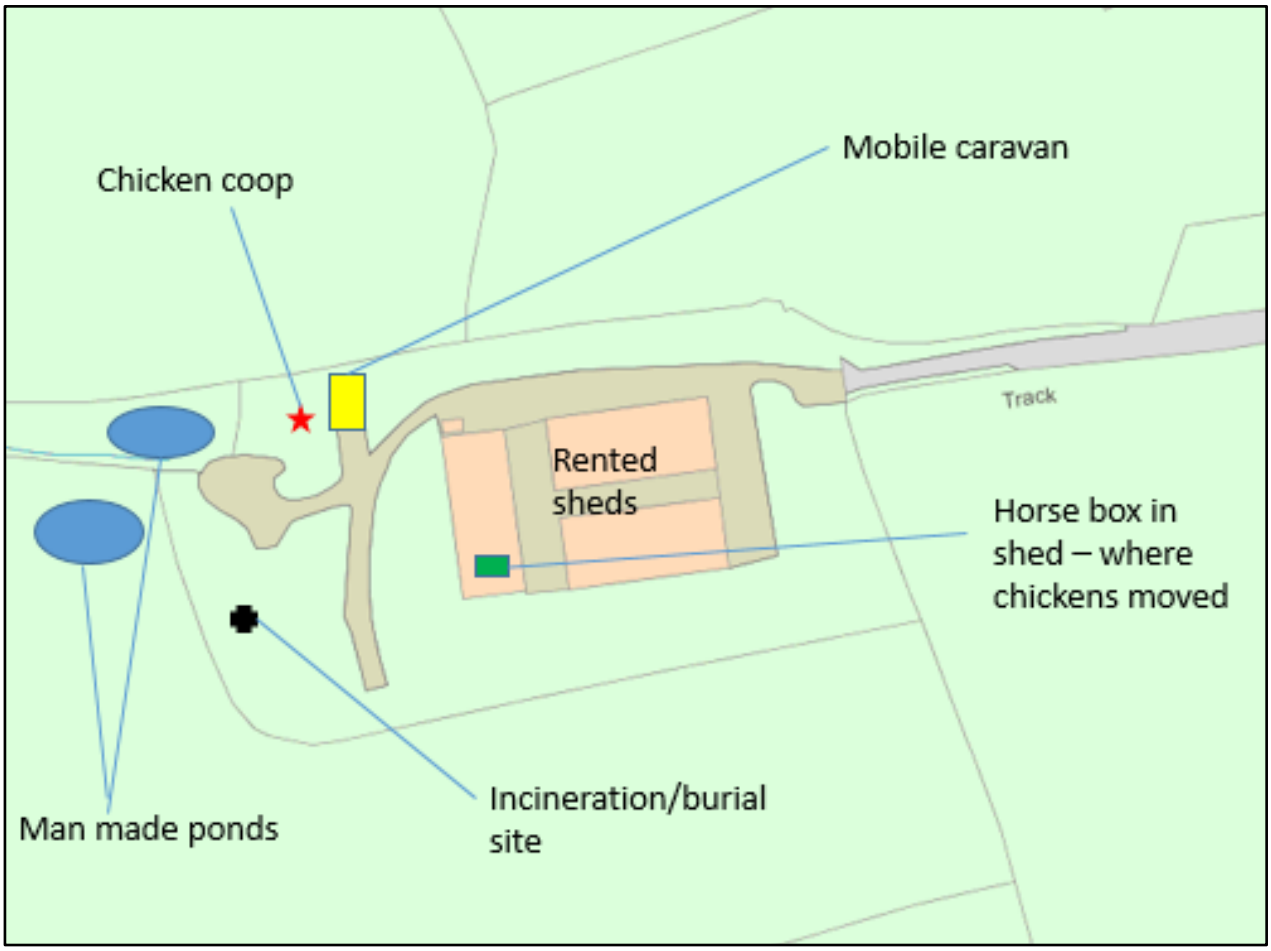
Location in GB

Figure 42: Location of AIV 2020/18



Plan of the infected premises

Figure 43: Plan of AIV 2020/18



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	01/12/2020 – 07/12/2020
Likely:	08/12/2020 – 18/12/2020
High risk:	19/12/2020 – 21/12/2020

Spread tracings window:

Precautionary:	02/12/2020 – 08/12/2020
Likely:	09/12/2020 – 19/12/2020
High risk:	20/12/2020 – 28/12/2020

Most likely date of infection (Start of high-risk source tracing window)**:** 19/12/2020

Timeline

Table 18: Timeline for 2020/18

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**01/12/20**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20	Day 1	**02/12/20**	Start of precautionary spread tracing window (source + 24h).
Day 19	Day 2	03/12/20	
Day 18	Day 3	04/12/20	
Day 17	Day 4	05/12/20	
Day 16	Day 5	06/12/20	
Day 15	Day 6	07/12/20	
Day 14	Day 7	**08/12/20**	Start of likely source tracing window (-14d).
Day 13	Day 8	**09/12/20**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 9	10/12/20	
Day 11	Day 10	11/12/20	
Day 10	Day 11	12/12/20	
Day 9	Day 12	13/12/20	
Day 8	Day 13	14/12/20	
Day 7	Day 14	15/12/20	
Day 6	Day 15	16/12/20	
Day 5	Day 16	17/12/20	
Day 4	Day 17	18/12/20	
Day 3	Day 18	**19/12/20**	Start of high risk source tracing window (-3d) **Most likely infection date for this outbreak.**
Day 2	Day 19	**20/12/20**	Start of high risk spread tracing window (source +24h).
Day 1	Day 20	21/12/20	
	Day 21	**22/12/20**	**Precautionary start of clinical signs.**
	Day 22	23/12/20	Sudden death of 3 chickens (of 9) after movement into horse box.
	Day 23	24/12/20	Deaths reported to CAD vet & 1 chicken sneezing. NFA.
	Day 24	25/12/20	2 chickens died including sneezing bird.
	Day 25	26/12/20	1 bird with swollen head.
	Day 26	27/12/20	2 birds dead including swollen head bird.
	Day 27	**28/12/20**	Last 2 birds died. Reported to APHA (DPR 2020/69). Restrictions served. Carcases collected and submitted to Weybridge.
	Day 28	**29/12/20**	H5N8 confirmed (AIV 2020/18).
	Day 29	**30/12/20**	Preliminary C&D completed.
	Day 30	**31/12/20**	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

No routine biosecurity measures were practised, prior to the housing of the chickens in the horse box. At this point a covered foot dip containing an iodine-based disinfectant was

placed outside the shed. No changes of clothing or protective clothing were worn when tending to the chickens.

The temporary enclosure created after 14/12/2020 only had a netted roof.

There was no vermin control, although no rodent problems reported.

Overview of tracing activities

Nine sets of people were renting the sheds, and these were the only tracings identified. Only eight proved to be contactable and none had any other bird contact.

The IP owner purchased all the chicken feed and bedding himself, directly from agricultural stores, so no further tracings were initiated.

Source investigations

Hypothesis for the source

The most likely source has been assessed as indirect contact from wild birds with high likelihood and low uncertainty. Direct contact from wild birds has been assessed as being of medium likelihood and low uncertainty.

Assessment and evidence base for the likely source

- Indirect wild bird access to temporary enclosure.
- Presence of wild ducks associated with ponds.
- No other obvious sources.

Spread investigations

Assessment of potential and likelihood of spread

All potential routes of spread have been assessed as being very low or negligible likelihood, with low uncertainty.

Remaining uncertainty

One outstanding tracing remains. It was not possible to make contact with this individual, however, they would have had very little, if any, indirect contact with the chickens during the high-risk tracing window. On that basis, this tracing was closed.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2021/01, Anglesey

Description of the premises

Overview of the premises and the wider business

The infected premises consisted of three sheds located in a large country estate rearing game birds, principally pheasants, partridges and ducks for eventual release to the wild, providing mixed game commercial shooting. The estate was 2000 acres in size and located on the north-east coast of Anglesey. It comprised land for mixed farming and game shooting, as well as some dwellings. The game bird business includes several facilities spread across an extended area.

The game shooting business calendar starts in May, with the purchase of 10,000 day-old chicks of both species, pheasants, and partridges. Birds were initially reared in pens and later transferred into runs before being released onto the estate. In addition, 4,000 ducks were also brought on as six-week-old 'growers' in June, to go straight onto several man-made ponds, most of these are within 1 km of the estuary or the coast.

Before the end of January, once the shooting season in Wales has finished, hen pheasants that have survived the season would be caught, temporarily held in the above sheds, and then moved to the breeding premises in Cheshire. This was what was happening at the time the outbreak was identified.

There were two gamekeepers employed to look after the birds. The three sheds used for temporarily housing the pheasants were situated in two separate locations. Shed one was around 1 km away from sheds two and three, which were located next to each other (Figure 55)

The location and the plan sites were presented below in Figure 53, Figure 54 and Figure 55.

Description of the housing

Shed 1 was in an open hilly area, near a small gathering of houses, it was accessed by a private track in a little enclosure where there was a house, a high open barn for hay storage and some old empty sheep sheds. Shed 1 was one of these sheep sheds and it was being used for housing birds for the first time. It was a building approximately 12 x12 meters and it had a wire mesh door on the front, solid stone walls, a wooden back door in poor condition, and a roof with holes and cracks.

