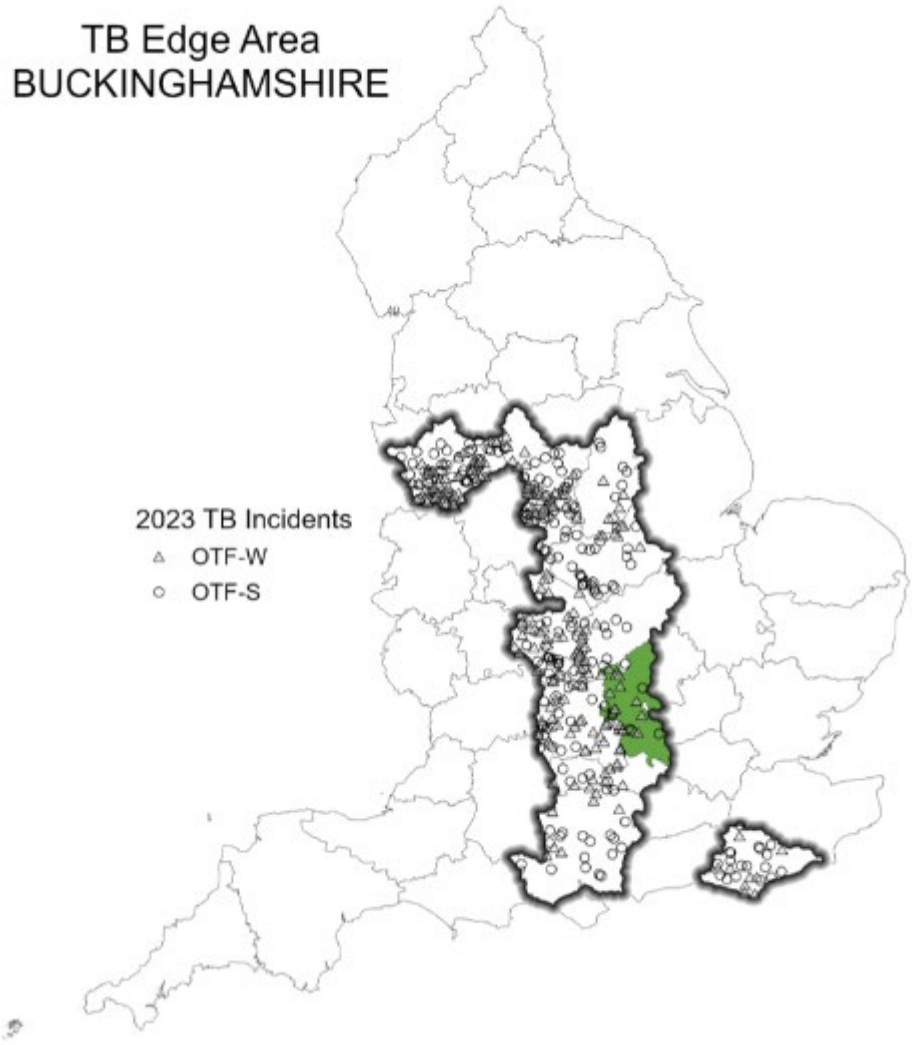
Animal &
Plant Health
Agency

Year End Descriptive Epidemiology Report: Bovine TB in the Edge Area of England 2023

County: Buckinghamshire



Contents

Introduction

The Edge Area was originally established in 2013, along with the Low Risk Area (LRA) and High Risk Area of England. In 2014, the 3 bovine tuberculosis (TB) risk areas were incorporated into the UK government's strategy to achieve Officially TB-Free (OTF) status for England by 2038. A key action was to recognise the different levels of TB in different parts of the country and to adjust the approaches to TB surveillance and control in each risk area accordingly. The current aim is to obtain OTF status for the Edge Area as soon as possible.

This report describes the frequency and geographical distribution of TB in cattle herds in Buckinghamshire, an Edge Area county, in 2023. It examines what factors are likely to be driving TB in this area, and the risks the disease in this county may pose to neighbouring areas.

TB in cattle and other mammals is primarily caused by the bacterium *Mycobacterium bovis* (*M. bovis*), and the disease is subsequently referred to in this report as TB. Although other sources may refer to TB 'Incidents', this report will use the term 'incidents' throughout.

This report is intended for those involved in the control of TB, both locally and nationally. This includes, but it is not limited to, cattle farmers, government and private veterinarians, policy makers and the scientific community.

Details of the data handling methodology used in this report, a glossary of terms, and the TB control measures adopted in the Edge Area, can be found in the explanatory supplement for the annual reports 2023.

Types of TB incidents

Unless otherwise specified, this report includes all new TB incidents detected during the reporting period (1 January to 31 December 2023). This includes both 'Officially Tuberculosis-Free Status Withdrawn' (OTF-W) and 'Officially Tuberculosis-Free Status Suspended' (OTF-S) incidents.

OTF-W incidents are those involving at least one skin test reactor, an animal positive to the Single Intradermal Comparative Cervical Tuberculin (SICCT) test, with either:

- typical lesions of TB identified at post-mortem (PM) meat inspection
- at least one animal with an *M. bovis*-positive polymerase chain reaction (PCR) test (or bacteriological culture results in tissue samples collected from carcasses during the PM inspection)

OTF-S incidents are triggered by reactors to the skin test, but without subsequent detection of TB lesions or positive PCR test (or culture) results in any of those animals.

TB incidents in Approved Finishing Units (AFUs) without grazing are not included in the prevalence and incidence calculations in this report due to the limited epidemiological impact of these incidents.

Furthermore, the number of TB incidents and designation of those incidents as OTF-W or OTF-S may differ in this report compared to other official TB statistics due to differences in the information available at the time datasets are accessed.

Cattle industry

There was a total of 378 herds in Buckinghamshire in 2023, with beef herds being the predominant cattle enterprise. Most herds (41%) are small and had fewer than 50 cattle. Appendix 1 provides further details on the cattle industry demographics in Buckinghamshire.

There are no livestock markets in Buckinghamshire. Many cattle farms purchase cattle through Thame Market in Oxfordshire near the border with Buckinghamshire, channelling animals into Buckinghamshire from the Edge Area, LRA, but also from the HRA counties with more abundant cattle. There was a total of 6 active non-grazing AFUs in Buckinghamshire during 2023, which was unchanged from 2022.

The number of cattle markets in operation in 2023 is captured and maintained centrally by the Animal and Plant Health Agency (APHA) TB Customer Service Centre. Where possible, this data is then subject to further validation by APHA veterinarians subject to their best knowledge of the local area. Some small discrepancies may therefore exist where changes to markets were not captured in time for this report.

There are no grazing AFUs or EFUs in the county, and all herds are subject to 12 monthly (annual) testing.

New TB incidents

Figure 1 shows that in 2023 there was a 39% decrease in the number of new TB incidents in Buckinghamshire compared to 2022 (from 31 to 19 in 2023). This followed a 2-year increase in the number of new TB incidents from 2020 to 2022 (21 to 31). This was driven by a 63% fall in the number of OTF-S incidents, which fell from 16 in 2022 to just 6 in 2023. There was also a slight decrease in the number of OTF-W incidents in 2022 compared to 2023 (from 15 to 13).

The number of new TB incidents tripled from 2016 to 2017 (from 13 to 37). Since the peak of new TB incidents in 2017 and until 2022, the number of new TB incidents has remained above 21 each year, with the fewest new TB incidents disclosed in 2020. The linear decline from 2017 to 2020 was reversed by increases in numbers of incidents from 2020 to 2022. This reflected areas of developing local spread of infection across the county.

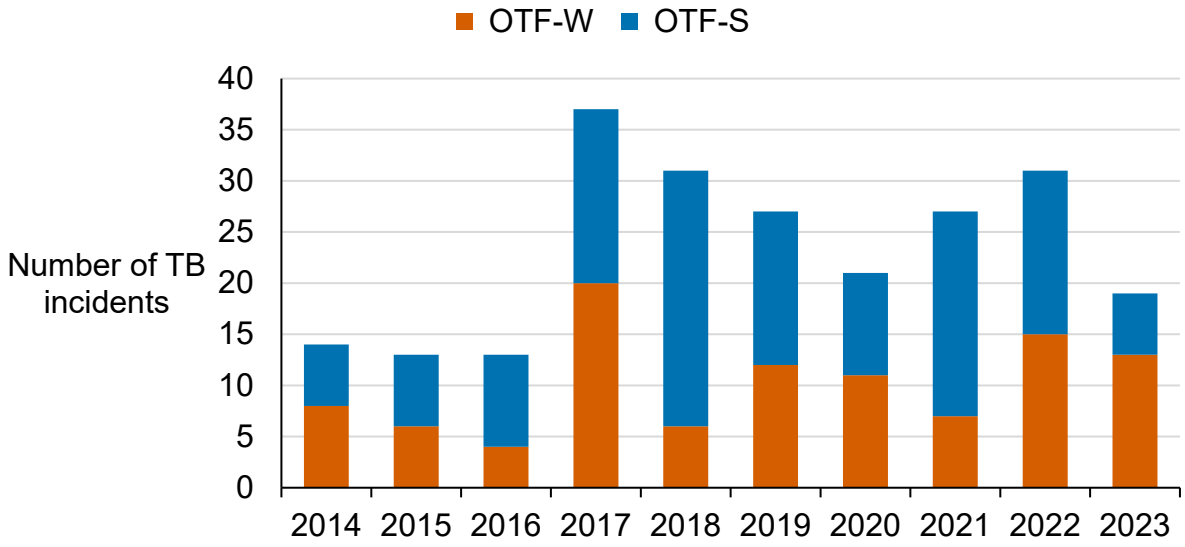


Figure 1: Annual number of new TB incidents in Buckinghamshire, from 2014 to 2023.

Figure 1 description: Bar chart showing the number of confirmed TB incidents (OTF-W, in orange) and suspected (OTF-S, in blue) in the whole of Buckinghamshire between 2014 and 2023. In 2023, there were 19 TB incidents in the whole county, 13 OTF-W and 6 OTF-S.

Disclosing test types

As in previous years, whole-herd (annual routine surveillance) testing continued to detect the most incidents of TB in Buckinghamshire in 2023 (8). This was followed by 6-month post-breakdown testing (4), as shown in Figure 2.

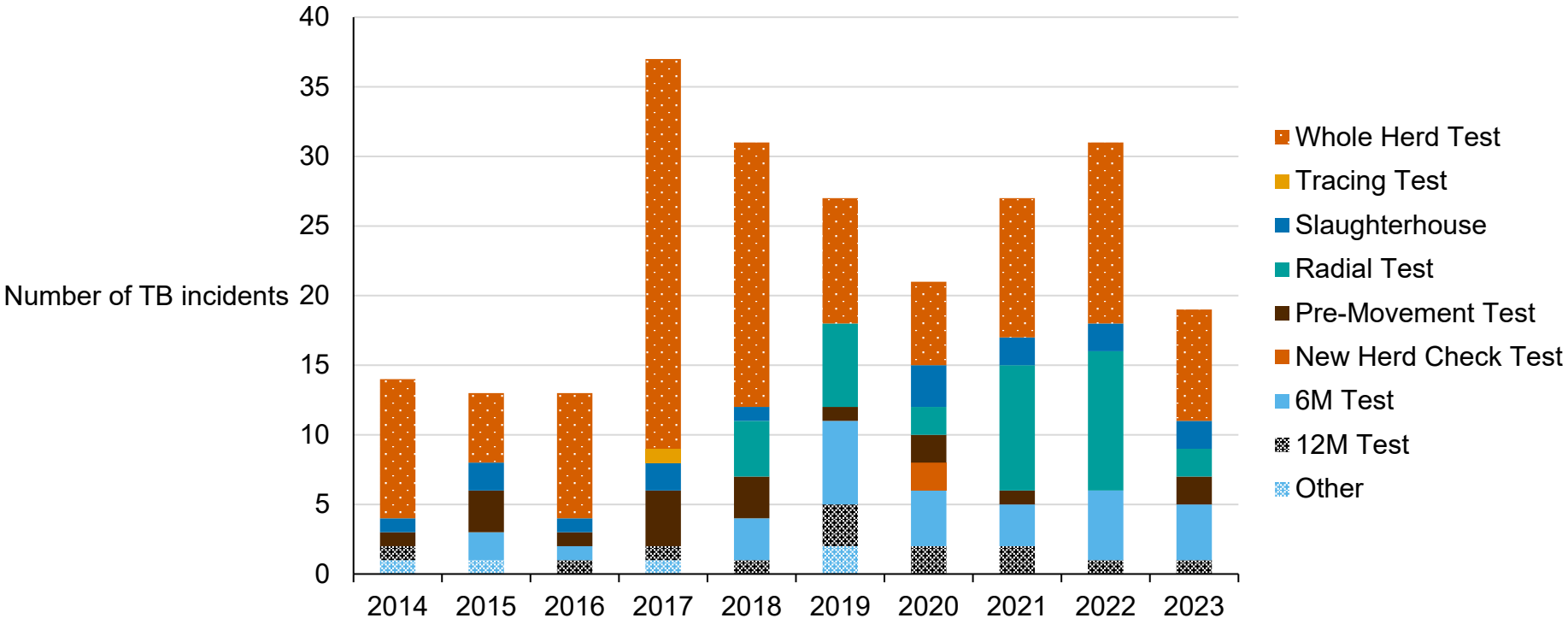


Figure 2: Number of new TB incidents (OTF-W and OTF-S) in Buckinghamshire in 2023, according to the surveillance methods that detected them.

Figure 2 description: A bar chart showing the number of new TB incidents disclosed by test type in Buckinghamshire between 2014 and 2023. In 2023, most incidents were disclosed by whole herd tests (8), followed by a 6-month post-incident test (6M test, 4), slaughterhouse cases (2), pre-movement tests (2), radial tests (2) and 12-month post-incident test (1).