Sheds 2 and 3 were in a wooded area accessed by a private track, and located close to some houses. They were in an old overgrown (by weeds) kitchen garden that was

surrounded by a high brick wall. This wall had two entrances that were both open on arrival. The two sheds were solid brick construction with wooden doors that were in poor condition, plus wire mesh windows. The roof was in poor condition with holes and cracks present, and vegetation growing on it. Each shed was 12 x 6 meters in size. These sheds were used to rear birds nine years ago and they were used for a short period last year to gather the hens before moving them to the breeding premises in Cheshire.

Species and number of each present

At the time of the HPAI outbreak the game keepers estimated that around 3000 partridges, 2000 ducks and 2500 pheasants had survived the season.

Of the above 2500 pheasants, 1500 were housed in the three sheds, each of which were filled with 500 birds each.

Description of the surrounding area

The IP was geographically located on the north east coast of the Isle of Anglesey, in the north west of Wales, 2 km from the Irish sea. There were numerous permanent waterbodies local to the IP (small lakes, ponds and rivers). As it was a coastal location, a mix of terrestrial and marine conservation areas and designated sites can be found close to the IP.

The surrounding area has a low density of poultry holdings.

Surveillance activity

PZ (0-3km)

40 premises with poultry holding between 2-100 birds

(3 premises with 50 or more birds)

SZ (3-10km)

9 premises with poultry holding between 5-137,852 birds

(2 premises holding 50 or more birds)

For all HPAI IPs confirmed after 01 January 2021, enhanced surveillance was implemented within 0-10km for a period of 90 days following effective preliminary C&D on the relevant IPs.

Ornithological assessment

A desk top ornithological assessment was completed and revealed this following.

This was a coastal IP, which includes a number of features which may have encouraged the housed birds to have mixed closely with wild birds and waterfowl of a range of types, which are a plausible source of AIV.

- Local abundance of wildfowl and waders,
- General ubiquity and abundance of bridge species (principally gulls).
- The overall conclusion of the ornithological assessment was that wild birds represented an obvious substantial source of infection pressure to the IP.

Location in GB

Figure 44: Location of AIV 2021/01

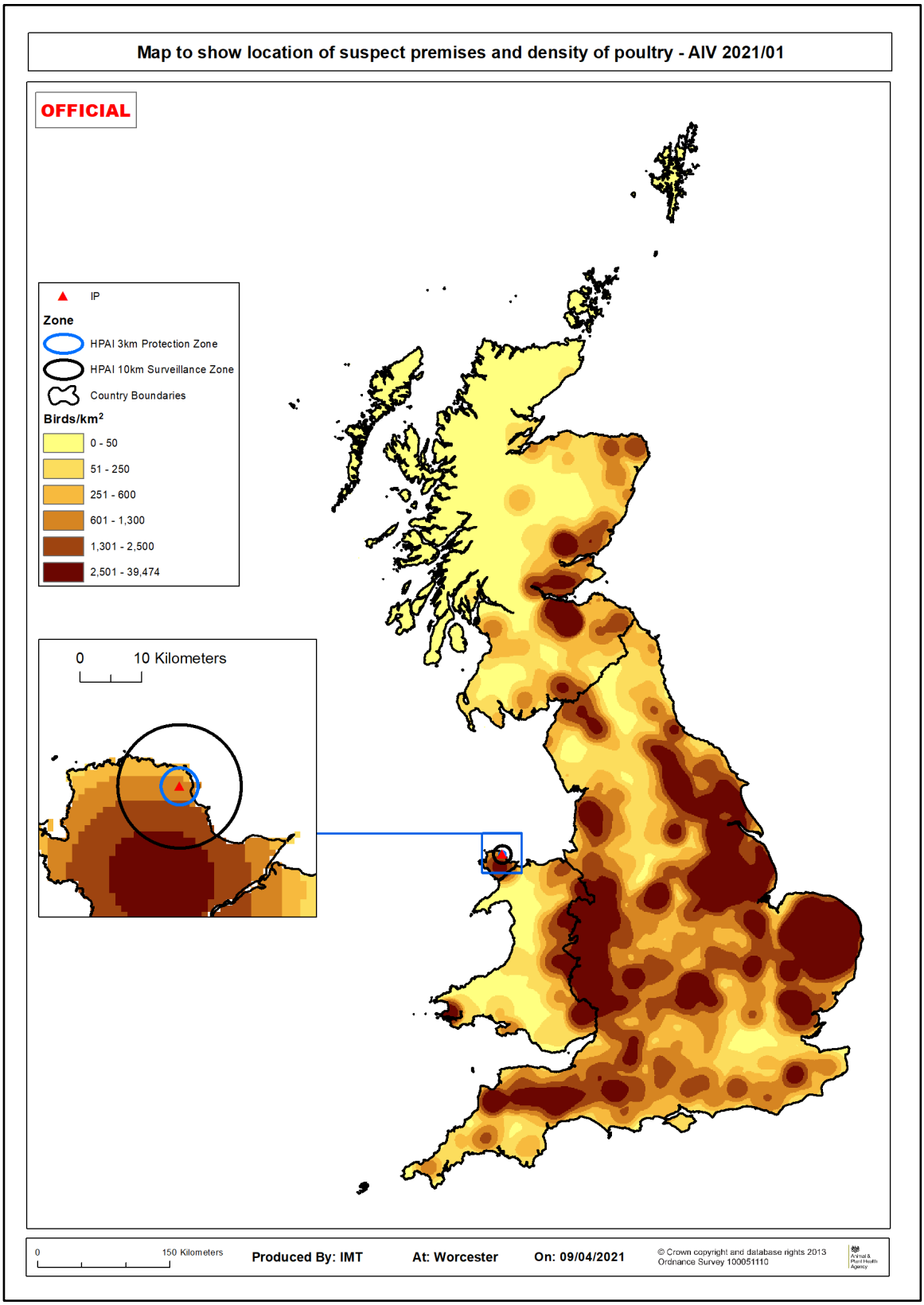


Figure 45: Plan of the infected premises – shed 1

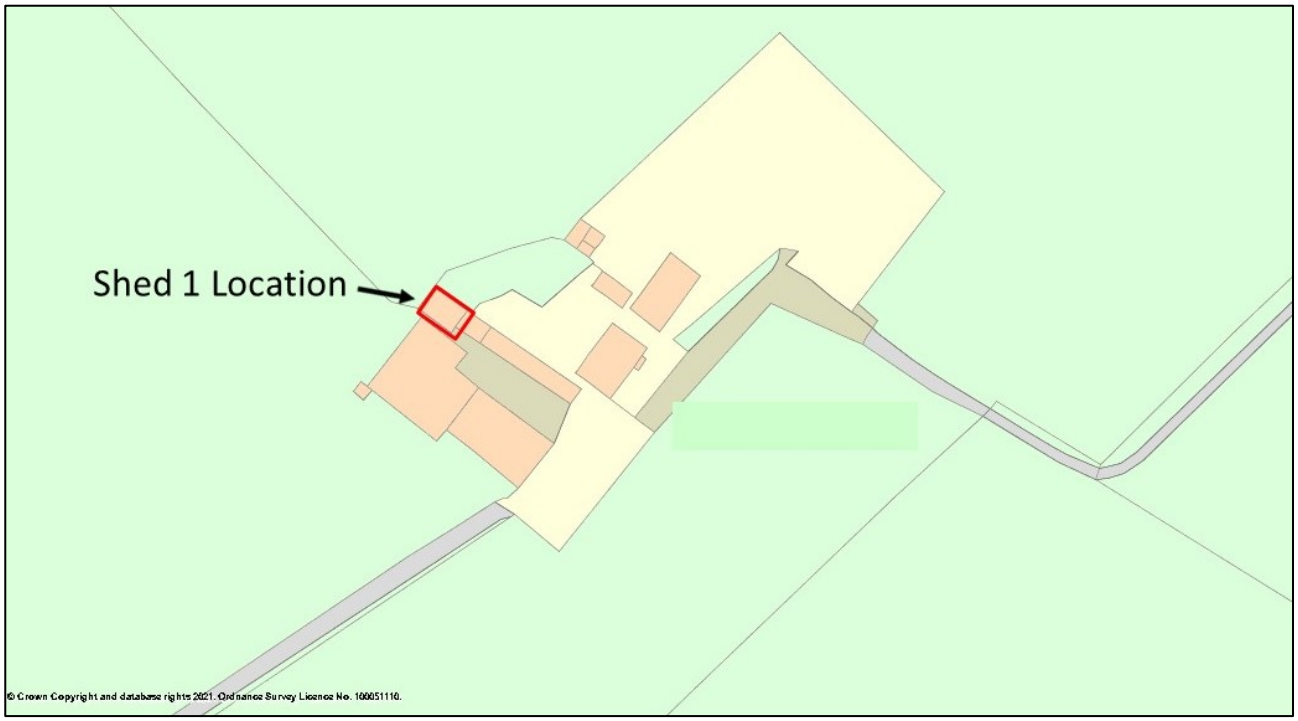
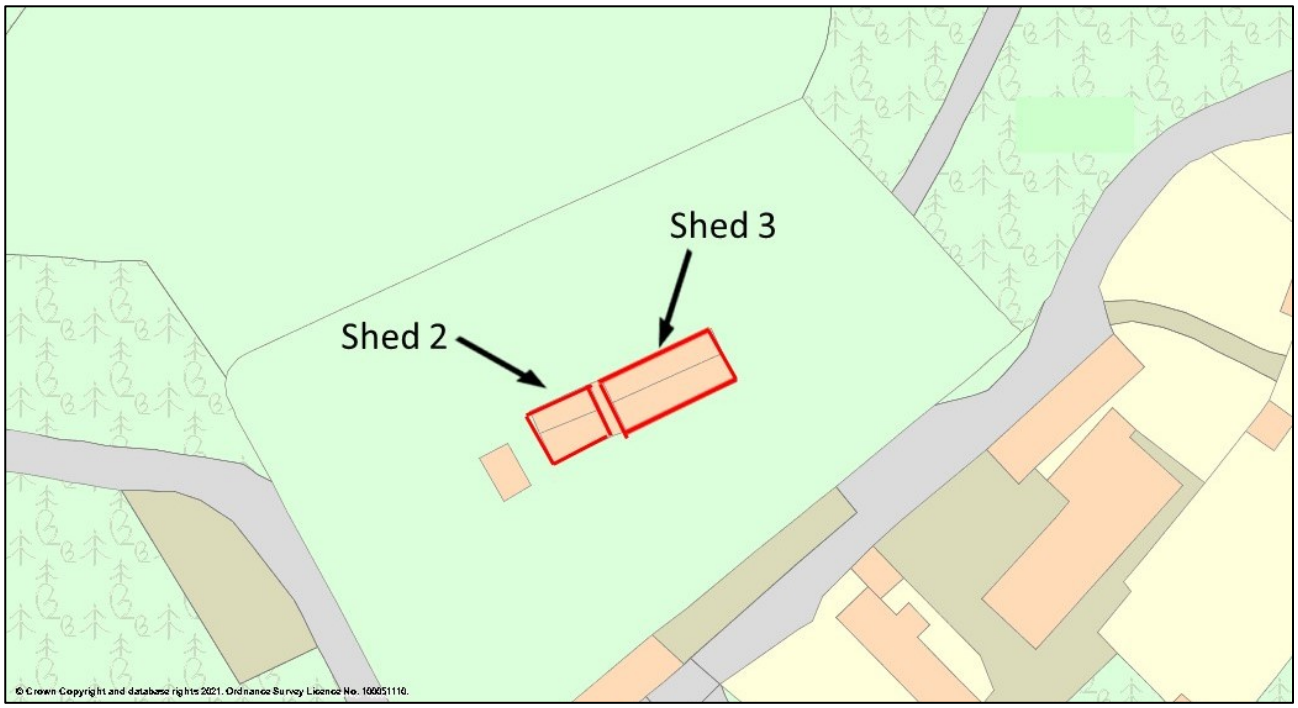