Duration of TB incidents

A total of 25 TB incidents were resolved in Buckinghamshire during 2023. Of these, 7 were new TB incidents that started in 2023, and 18 started in 2022. The median duration of OTF-W incidents that ended in 2023 was 270 days, interquartile range (IQR) 175 to 284.

Fourteen out of the 16 OTF-W incidents that ended in 2023 were resolved within 550 days. Most OTF-S incidents ending in 2023 (8 out of 11) were resolved within 204 days. However, 3 took between 241 and 550 days to resolve and the median was 164 days (IQR 158 to 265).

The median duration of all incidents that were resolved in 2023 was 249 days (IQR 160 to 280). This was longer than the duration of incidents that ended in 2022; 190.5 days (IQR 166 to 272), and a higher duration than the total Edge Area in 2023.

For the whole Edge Area, the median duration of TB incidents that ended in 2023 was 188 days (IQR 159 to 265).

There were 16 TB incidents still open at the end of 2023, including one persistent OTF-W TB incident (under movement restrictions for more than 550 days).

Unusual TB incidents

There were no TB incidents reportable as unusual in Buckinghamshire in 2023.

TB in other species

There is no statutory routine TB surveillance of non-bovine species, apart from Post-Mortem Examination (PME) of animals slaughtered for human consumption. Targeted TB testing takes place in non-bovine herds under TB movement restrictions due to laboratory-confirmed incidents of *M. bovis* infection, and in specific herds of camelids, goats and captive deer at an elevated risk of infection.

There were no new incidents of TB in non-bovine species in Buckinghamshire in 2023.

APHA, in collaboration with the University of Nottingham, conducted a project to detect the presence and location of TB infection in badgers in Buckinghamshire, Oxfordshire, Berkshire, Hampshire and East Sussex - collectively known as the ‘Southern Edge Area’. Volunteers were recruited in each county to help with the safe and timely retrieval of badger carcasses. They were delivered to the University of Nottingham, where they underwent post-mortem examination and testing for the presence of TB infection by culture. Those that tested positive were sent for further whole genome sequencing and clade identification (genetic strain). The project aimed to collect 100 carcasses of badgers

found dead per county, most likely those killed in road traffic accidents (RTAs). Once 100 carcasses of a sufficient quality were examined per county, collection ceased in that county. Once county targets were achieved, all stakeholders were informed. The survey ended in April 2023 and its results will be communicated to all stakeholders once all the bacteriological cultures and Whole Genome Sequencing (WGS) analysis have been completed. Its results will help develop a picture of the disease situation in the Southern Edge Area.

Incidence of TB

Buckinghamshire had the fourth lowest incidence of TB, 5.9 incidents per 100 herd-years at risk (HYR), out of the 11 Edge Area counties. This was lower than the Edge Area overall (7.2 incidents per 100 HYR). Figure 3 shows that the annual incidence rate of TB in Buckinghamshire decreased from 8.5 incidents per 100 HYR in 2022 to 5.9 in 2023. This reflects the decrease in the number of new incidents in 2023. However, the fall in incidence was not statistically significant (incidence rate ratio=0.69, p=0.103), likely because the time at risk between 2022 and 2023 saw a proportionally smaller fall compared to the number of incidents.

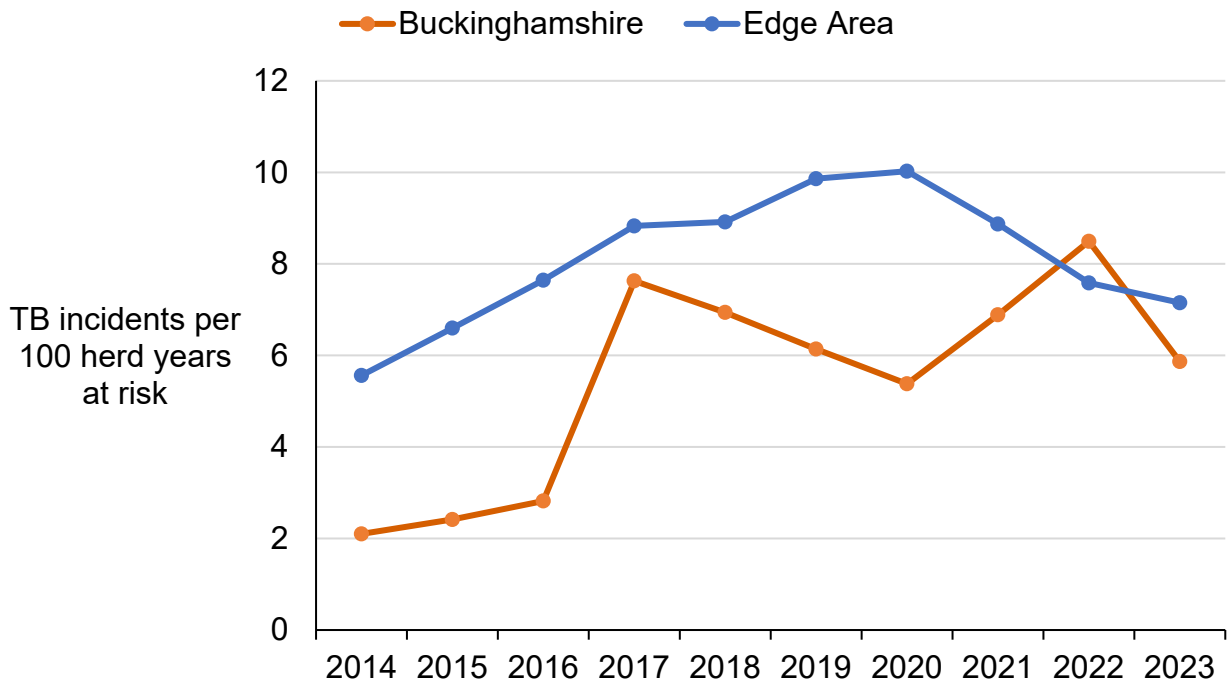


Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Buckinghamshire, from 2014 to 2023.

Figure 3 description: Line chart showing the incidence rate of new TB incidents per 100 herd years at risk (100 HYR) in Buckinghamshire and the overall Edge area between 2014 and 2023. Incidence in Buckinghamshire has fluctuated over the last decade, with a decrease between 2022 and 2023. In 2023, the incidence rate in Berkshire was 5.9 new

incidents per 100 HYR and in the Edge Area overall, incidence in 2023 was 7.2 new incidents per 100 HYR.

Prevalence of TB

In 2023, the end-of-year herd prevalence in Buckinghamshire decreased to 3.6% from 4.8% in 2022, as shown in Figure 4. This returned to levels seen in the previous 5 years, with the exception of in 2022 when the prevalence was the highest reported in the last decade. Prior to 2022, the prevalence in Buckinghamshire had been relatively stable since 2018 at around 4%.

Buckinghamshire had the sixth highest end of year prevalence out of the 11 counties in the Edge Area. This was slightly lower than the overall rate for the whole of the Edge Area in 2023 (3.7%).

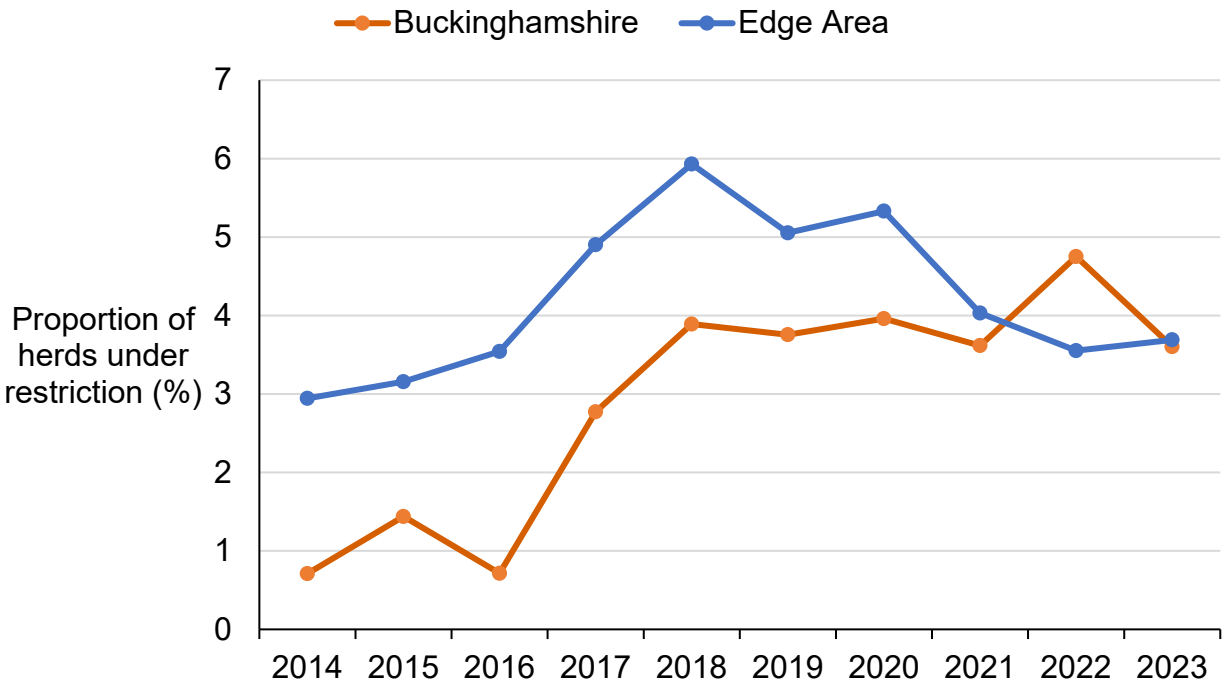


Figure 4: Annual end of year prevalence in Buckinghamshire, from 2014 to 2023.

Figure 4 description: Line chart showing the annual end of year prevalence in Buckinghamshire and within the overall Edge Area, between 2014 and 2023. Annual end of year prevalence has been stable since 2018, with a peak in 2022 in Buckinghamshire. In 2023, the end of year prevalence for Buckinghamshire was 3.6% of herds placed under TB-restrictions in the county. Prevalence in the Edge Area overall in 2023 was 3.7% of herds.

Recurring TB incidents

Three-year recurrence

Of the 19 new TB incidents in Buckinghamshire in 2023, 9 (47%) occurred in herds that had experienced another TB incident in the previous 3 years, as in Figure 5. This was lower compared to neighbouring Edge Area counties where recurring TB incidents contributed a much higher proportion of their new TB incidents in 2022: Berkshire (69%), Oxfordshire (52%) and Northamptonshire (50%). It was also lower than the whole of the Edge Area recurrence rate, which was 54% in 2023. The recurrent TB incidents could be a result of residual infection remaining undetected within the herd from a previous incident, reinfection from other sources such as wildlife, or as a result of purchased cattle with undetected infection.

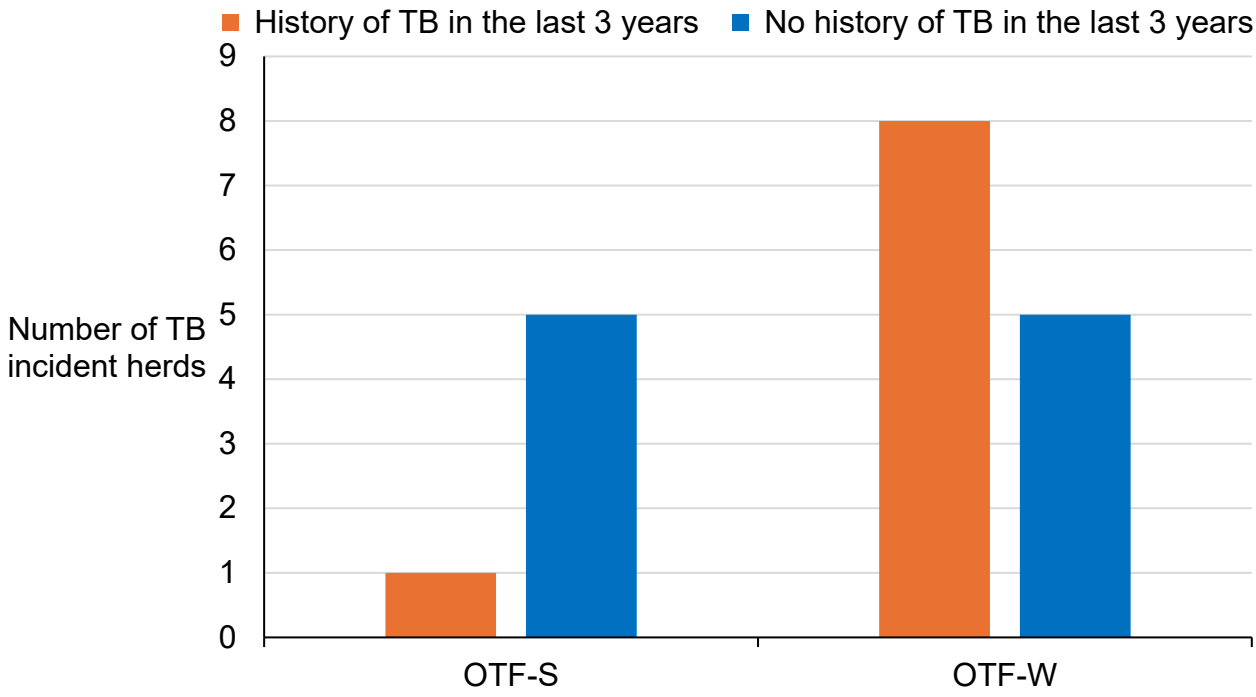


Figure 5: Number of herds with a TB incident (by OTF-W and OTF-S) in Buckinghamshire in 2023, with and without a history of any TB incident in the previous 3 years.