Figure 46: Plan of the infected premises – shed 2 & 3



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	02/01/2021 – 08/01/2021
Likely:	09/01/2021 – 17/01/2021
High risk:	18/01/2021 – 22/01/2021

Spread tracings window:

Precautionary:	03/01/2021 – 09/01/2021
Likely:	10/01/2021 – 17/01/2021
High risk:	18/01/2021 – 26/01/2021

Most likely date of infection (Start of high-risk source tracing window)**:** 18/01/2021

Clinical Picture

On 24/01/2021, the game keeper noticed several dead pheasants in shed two. No records were kept on site and thus this information was based on his recollection.

On 26/01/2021, the gamekeeper called a veterinary surgeon who specialised in gamebirds. After examination of the birds and carrying out twenty post-mortem examinations, he contacted APHA to report a suspicion of notifiable avian disease. The post-mortem examination disclosed birds with haemorrhages on the proventriculus and ovaries, mild haemorrhages in the intestine and fluid around the heart. Four birds had perihepatitis, and 13-14 had splenomegaly and haemorrhages in the caeca. There were no obvious respiratory signs, but neurological signs with weakness and ataxia were present.

The same night, an APHA veterinary inspector inspected the premises and confirmed suspicion of notifiable avian disease. The APHA investigation noted additional clinical signs such as green loose droppings, depression, torticollis, recumbency, haemorrhages in the skin around the eyes and a decrease in food and water intake.

On 27/01/2021, all the birds in shed 2 were dead, only 60 remained in shed 1 and 65 carcasses were found in shed 3. By 28/01/2021 there were 130 birds left alive in shed 1 and these were culled. There were also 260 alive in shed 3 that were also culled.

Timeline

Table 19: Timeline for AIV 2021/01

Source Tracing Window	Spread Tracing Window	Date	AIV 2021/01 ESTIMATED TIMELINE FOR SOURCE AND SPREAD OF INFECTION
Day 21		**02/01/21**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**03/01/21**	Start of precautionary spread tracing window (source + 24h).
Day 19		04/01/21	
Day 18		05/01/21	
Day 17		06/01/21	
Day 16		07/01/21	
Day 15		08/01/21	
Day 14		**09/01/21**	Start of likely source tracing window (-14d).
Day 13	Day 1	**10/01/21**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	11/01/21	
Day 11	Day 3	12/01/21	
Day 10	Day 4	13/01/21	
Day 9	Day 5	14/01/21	
Day 8	Day 6	15/01/21	
Day 7	Day 7	16/01/21	
Day 6	Day 8	17/01/21	
Day 5	Day 9	18/01/21	Start date gathering pheasants for housing (Shed 2). **Precautionary most likely infection date for this outbreak if infection introduced with gathered pheasants** - if so then start of high risk source and spread windows should be here - **note high degree of uncertainty as no serology positives and no further epi sampling, especially in shed 2 which was first**
Day 4	Day 10	19/01/21	
Day 3	Day 11	**20/01/21**	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak based on onset of clinical signs.**
Day 2	Day 12	**21/01/21**	Start of high risk spread tracing window (source +24h). Continuation gathering pheasants (hens) for housing (Shed 1 - 3) and further catching (cocks) for
Day 1	Day 13	22/01/21	Further catching (cocks) for translocation
	Day 14	**23/01/21**	**Precautionary onset of clinical signs.**
	Day 15	24/01/21	
	Day 16	25/01/21	
	Day 17	**26/01/21**	APHA report case (DPR 2021_08). Restrictions applied, sampling undertaken Shed 1
	Day 18	**27/01/21**	**Disease confirmed (AIV 2021_01)**. Further sampling Shed 1
	Day 19	28/01/21	High pathogenicity confirmed. Culling commence
	Day 20	29/01/21	Culling completed. Preliminary C&D completed.
	Day 21	30/01/21	Preliminary C&D considered effective.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

Prior to their housing, these pheasants were wild birds released in the grounds of the estate.

Once the birds were housed, biosecurity was poor with no specific clothes and footwear used by the game keepers when working in the sheds or fields, and no C&D measures were in place, either for people or equipment, on entering/exiting the sheds.

The birds were housed in three separate sheds which, as described above, were in poor condition with holes and cracks present, providing, if not direct access, potential indirect contact with wild birds.

There was no rodent or pest control.

Overview of tracing activities

Four main lines of enquiry were followed up:

- Movement off the IP during the high-risk tracing window of 800 cock pheasants for direct release onto rough land in another premises in Anglesey – very low risk of spread following investigation. Closed after investigation.
- A small number of semi-feral chickens kept by the two game keepers – these were culled.
- The private veterinary surgeon who visited and carried out the post-mortem examinations – it was confirmed that there were satisfactory biosecurity arrangements in place, and no other bird contact for seven days after the visit to the IP. Closed after investigation.
- One feed delivery which took place outside the OIE precautionary tracing window. Closed after investigation.

Source investigations

Hypothesis for the source

The incursion of H5N8 was highly likely (with low uncertainty) to have occurred due to direct or indirect contact of the pheasants with infected wild birds. This was more likely to have taken place before the pheasants were housed, and less likely after housing took place.

Assessment and evidence base for the likely source

1. Pheasants were roaming freely the extent of the estate prior to housing.
2. Ponds present on the estate and outside game bird feeders were known to be attractive to wild birds.
3. There was poor overall biosecurity.
4. There were some holes in the sheds, where small birds could have entered.

5. There was evidence of contamination by wild birds of equipment used to transport feed, water and bedding.
6. There was no pest control programme in place.

Spread investigations

Assessment of potential and likelihood of spread

All potential routes of spread have been assessed as very low likelihood with medium uncertainty:

- The four semi-feral chickens were culled with the pheasants at the IP.
- Poor biosecurity, but there was no personnel or equipment shared with other businesses.
- The PVS had satisfactory biosecurity arrangements.

All regulatory surveillance visits were completed with no evidence detected of onward spread.

Remaining uncertainty

The infection status of the 800 pheasants, which were gathered and subsequently released as wild birds on another premises in Anglesey could not be determined. However, this risk was considered to be equivalent to, and no greater than, the likely background level of infection in wild birds in this area.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2021/02, Redcar

Description of the premises

Overview of the premises and the wider business

The infected premises was a small, commercial laying unit with 1500 free-range chickens, which only sold eggs direct to customers at the farm gate. The unit was part of an arable farm business.

The birds were free-range until December 2020 when they were housed in one single shed in accordance with the AIPZ. The shed was designed to take 3000 to 4000 birds, but only 1500 birds were regularly stocked. There was an extensive range for the birds under normal circumstances.

Approximately 1200 eggs were produced daily and were all sold as farm gate sales on the day of production.

There were no public rights of way across the land.

Description of the housing

The poultry were normally free-range, with access to a shed which includes egg laying / collection facilities. The poultry shed was on skids so that it could be pulled back and forward between flocks for cleaning down.

The shed was relatively newly built and was in a good state of repair. The surrounding area was not concreted.

Biosecurity was relatively poor compared to permanent indoor poultry units.