Figure 5 description: Bar chart showing the number of herds with (in orange) and without (in blue) a history of a TB incident in the last 3 years in 2023, for OTF-S and OTF-W herds. A description of the data is provided in the text.

Overall recurrence

In 2023, 58% of incidents reported in Buckinghamshire were in herds with a history of TB in the herd's lifetime (2 out of 6 OTF-S and 9 out of 13 OTF-W), as shown in Figure 6.

Overall recurrence of TB decreased this year compared to 2022 (61%, 8 out of 16 OTF-S and 11 out of 15 OTF-W).

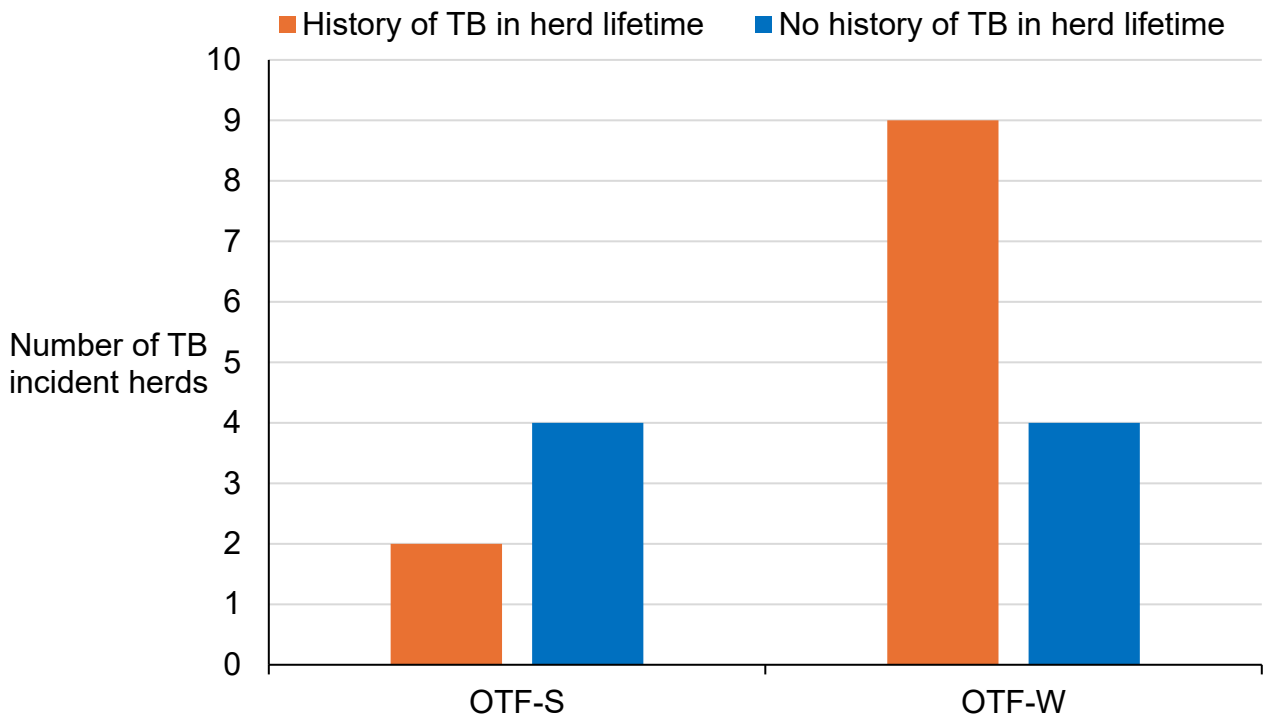


Figure 6: Number of herds with a TB incident (by OTF-W and OTF-S) in Buckinghamshire in 2023, with and without a history of any TB incident during the herd's lifetime.

Figure 6 description: Bar chart showing the number of herds with (in orange) and without (in blue) a history of a TB incident in the herd's lifetime in 2023, for OTF-S and OTF-W herds. A description of the data is provided in the text.

Geographical distribution of TB incidents

Figure 7 shows that most new TB incidents were in the areas of Buckinghamshire with higher cattle density. Most new OTF-W incidents in Buckinghamshire during 2023 were in the west of the county, whereas OTF-S incidents were spread across the county.

As in previous years, most OTF-W incidents were associated with WGS clade B6-62 of *M. bovis*. There were 3 separate incidents identified with clades B6-11, B6-85 and B4-11.

Buckinghamshire abuts the LRA to the east and other Edge Area counties to the north, south and west. The neighbouring counties to Buckinghamshire had very varied levels of

TB incidence (number of incidents per 100 HYR) in 2023. Oxfordshire to the west had the highest incidence of TB out of all of the Edge Area counties (18.4 incidents per 100 HYR). Berkshire (9.0 incidents per 100 HYR) also had a higher incidence than Buckinghamshire in 2023, whereas Northamptonshire had a lower incidence at 4.2 incidents per 100 HYR.

In the north of Buckinghamshire, towards the border with Northamptonshire, there was a cluster of incidents all with clade B6-62. WGS analysis of these incidents has found close genetic relationships between them. This Buckinghamshire cluster includes incidents from 2018 onwards, with various species involved including a badger, alpacas and wild deer. It is likely that this cluster is a result of spread from the North Banbury B6-62 cluster.

At the border with Oxfordshire and Northamptonshire, near Westbury, there was one incident with clade B6-85. This clade is common in the south-west, although there were sporadic incidents in 2021 and 2022 in south-west Oxfordshire.

One incident with clade B4-11, which has a homerange in the south-west, has been disclosed in 2023. This incident has been attributed to cattle movement.

There was one incident with clade B6-11 in the east of the county, within close proximity to Leighton Buzzard, and to the north of Hotspot 30 (HS30). This clade appeared in 2 incidents in 2021 and one in 2022. WGS analysis found a close genetic relationship to the 2023 incident (2 SNPs difference for the 2022 and 2021 incidents each compared to the 2023 incident). Given the lack of known epidemiological links between these herds, wildlife is suspected of being a potential source of infection in the 2023 incident.

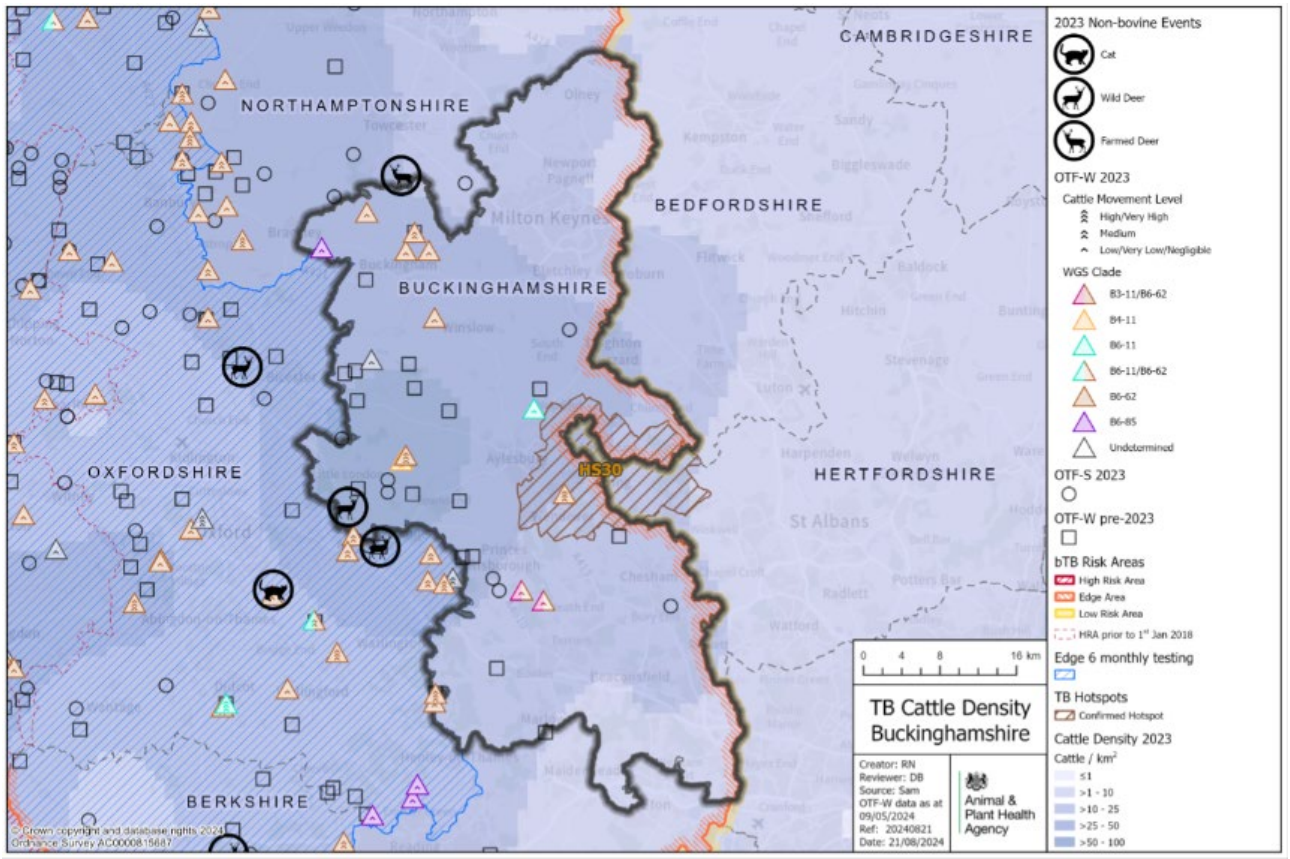


Figure 7: Location of cattle holdings in Buckinghamshire with new TB incidents (OTF-W and OTF-S) in 2023 and cattle holdings with pre-2023 OTF-W incidents still ongoing at the beginning of 2023, overlaid on a cattle density map. The movement score for each farm is symbolised with 3 chevrons for cattle movements associated with a high likelihood of infection, 2 chevrons for a medium likelihood and one chevron for a low likelihood.

Figure 7 description: Map of the Buckinghamshire county showing the locations of cattle holdings in Cheshire with new TB incidents (OTF-S and OTF-W) in 2023 and pre-2023 OTF-W incidents on the map. The 2023 OTF-W incidents are shown as triangles, 2023 OTF-S as circles and pre-2023 OTF-W as squares. The 2023 OTF-W incidents are also coloured by WGS clade and contain chevrons to show the cattle movement algorithm score allocated to the incident (low/medium/high risk of cattle movements). Most incidents occurred in the west of the county – further detail provided in the text.

Hotspot 30 (HS30)

A hotspot is an area of enhanced bovine TB surveillance set up in the LRA of England around a herd (more usually a cluster of herds) of OTF-W status, where the incidents are of an uncertain origin. This means there is no clear explanation or route of infection. Epidemiological evidence can require Hotspot areas to also include parts of the Edge Area.

A hotspot 30 area was identified in the parish of Tring, Hertfordshire, including parishes across the border in Buckinghamshire, south-east of Aylesbury, as shown in figure 7.

There was compelling evidence for locally spread infection in this area supported by the WGS or genotyping results and other epidemiological evidence. A badger carcass collected in 2022 close to Tring in Hertfordshire as part of Southern Edge RTA badger survey was confirmed as infected with *M. bovis* clade B6-62 and was genomically identical to 3 cattle isolates from Hertfordshire TB incidents and 1 cattle isolate from Buckinghamshire just across the county border.

In 2023, one incident occurred in HS30, with clade B6-62, but this was not closely genetically related to the other hotspot isolates and there was a high likelihood of cattle movement as the source.

Skin test reactors and interferon gamma test positive animals removed

Appendix 2 provides a summary of headline cattle TB statistics in Buckinghamshire. A total of 240 cattle were removed from TB incidents in Buckinghamshire during 2023, as shown in Figure 8. The tuberculin skin test detected 113 infected animals and 127 were detected through the interferon gamma (IFN-γ) blood test. This is an is increase of 91 reactors (18%) since 2022. This increase was contributed to by 2 persistent herds and one recurrent herd which have produced 70 gamma reactors in 2023.

The number of IFN-γ test positives more than doubled between 2022 and 2023 (53 to 127). The proportion of skin (47%) to IFN-γ blood (53%) test reactors in 2023 has also changed compared to previous years, when there was a higher proportion of skin compared to IFN-γ blood test reactors.