Species and number of each present

1500 chickens (laying hens).

Description of the surrounding area

The IP was near Redcar, in Cleveland, in an area of low poultry density.

Surveillance activity

PZ (0-3km)

37 premises with poultry holding between 1-56 birds

(1 premises with 50 or more birds)

SZ (3-10km)

24 premises with poultry holding between 1-4,000 birds

(6 premises holding 50 or more birds)

1 premises has both pigs and poultry present

Ornithological assessment

A desk top ornithological assessment was completed and advised the following:

“The landscape surrounding this IP combines elements of a mixed rural character with substantial peri-urban and industrial components, all close enough to coastal and estuarine features to produce the potential for significant AIV infection pressure”-

The overall assessment was that wild birds represent a plausible source of infection pressure.

However, the local investigation reported that there was a local pheasant shoot so wild birds were often seen in the area of the range.

Location in GB

Figure 47: Location of AIV 2021/02

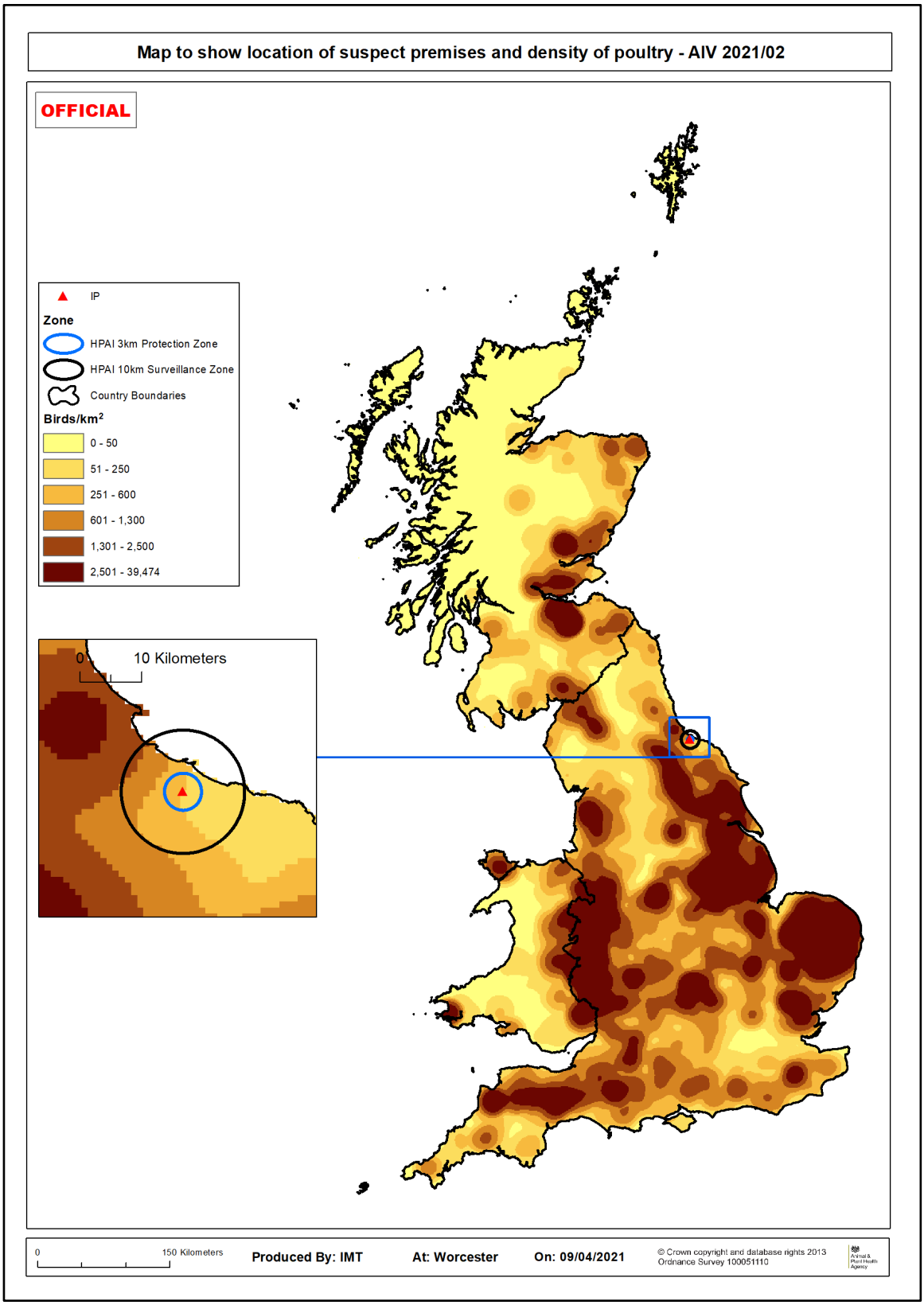


Figure 48: Plan of the infected premises

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	12/01/2021 – 18/01/2021
Likely:	19/01/2021 – 29/01/2021
High risk:	30/01/2021 – 01/02/2021

Spread tracings window:

Precautionary:	13/01/2021 – 19/01/2021
Likely:	20/01/2021 – 30/01/2021
High risk:	31/01/2021 – 05/02/2021

Most likely date of infection (Start of high-risk source tracing window)**:** 30/01/2021

Clinical Picture

Before 02/02/2021 mortality was zero daily deaths during the risk window.

03/02/2021 - The first clinical signs were an increase in mortality with no other signs. 7 birds were found dead in the morning and a further 20 died throughout the day.

The owner sent carcasses to a private veterinary surgeon (PVS). The PME findings were: Vent pecking, peritonitis and worms; a diagnosis of *E. coli* was made, and antibiotics were prescribed.

As disease progressed, some birds became lethargic, wing drooping, with ruffled feathers and were very quiet. This progressed rapidly with birds becoming recumbent, comatose and dying.

There were no apparent changes to wattles, legs or extremities.

Water and feed was not monitored daily, but no obvious changes were seen in appetite and thirst prior to 05/02/2021 (day 3 of increasing mortality)

04/02/2021 - Mortality continued the next day with 65 birds reported to have died.

There was a decrease (13% drop) in the number of eggs produced.

05/02/2021 - Mortality increased to 100 birds. There was also a sharp decrease (70%) in egg production and quality. Laid eggs had extremely soft and/or misshapen shells.

At this point, the PVS contacted APHA to report a suspicion of avian notifiable disease.

An APHA veterinary inspector visited the premises late on 05/02/2021, restrictions were served. During the visit approximately 50 birds died. Report case samples were collected (20/20/20 from sick looking birds, plus 2 carcasses) and sent to Weybridge.

06/02/2021 - It was estimated that a further 300 birds had died over night.

Laboratory PCR testing revealed positive results for H5, N8 and Influenza A. Based on this information and the deteriorating clinical picture, the CVO confirmed avian influenza H5N8

07/02/2021 - Only 200 of the 1500 birds remained alive when culling took place.

Timeline

Table 20: Timeline for AIV 2021/02

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**12/01/21**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**13/01/21**	Start of precautionary spread tracing window (source + 24h).
Day 19		14/01/21	
Day 18		15/01/21	
Day 17		16/01/21	
Day 16		17/01/21	
Day 15		18/01/21	
Day 14		**19/01/21**	Start of likely source tracing window (-14d).
Day 13	Day 1	**20/01/21**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	21/01/21	
Day 11	Day 3	22/01/21	
Day 10	Day 4	23/01/21	
Day 9	Day 5	24/01/21	
Day 8	Day 6	25/01/21	
Day 7	Day 7	26/01/21	
Day 6	Day 8	27/01/21	
Day 5	Day 9	28/01/21	
Day 4	Day 10	29/01/21	
Day 3	Day 11	**30/01/21**	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak.**
Day 2	Day 12	**31/01/21**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	01/02/21	
	Day 14	**02/02/21**	**Precautionary onset of clinical signs.**
	Day 15	**03/02/01**	First deaths (7 overnight, 20 over the course of the day, 4 carcases sent for PME)
	Day 16	04/02/21	Increasing mortality (15 overnight, 50 over course of say)
	Day 17	05/02/21	100 deaths. 6 carcases for PME. APHA report case (DPR 2021/09). Restrictions applied, sampling undertaken
	Day 18	**06/02/21**	Disease confirmed (AIV 2021/02).
	Day 19	07/02/21	Culling commences, completed by 15:40
	Day 20	08/02/21	Preliminary C&D completed 13:00
	Day 21	**09/02/21**	Preliminary C&D effective 13:00
	Day 22		
	Day 23		
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

This farm operates normally as a free-range unit, but when the outbreak occurred all birds were housed in compliance with the AIPZ.

Biosecurity was relatively poor compared to permanent indoor poultry units. Farm records were basic (diary with minimum information for mortality and production records, no water/feed consumption records.).

The shed was relatively newly built and well maintained, with the fabric of the shed in good condition. The surrounding area was not concreted.

There was a single foot dip at the staff entry to the shed, but no dedicated protective clothing was in use (same clothes and boots were used outside the shed).

There were no C&D facilities or procedures for vehicles. Feed vehicles need to enter the farm perimeter for deliveries.

Eggs were collected by 11:00 from each morning's production and placed in the van to be sold. The van was sited beside the entry gate, so the public did not come near the shed (approximately 10 metres away). There were no C&D facilities by the access gate. The farm operates on an 'honesty box' system, where the clients take the eggs from the van and place the payment in the box, with no staff required to attend the sales.