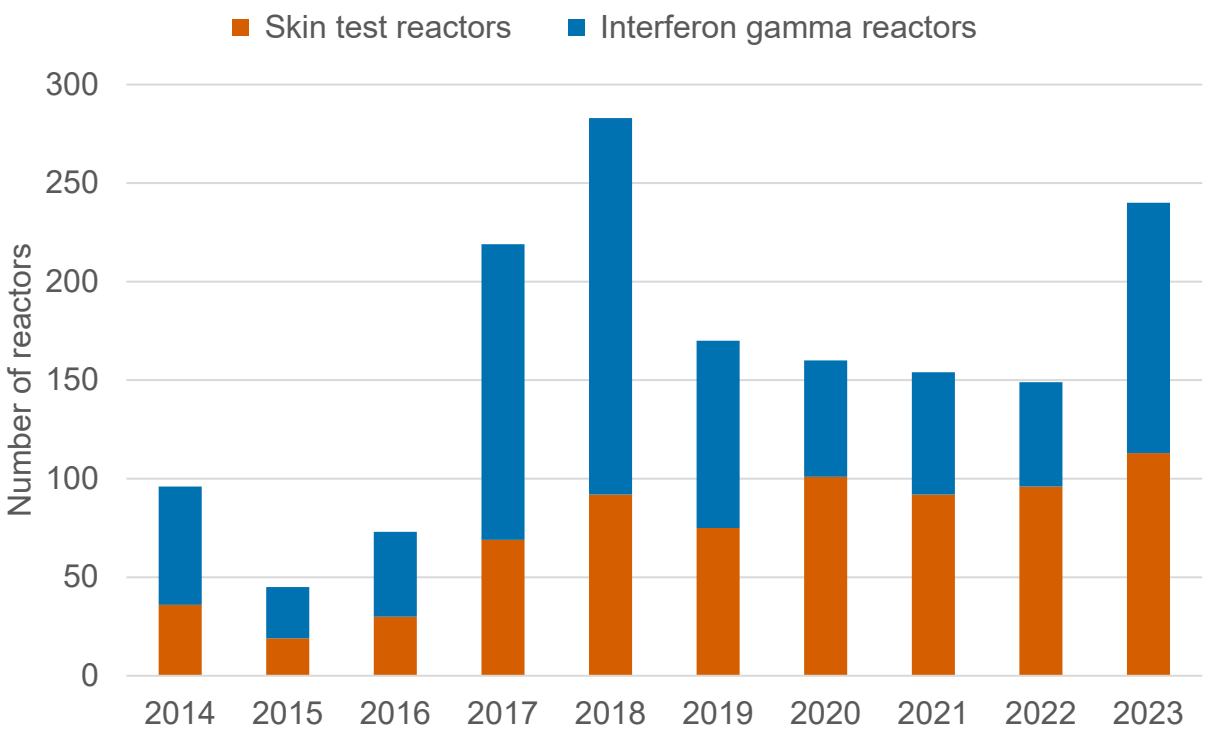


Figure 8: Number of skin test reactors (SICCT) and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Buckinghamshire, from 2014 to 2023.

Figure 8 description: Bar chart showing the number of skin test reactors and interferon gamma test reactors removed for TB control reasons in Buckinghamshire between 2014 and 2023. In 2023, 113 skin test reactor cattle and 127 interferon gamma reactors were removed in Buckinghamshire, the second highest number in the last 10 years.

Main risk pathways and key drivers for TB infection

It is important to try to understand the risk pathways and key drivers that are likely to have introduced TB infection into a herd. This information can help identify biosecurity measures that may reduce the TB risk for individual businesses.

Implementing practical measures can help to reduce the risk of TB incursion into a herd that is TB free (biosecurity), as well as slowing disease spread within a herd where TB is present (biocontainment).

Furthermore, the ibTB online tool can be used to inform purchasing choices, reducing the risk of introducing undetected infection when moving cattle into a herd.

In 2023, 12 out of 19 (63%) of new TB incidents in Buckinghamshire received a preliminary or final APHA veterinary investigation to identify the source of infection. The findings from these investigations are reported in Appendix 3. The small number of

investigations carried out in 2023 was mainly due to the diversion of field resource to the bluetongue outbreak in GB which began in Summer 2023.

New data-driven methods to quantify the likelihood of risk pathways for TB infected herds have been developed by APHA. These include the:

- cattle movement algorithm
- WGS local transmission of infection indicator

The cattle movement algorithm uses cattle movement data to identify individual animals that were moved into a TB incident herd as having a negligible, very low, low, medium, high or very high likelihood of being the source of the TB infection. At the herd level, the cattle movement score is dictated by the animal with the highest ranked movement into that herd. Herds are classified as having either:

- cattle movements associated with a high likelihood of infection (a herd with any movements scored as a high or very high likelihood)
- no cattle movements with a high likelihood of infection (the highest likelihood score was negligible, very low, low or medium)

The WGS local transmission of infection indicator uses WGS data from cattle *M. bovis* isolates to identify TB incidents that are linked by genetics, time and space. A TB incident where at least one other TB incident is identified that satisfies all the following 3 criteria is considered to have evidence of a local transmission event:

- it has a WGS with no more than 3 single nucleotide polymorphism (SNP) differences relative to the TB incident of interest
- it is within 4 years before or 6 months after the start date of the incident of interest
- it is within a 9km radius of the incident of interest

Further details about the methodology used can be found in the explanatory supplement to the annual reports 2023.

There is always a degree of uncertainty about the estimated true routes of TB infection into a herd. The absence of a local transmission event, or cattle movements associated with a high likelihood of infection does not completely negate these pathways. Nonetheless, the evidence provided by the cattle movement and WGS data, when combined, can provide valuable insights into the possible risk pathways. Figure 9 provides the percentage of herds where each risk pathway combination was identified. The spatial distribution of these categories is presented in Figure 10. Each category is described in greater detail in the following text.