Overview of tracing activities

Three main lines of tracing investigations were carried out:

CARCASES SENT TO PVS FOR PME – Confirmed PME dates, absence of visit, C&D protocols & final destination of carcases. Closed after investigation.

FEED DELIVERY - Feed was delivered approximately once per month and the last load was on 22/01/2021. This date is outside the high-risk source window. Closed after investigation.

DATE OF LAST ABP COLLECTION - Carcases were sent to the local hunt kennels, but there were no collections during the spread risk window. Closed after investigation.

Source investigations

Hypothesis for the source

Indirect transmission from infected wild birds with high likelihood and low uncertainty, with several possible routes identified:

- Contaminated surface flood water seeping into shed.
- Contaminated straw bedding.
- Mechanical contamination though vermin on straw.
- Contaminated footwear (same boots used inside and outside the chicken house).

Assessment and evidence base for the likely source

Since mid-December 2020, due the rain and localised flooding water, the water table rose leading to water ingress into the scratching area of the shed (possibly due to a failure in the design of the floor). Since this incident, straw was regularly added to raise the height of the birds above this water.

The straw was homegrown and stored in an open-ended shed, where wild birds have been known to roost. Vermin, including mice were likely to be also present within the straw.

Biosecurity in this unit was poor, as typically it operates as a free-range unit.

A desk top ornithological assessment and local information indicate that there was potential for significant AIV infection pressure from wild birds.

Spread investigations

Assessment of potential and likelihood of spread

No local poultry units are located near the IP. There was rapid progress of disease and the cull was completed quickly. Following investigations and surveillance activity in the area the assessment of spread risk was as follows:

Products: Very low likelihood of spread.

Farm personnel: Very low likelihood of spread.

Other visitors: Very low likelihood of spread.

Vehicles: Negligible likelihood of spread.

Carcases / ABP: Very low likelihood of spread.

Wildlife / wild birds: Very low likelihood of spread.

Movements of live animals from IP: Negligible likelihood of spread.

Manure, slurry: Negligible likelihood of spread.

Equipment: Negligible likelihood of spread.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2021/05, Uttoxeter

Description of the premises

Overview of the premises and the wider business

This was an organic, free-range, multi-age broiler unit, with birds sent to slaughter at 61-64 days old. The site comprised five brooding sheds and 40 free-range mobile rearing sheds sited on grass fields (although all birds had been housed since 14/12/2021).

The premises was part of an integrated broiler business, including broiler breeder flocks and a hatchery, all located on a large estate, which operated a mixed, organic, free-range farming enterprise with 400 beef cattle, 2500 ewes plus followers, and 500 farmed red deer.

Most of the livestock were finished on farm and slaughtered at the estate's own abattoir (which has both red and white meat lines).

Description of the housing

The site comprised five brooding sheds, and forty mobile rearing sheds situated across three large pasture fields.

Species and number of each present

Broiler chickens:

22,358 young birds (5 to 27 days old) kept in 4 brooding sheds (the fifth shed was empty at time of disease incident).

26,847 older birds (33 to 61 days old) kept in 40 mobile sheds.

Description of the surrounding area

There were multiple lakes on the estate, one of which was close to the IP.

Waterfowl (ducks, swans, geese) observed around the farm, as well as large numbers of wild pheasants and corvids in the fields where the rearing chickens were kept.

Surveillance activity

PZ (0-3km)

47 premises with poultry holding between 1-45 birds

(0 premises with 50 or more birds)

SZ (3-10km)

118 premises with poultry holding between 1-360,000 birds

(24 premises holding 50 or more birds)

5 premises holding both pigs and poultry

Ornithological assessment

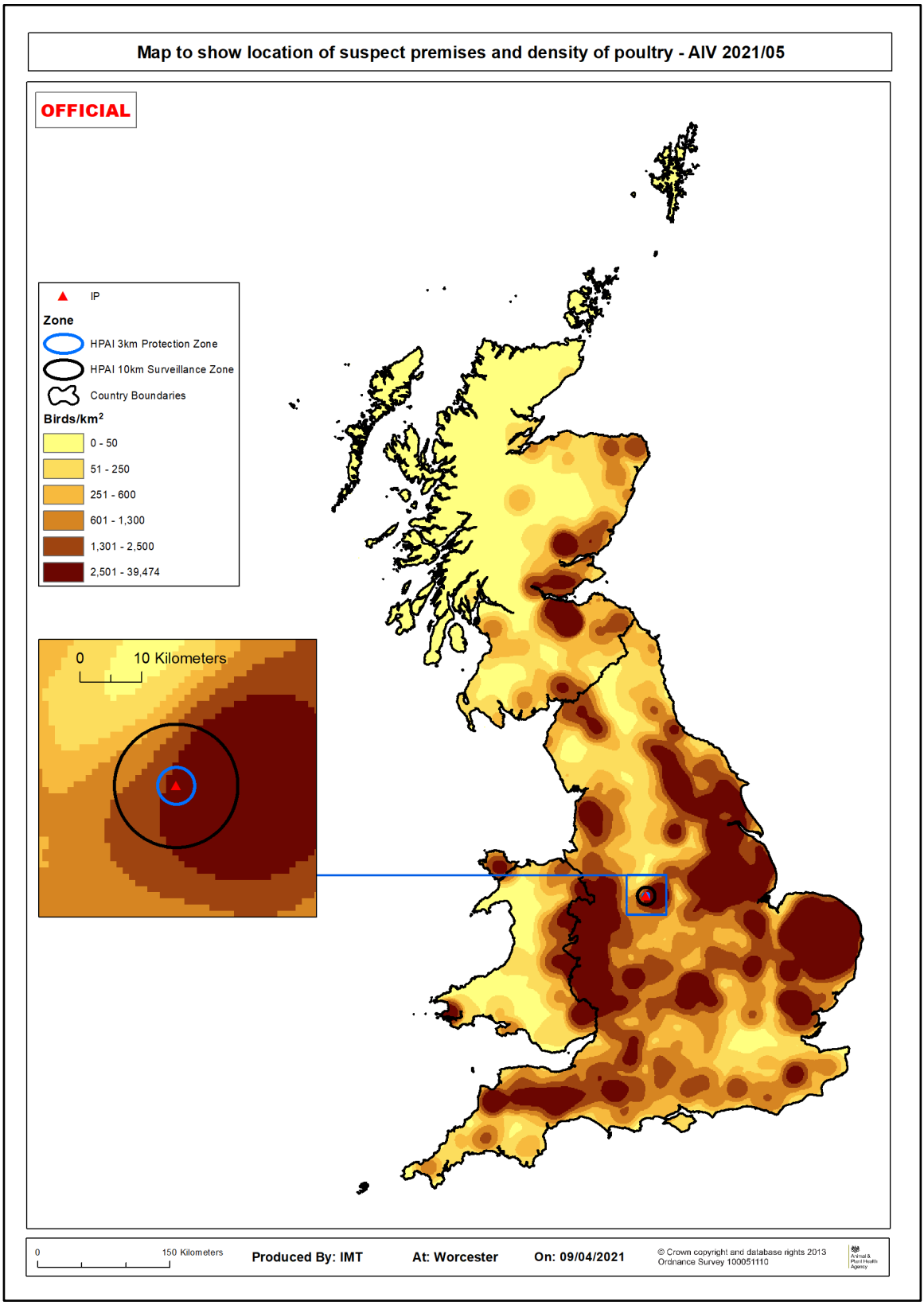
Most wild birds that were observed on waterbodies within the estate, and in the wider landscape, were indigenous to the estate and largely sedentary species with many found in pairs distributed across ponds and lakes (i.e. likely to be restricted to a breeding site and adjacent waters). Other wildfowl on the estate are likely to be restricted to the estate. No migrant birds were thought to remain on either the estate, or in the wider landscape.

Bridge species (primarily gulls and Corvids) were observed. Gulls were relatively sparse, both on waterbodies within the estate and at two more distant large waters, previously recorded as hosting large colonies. At one of these, observation of gull flight-lines at dusk did not suggest that the estate, or its wider neighbourhood hosted an unusual proportion of foraging gulls returning to roost. Corvids were numerous, though neither their number nor behaviour were considered exceptional.

Wild birds were considered to have been a likely source of infection pressure.

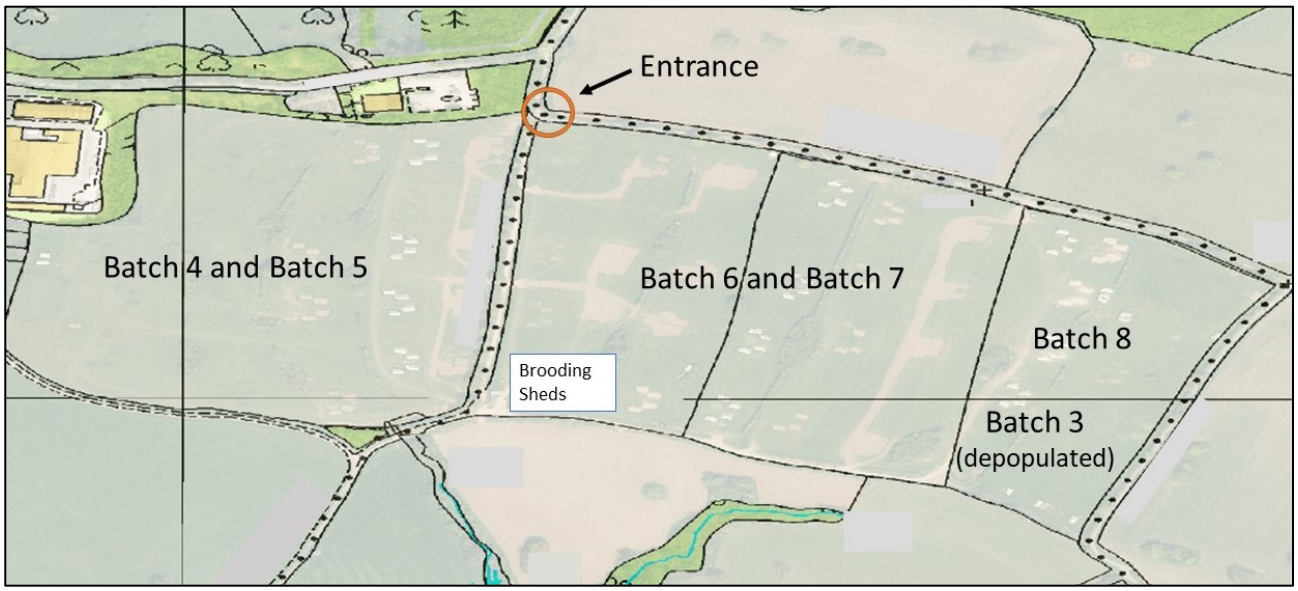
Location in GB

Figure 49: Location of 2021/05



Plan of the infected premises

Figure 50: Plan of 2021/05



TIMELINE

Tracings windows

Source tracings window:

Precautionary:	28/02/2021 – 06/03/2021
Likely:	07/03/2021 – 17/03/2021
High risk:	18/03/2021 – 20/03/2021

Spread tracings window:

Precautionary:	01/03/2021 – 07/03/2021
Likely:	08/03/2021 – 18/03/2021
High risk:	19/03/2021– 26/03/2021

Most likely date of infection (Start of high risk source tracing window)**:** 18/03/2021

Timeline

Table 21: Timeline for 2021/05

Source Tracing Window	Spread Tracing Window	Date	
Day 21		**28/02/21**	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		**01/03/21**	Start of precautionary spread tracing window (source + 24h).
Day 19		02/03/21	
Day 18		03/03/21	
Day 17		04/03/21	
Day 16		05/03/21	
Day 15		06/03/21	
Day 14		**07/03/21**	Start of likely source tracing window (-14d).
Day 13	Day 1	**08/03/21**	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	09/03/21	
Day 11	Day 3	10/03/21	
Day 10	Day 4	11/03/21	
Day 9	Day 5	12/03/21	
Day 8	Day 6	13/03/21	
Day 7	Day 7	14/03/21	
Day 6	Day 8	15/03/21	
Day 5	Day 9	16/03/21	
Day 4	Day 10	17/03/21	
Day 3	Day 11	**18/03/21**	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak.**
Day 2	Day 12	**19/03/21**	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	20/03/21	
	Day 14	**21/03/21**	**Precautionary onset of clinical signs. Deaths in Batch 3 (8 sheds)**
	Day 15	22/03/21	4 sheds from Batch 3 sent for slaughter.
	Day 16	23/03/21	Approximately 100 deaths. 3 carcases from Batch 3 and 3 carcases from Batch 6 submitted to APHA Lasswade.
	Day 17	24/03/21	A further 3 sheds from Batch 3 sent for slaughter. Last shed from Batch 3 culled by owner due to high mortality ar C/S.
	Day 18	25/03/21	3 carcases from Batch 3 and 3 carcases from Batch 6 submitted to APHA Lasswade.
	Day 19	26/03/21	APHA investigation and sampling (DPR 2021/19). **Restrictions served.**
	Day 20	27/03/21	**Avian Influenza H5N8 confirmed based on PCR results with case reference AIV2021-05.**
	Day 21	28/03/21	Culling commenced. VFEI investigation.
	Day 22	29/03/21	**HPAI H5N8 confirmed.**
	Day 23	30/03/21	**Culling completed.**
	Day 24	31/03/21	**Preliminary C&D completed 17:10**
	Day 25	01/04/21	**Preliminary C&D considered effective 17:10**
	Day 26	02/04/21	
	Day 27	03/04/21	
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Investigations on the infected premises

Overview of biosecurity

BROODING SHEDS - the five brooding sheds were of recent construction and good structural integrity (no gaps allowing entry of wild birds or rodents). There was a dedicated sealed feed silo for each shed and the water supply was from mains water.

Personnel biosecurity was reasonable, comprising a separate entrance and dedicated footwear for every brooder, with a disinfectant footbath outside (Cyclex at a dilution of 1:24). Handwashing facilities were available. But there were no changes of either site-specific nor shed-specific clothing. No visitor's book was kept.

REARING SHEDS - the 40 mobile free-range sheds were of wood and metal construction, but without solid flooring. They were placed directly on grass across three fields, which occupied 0.3 km^2 (60 acres) in total. Erosion of the earth beneath the shed walls had allowed gaps to develop which could have allowed rodent or small wild bird ingress, but were not large enough to have allowed poultry to escape, or larger wild birds to enter. Mobile sheds were routinely moved following depopulation. There was a dedicated feed silo for each shed and mains water supplied in covered tanks.

Personnel biosecurity was noted as being poor – there were no disinfectant footbaths, nor dedicated clothing and footwear.

Overview of tracing activities

TWO CONSIGNMENTS OF BROILERS - moved off the IP to slaughter within the high risk tracing window on 22/03/2021 and 24/03/2021. The Food Standards Agency was immediately informed following disease confirmation on 28/03/2021. The first batch had been sold to retail, but the second was detained and destroyed.

THE ESTATE MANAGER - delivered day-old chicks from the hatchery and returned the trays within the high risk spread window – a visit and a veterinary risk assessment were completed and concluded that the likelihood of spread to the hatchery was very low.

THE CATCHING GANG - employed to handle the last two consignments of broilers – a telephone tracing to the agency established that none of the nine workers involved worked on other premises on the same day, or owned poultry. Biosecurity instructions for this gang were followed and were considered to be effective. This spread tracing was closed with no further action taken.

STAFF WORKING ON THE IP - were contacted, including the driver of the vehicle taking broilers to slaughter. Telephone tracings established that none had any other bird contacts, and this line of enquiry was closed.

FEED DELIVERIES - only occurred during the high risk spread tracing window. Feed lorries delivered to silos near the brooding sheds, which were unaffected. The likelihood that infection could spread via this route was assessed as very low and closed.

BEDDING DELIVERIES – the last delivery was outside the high risk tracing window and no further action was taken.

ABATTOIR - A visit to the abattoir was commissioned to better understand any other potential routes of transmission either via the staff, vehicles or ABP disposal arrangements. There was potential for wild bird access to the slaughterhouse ABP skip. .

THE ABP CONTRACTOR - became a telephone tracing. It was established that biosecurity protocols were followed, and all material had been treated appropriately. This line of enquiry was closed.

A CASUAL AGENCY WORKER AT THE SLAUGHTERHOUSE - who washed the crates of the last infected consignment was identified and a telephone tracing initiated. Both the agency and the worker confirmed that he had no birds of his own, nor any poultry contact within 24 hours of this work. This line of enquiry was closed.

Source investigations

Hypothesis for the source

Direct or indirect wild bird contact with poultry in the rearing sheds was considered to be the most the likely source of infection.

Assessment and evidence base for the likely source

DIRECT INTRODUCTION BY DOMESTIC FLOCK/HERD/ANIMAL OR ANIMAL PRODUCTS - negligible likelihood with low uncertainty. Birds placed in rearing sheds came from the brooding site which was a part of the IP – no birds had been moved on from elsewhere.

INDIRECT INTRODUCTION BY DOMESTIC FLOCK/HERD/ANIMAL WITH KNOWN OR UNDISCLOSED INFECTION – very low likelihood with low uncertainty. Investigations were undertaken into the feed and bedding deliveries, catching gang, and farm worker who moved birds to the slaughterhouse.

INTRODUCTION FROM CONTAMINATED PRODUCT(S) AT SOURCE - very low likelihood with low uncertainty. Mains water supply – two large tanks by the road which supplied the premises. Each individual rearing shed had a small internal covered holding tank. No indication of contamination at source (dedicated organic feed company supplying many businesses). Straw bedding delivered every 4 weeks with last delivery outside the high risk window.

INFECTED WILD ANIMAL SOURCE – direct introduction - high likelihood with low uncertainty. Signs of possible direct contact between wild birds and poultry via gaps under the walls of the sheds. Indirect introduction - high likelihood with low uncertainty.

INTRODUCTION OF BEDDING TO REARING SHEDS - during lifetime of crop carried out with high risk of contamination via staff footwear, because of the poor biosecurity (no foot dips and no boot changes).

WATER - supplied from the mains via a sealed system. All feed delivered by feed company and discharged directly into bulk feed silos (sealed, good condition) adjacent to brooding sheds on IP. This area was distant from the free-range area (location of affected birds). Farm staff used a telehandler and metal hopper to transport feed from these main silos to replenish smaller silos as needed (one attached to each FR shed). Opportunity of contamination of feed was low.

VERMIN - No vermin control records, but there was likelihood of rodent travel between the rearing sheds.

INFECTION FROM INTERNATIONAL SOURCE - negligible likelihood with low uncertainty. No known international connections.

Spread investigations

Assessment of potential and likelihood of spread

DIRECT CONTACT WITH OTHER DOMESTIC SUSCEPTIBLE ANIMALS OR ANIMAL PRODUCTS - very low likelihood with low uncertainty. Live birds moved to company's own slaughterhouse prior to report case (22/03/2021 and 24/03/2021).

INDIRECT CONTACT WITH OTHER DOMESTIC SUSCEPTIBLE ANIMALS - low likelihood with low uncertainty. Poultry carcases moved to laboratory for testing prior to the report case (23/03/2021 and 25/03/2021) - laboratory contingency plans followed. Fallen stock (ABP) poultry carcases moved to slaughterhouse ABP skip prior to the report case - removal process satisfactory. Casual worker who cleaned the poultry transport crates and then moved on to work on another poultry unit was confirmed to have had no other bird contact.

ONWARD TRANSMISSION THROUGH WILDLIFE - medium likelihood with high uncertainty but considered to be less significant risk than via the viral load in wild birds. Direct contact between poultry and wild bird species via holes at shed wall / earth floor level. Indirect contact via personnel and fomite movement out of poultry sheds. There was potential for wild bird access into the slaughterhouse ABP skip. Birds collected and submitted from the wider estate under the wild bird surveillance scheme have yielded results positive for HPAI H5N8.

ONWARD TRANSMISSION THROUGH INTERNATIONAL TRADE/CONNECTIONS - low likelihood with medium uncertainty.

Remaining uncertainty

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

The most likely hypothesis for the source of the virus, and the route of introduction onto the premises is direct or indirect contact with wild birds.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.

AIV 2021/06, Skelmersdale

Description of the premises

Overview of the premises and the wider business

This case was identified in a small aviary housing two falcons that were kept for leisure hunting. The aviary was situated in the back garden of a domestic dwelling and there was no contact with the wider poultry industry.

Description of the housing

The aviary was divided into three sections; it consisted of the entrance that lead to a corridor in the middle, plus two compartments, one on the right and one on the left side of the corridor. The two compartments can only be accessed by the corridor in the middle. There is one opening in the front wall of each compartment. Since February 2021 the birds were housed together. It was of solid wood construction. The front of the aviary was wire mesh; however, the mesh was of a size that would allow small birds to enter. This was unlikely to occur given the residents were falcons.

The birds perch to sleep and the floor was constructed of flag stones; however, this surface was covered by a tarpaulin that was removed and subjected to cleaning and disinfection on a weekly basis.

Species and number of each present

Two hybrid falcons – 11 year-old male (50/50 Gyrfalcon x Peregrine) and three year-old female (15/16 Peregrine x 1/16 Barbary).

Description of the surrounding area

The infected premises was situated in a rural location north of the conurbations of Ormskirk / Skelmersdale / Wigan. It was situated relatively close to the Irish Sea coast and is equidistant to Blackpool and Liverpool. It is surrounded by farmland, with a few small ponds visible and some wooded areas.

There were no other poultry within 1 km of the IP.

There was a small pond in the neighbour's garden, where a pair of mallard have bred over the last few years.

Surveillance activity

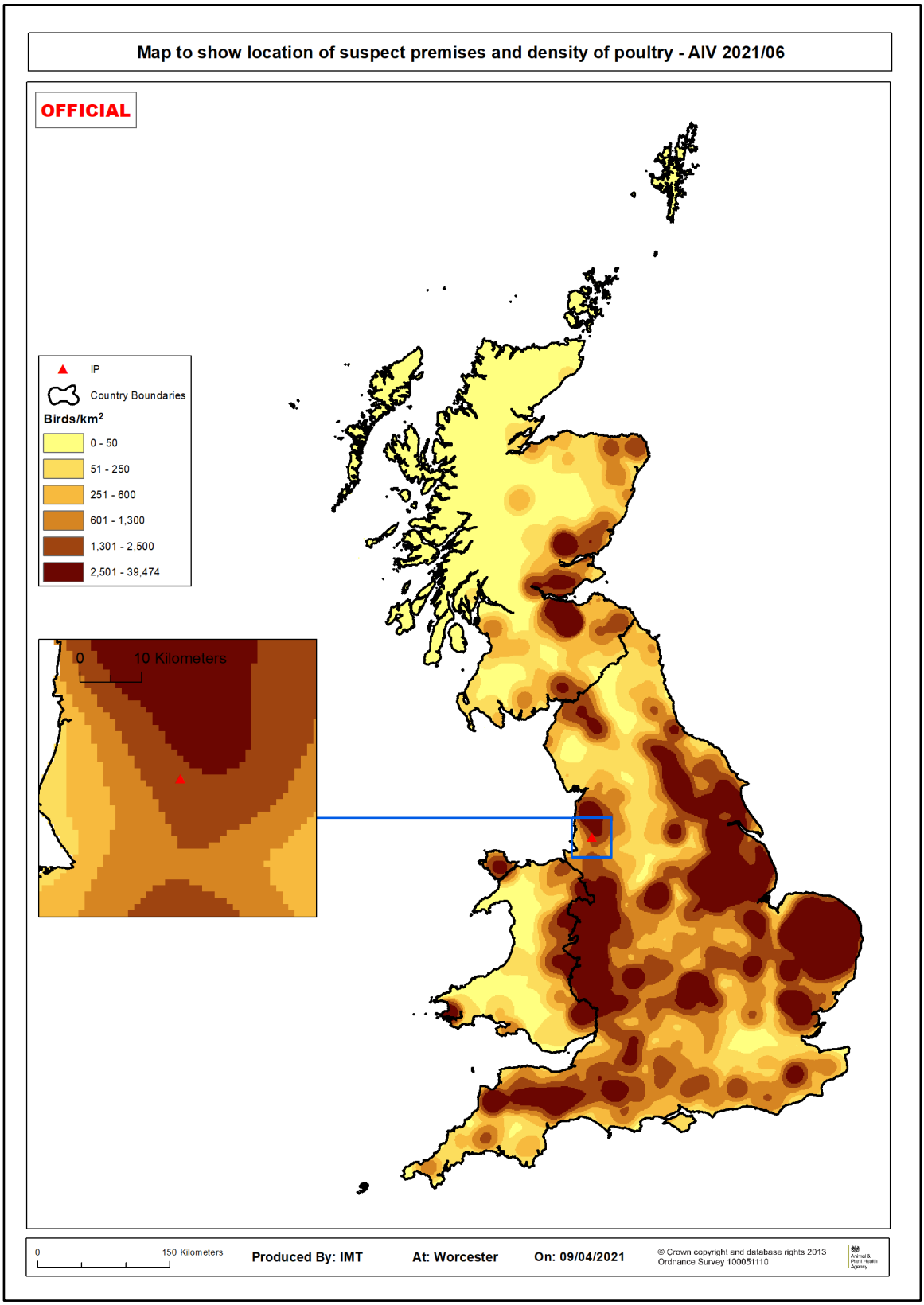
Under UK legislation, Article 33, Defra and the Devolved Administrations have the option to derogate from protection and surveillance zones (or apply reduced zones and reduced measures within them), around 'special category' premises. As the affected falcons were captive birds, with no co-located poultry and no links to poultry, no PZs or SZs were put in place around the IP.

Ornithological assessment

An ornithological assessment was not undertaken for this case.

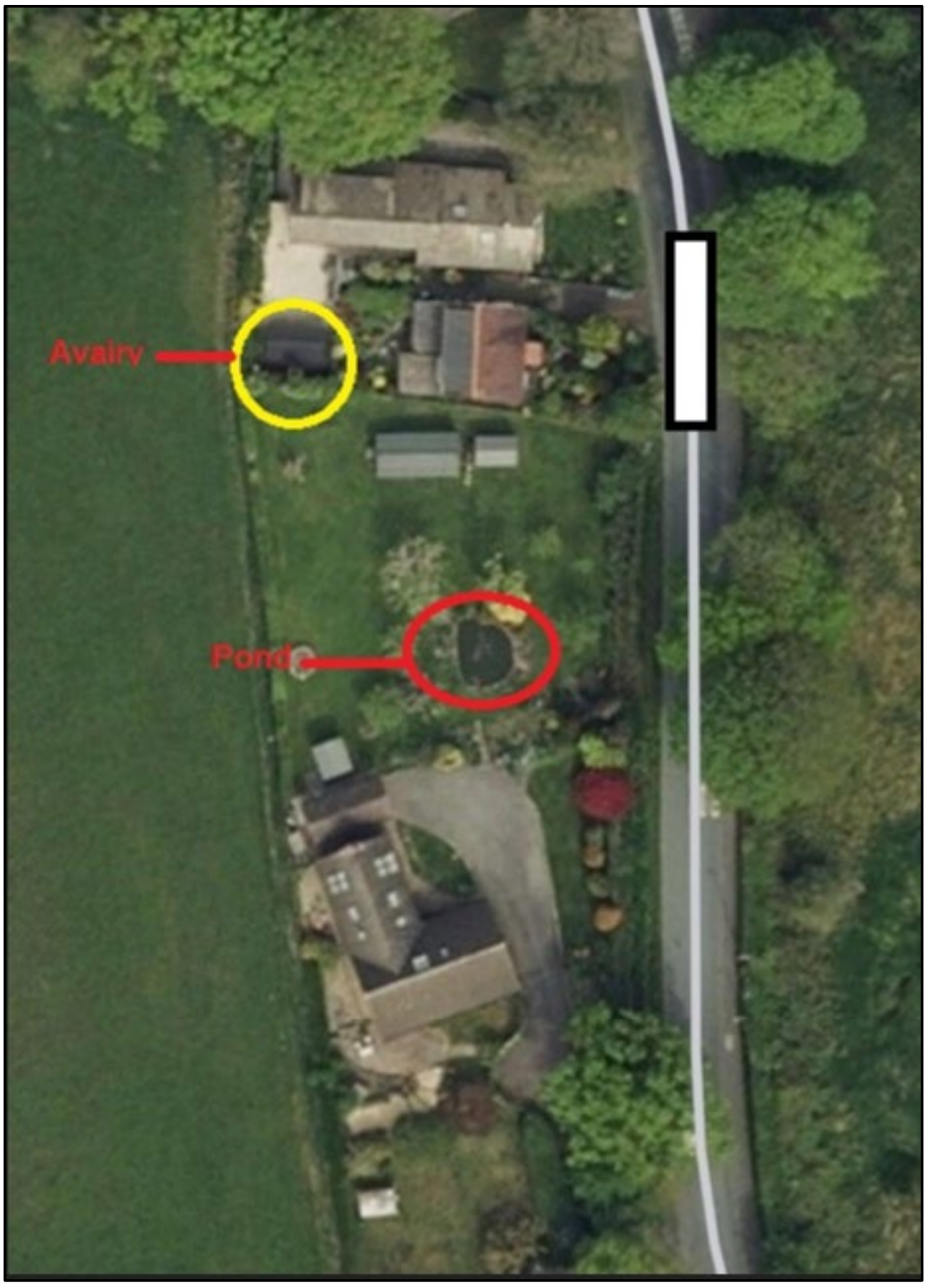
Location in GB

Figure 51: Location of AIV 2021/06



Plan of the infected premises

Figure 52: Plan of AIV 2021/06



Key:

Yellow circle – the aviary.

Red circle – a pond in the neighbour's garden.

TIMELINE

Tracings windows

Source tracings window:

Precautionary:	03/03/2021 – 09/03/2021
Likely:	10/03/2021 – 20/03/2021
High risk:	21/03/2021 – 23/03/2021

Spread tracings window:

Precautionary:	04/03/2021 – 10/03/2021
Likely:	11/03/2021 – 21/03/2021
High risk:	22/03/2021 – 30/03/2021

Most likely date of infection (Start of high risk source tracing window)**:** 21/03/2021

Timeline

Table 22: Timeline for AIV 2021/06

Source Tracing Window	Spread Tracing Window	Date	
Day 21		03/03/21	Start of precautionary source tracing window, as per OIE guidelines (-21d).
Day 20		04/03/21	Start of precautionary spread tracing window (source + 24h).
Day 19		05/03/21	
Day 18		06/03/21	
Day 17		07/03/21	
Day 16		08/03/21	
Day 15		09/03/21	
Day 14		10/03/21	Start of likely source tracing window (-14d).
Day 13	Day 1	11/03/21	Start of likely spread tracing window (source tracing window +24h).
Day 12	Day 2	12/03/21	
Day 11	Day 3	13/03/21	
Day 10	Day 4	14/03/21	
Day 9	Day 5	15/03/21	
Day 8	Day 6	16/03/21	
Day 7	Day 7	17/03/21	
Day 6	Day 8	18/03/21	
Day 5	Day 9	19/03/21	
Day 4	Day 10	20/03/21	
Day 3	Day 11	21/03/21	Start of high risk source tracing window (-3d). **Most likely infection date for this outbreak. Shot wild mallard fed 20/21st according to owner.**
Day 2	Day 12	22/03/21	Start of high risk spread tracing window (source +24h).
Day 1	Day 13	23/03/21	
	Day 14	24/03/21	**Reported onset of first clinical signs.** One falcon slightly lethargic and one eye closed. Feed consumption reduced.
	Day 15	25/03/21	
	Day 16	26/03/21	
	Day 17	27/03/21	Male falcon presented with neurological signs, lethargy and a swollen eye. Admitted to PVS practice. Female falcon died overnight.
	Day 18	28/03/21	Male falcon euthansed.
	Day 19	29/03/21	
	Day 20	30/03/21	APHA notified (**DPR 2021/20**). Disease restrictions applied - ?verbal?. Vet practice visited by APHA.
	Day 21	31/03/21	APHA veterinary investigation at home premises instructed.
	Day 22	01/04/21	Preliminary C and D completed at 16:10.
	Day 23	02/04/21	Preliminary C and D considered effective at 16:10.
	Purple colour reflects source tracing window. Increased intensity of colour reflects increased possibility of introduction on these dates.		
	Yellow colour reflects spread tracing window. Increased intensity of colour reflects increased possibility of spread from the IP on these		

Assumptions

- Detection of viral nucleic acid in birds indicates that infection took place within the last 14 days, after this only antibody is present.
- Spread of infection within a flock is generally rapid once established, but can vary depending on virological, epidemiological and environmental factors.
- Assume earliest onset of detectable seroconversion is from 7-8 days post-infection.
- Incubation period is 2-14 days, up to 21 days from onset of earliest clinical signs for the purposes of the OIE Terrestrial Animal Health Code.
- Incubation period is generally considered most likely to be around 48-72 hours.

Clinical Picture

On 24/3/2021 a private falconer noted that one of his two falcons had a shut eye and was slightly off colour. The appetite of the two birds was noted as having decreased.

On 27/03/2021 the male bird was found on the floor, rather than perching as usual, and was unable / unwilling to move when approached. This bird was taken to an avian

veterinary referral service practice where it was admitted for observation and treatment utilising robust barrier nursing techniques to mitigate against disease spread

On the morning of 28/03/2021, the remaining falcon was found dead and due to a marked deterioration in the hospitalised bird it was euthanised.

Both carcases were submitted to APHA for AIV testing and a notifiable avian disease report case initiated, with visits to the avian referral service and the home aviary.

Investigations on the infected premises

Overview of biosecurity

Biosecurity at the avian referral service can be described as robust, with care taken to follow sound barrier nursing techniques.

Biosecurity at the home aviary was non-existent, with no attempt being made to avoid the introduction of avian influenza.

Covid-19 requirements had limited the flying of the birds; however, the owner did not make any attempt to cleanse and disinfect footwear, clothing etc. prior to entering the aviary after walking his dogs in the local countryside.

In late 2020, a wild shot frozen mallard and wigeon were also fed – this was a high risk feed source considering the AI profile in the UK at the time.

Water was provided via a watering can that was stored outside the aviary in a way that would not prevent contamination.

Overview of tracing activities

PRIVATE VET PRACTICE RECEIVING SICK MALE FALCON – visited to assess potential spread to other avian patients. A VRA concluded very low and negligible risks for two bird contacts. No further action.

LOCAL HATCHERY – visited to assess potential source of day-old chicks fed to raptors. Subsequent VRA concluded very low likelihood. No further action.

INTERMEDIATE SUPPLIER SELLING QUAIL TO THE IP - telephone tracing established that quail consignment was only supplied directly to the IP.

PET FOOD WHOLESALER SUPPLYING FROZEN QUAIL - telephone tracings clarified source of frozen quail – imported as adult frozen farmed birds from France in March 2020. It was concluded that this was a very low likelihood source. No further action was taken.

SOURCE OF WILD SHOT WIGEON FROM LONGTON MARSH, PRESTON - the shooter was contacted. He verified that he had supplied one intermediate falconer with wigeon from Longton Marsh, and another with pigeons only. He had not supplied any mallards. He had no birds of his own, or any other bird contact. No further action was taken.

INTERMEDIATE PASSING WIGEON TO IP - telephone tracing established that only wigeons had been supplied to the IP. It was confirmed that his own birds were not affected and had been fed wigeon too. No further action was taken.

OTHER FALCONER RECEIVING PIGEONS - telephone tracings confirmed receipt of pigeons only. His own birds were healthy. No further action was taken.

IP owner reported receiving wild shot mallards from other hunters and falconers from across the Northwest of England in November/December 2020. These were frozen and one of these was fed to his falcons. One of these mallards was reportedly fed to the birds on 21/03/2021, the most likely date of infection for this IP. Widgeon were also fed the week before the falcons died.

Source investigations

Hypothesis for the source

It was concluded that the most likely source of infection for these two falcons was via infected frozen wild shot duck that were used for feeding purposes.

Fed day-old chicks and quail were also theoretical risk pathways that were discounted following further investigations.

Less likely risk pathways exist for indirect spread via contact with the owner following environmental contamination. Direct contact with small passerines was possible, but unlikely as was contact with vermin.

Assessment and evidence base for the likely source

The ducks used to feed the falcons were sourced from the surrounding countryside during the high-risk period during and prior to November 2020. The following map denotes the approximate position where the wild ducks were shot, and details the wild bird cases identified by APHA, as a result of routine wild bird surveillance testing.

Spread investigations

Assessment of potential and likelihood of spread

Due to Covid-19 restrictions limiting the movement of people over the recent months the likelihood of disease spread from this IP was considered to be very low.

Spread via the avian referral practice would be the most likely route; however, all investigations indicated that this route had been effectively mitigated.

Remaining uncertainty

There was no definitive proof that the infection route was via the fed frozen wild shot ducks; however, it remains the most likely risk pathway.

Following the conclusion of the extensive epidemiological, tracings and laboratory investigations undertaken, there were no other significant uncertainties remaining for this premises.

All the available evidence suggests that the premises was both the index and the primary case for this incursion of disease, and the level of uncertainty associated with this is low.