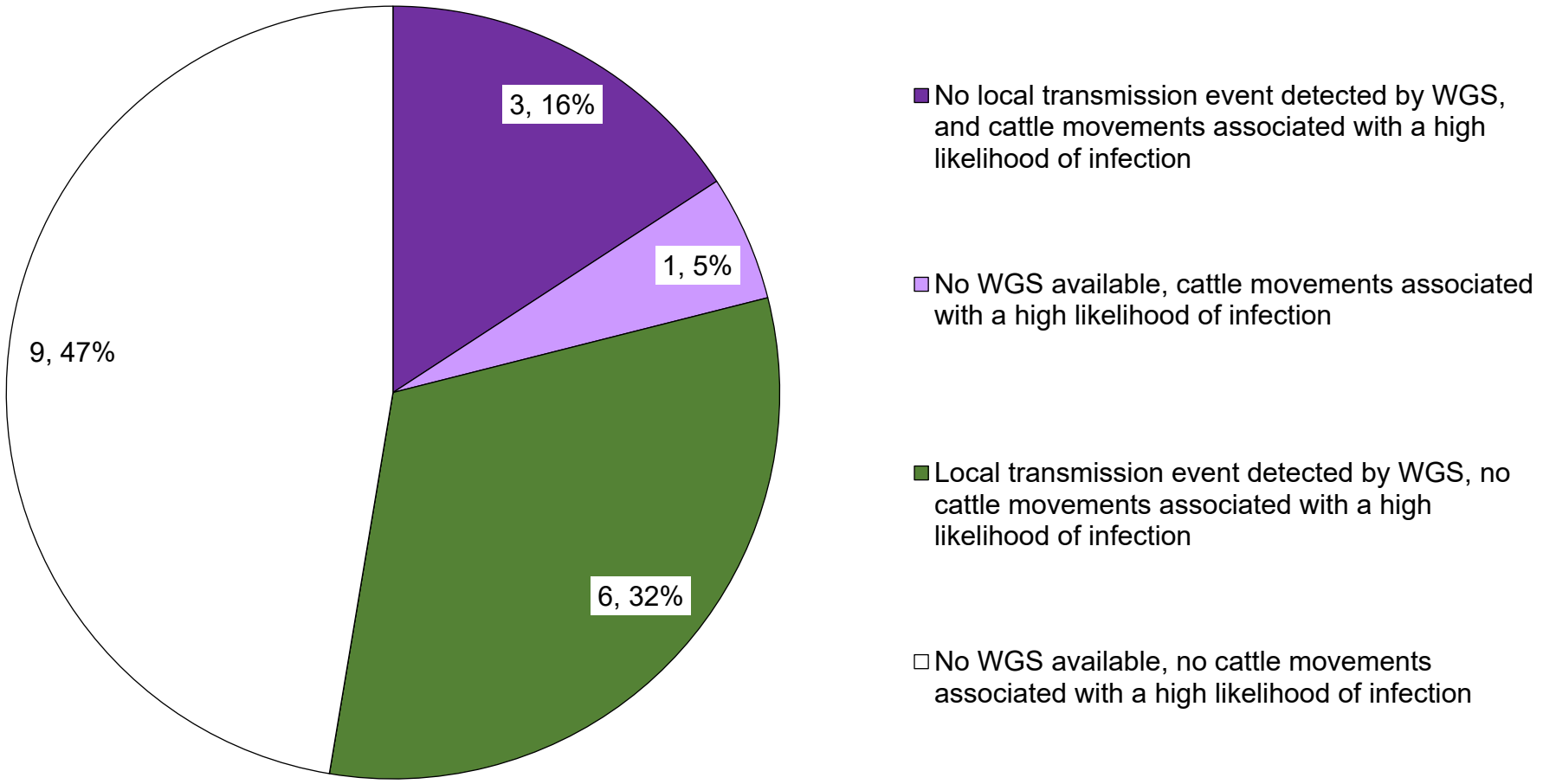


Figure 9: Risk pathway combinations identified by the WGS local transmission of infection indicator and cattle movement algorithm for all 19 new TB incidents starting in Buckinghamshire in 2023.

Figure 9 description: Pie chart showing the risk pathway combinations identified by the WGS local reservoir indicator and cattle movement algorithm for all 19 new TB incidents in Buckinghamshire in 2023. Most (9, 47%) did not have any WGS and no cattle movements were identified with a high likelihood of infection. Further description provided in the text.

WGS data was available for 9 (47%) of all new TB incidents in Buckinghamshire.

Most of the TB incidents with WGS data available had a local transmission event identified without strong evidence of cattle movements (6 of 11, 32% overall). These are dark green symbols in Figure 10.

For these incidents, a broad spectrum of local pathways cannot be ruled out, including:

- residual infection in the herd
- contiguous contact with infected cattle
- direct or indirect contact with potentially infected wildlife

In Buckinghamshire, 3 (16%) TB incidents had evidence of cattle movements associated with a high or very high likelihood of TB infection, and no local transmission event where WGS was available. For these 3 herds it was considered more likely than not that cattle movements played a part in the introduction of infection (dark purple symbols, Figure 10).

For a further 9 new TB incidents in 2023 (47%), there was no evidence of cattle movements associated with a high likelihood of TB infection, and no WGS data available to explore the potential for a local indicator of infection. These are shown as white dots in Figure 10, as there is insufficient evidence to determine a likely infection pathway.

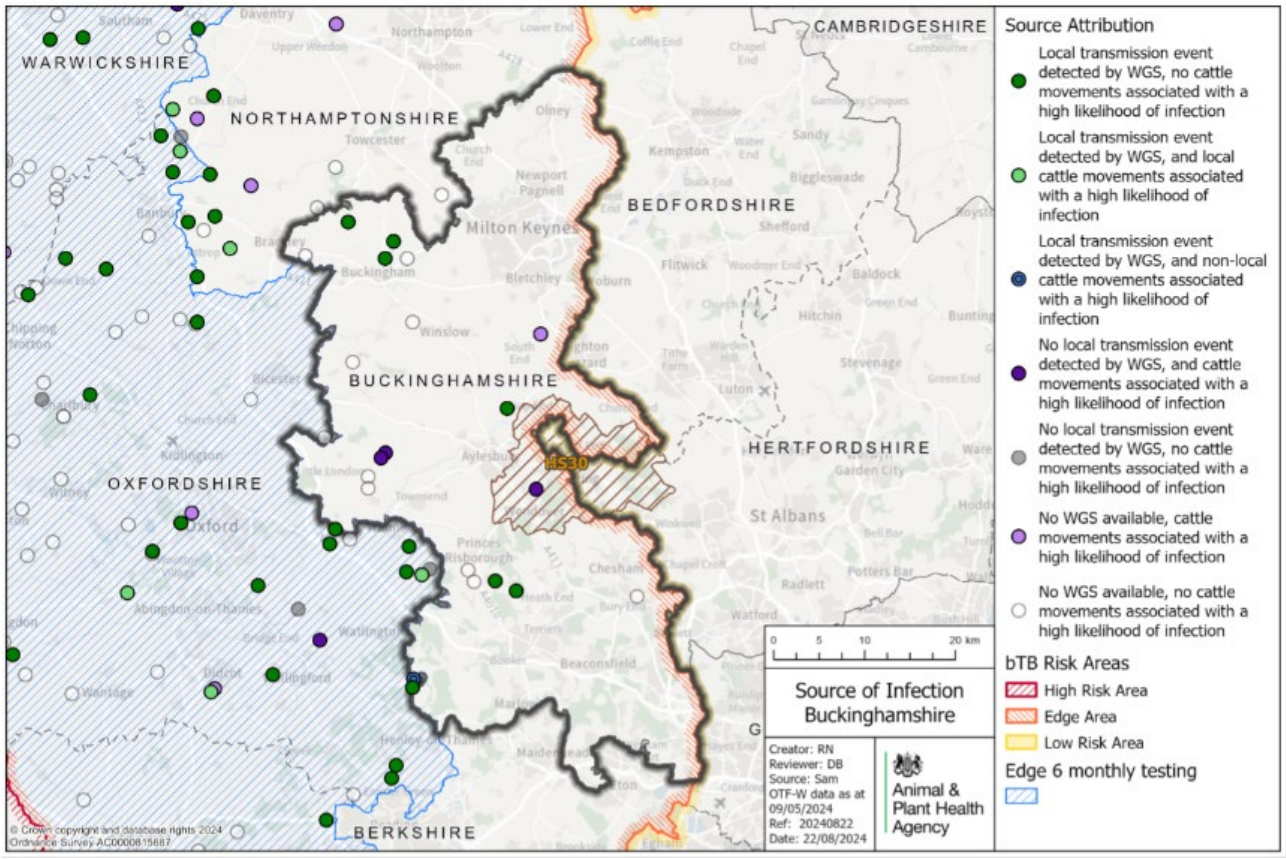


Figure 10: Map of the available evidence for risk pathways of TB infection into the herd, for all TB incidents (OTF-W and OTF-S) in Buckinghamshire that started in 2023.

Figure 10 description: Map of the Buckinghamshire county showing the locations of the 19 new TB incidents in Buckinghamshire, coloured by the risk pathway identified for the incident. Dark green are herds with a local transmission event was identified from WGS and no cattle movements with a high likelihood of infection were identified in the herd; light green represents incidents where local transmission event was identified from WGS and cattle movements with a high likelihood of infection were identified in the herd. Dark purple represents incidents where no local transmission event was identified from WGS and there were cattle movements identified with a high likelihood of infection in the herd. Light purple represents incidents with no WGS available and where there were cattle movements identified with a high likelihood of infection in the herd. Grey shows incidents where no local transmission event was identified from WGS and there were no cattle movements with a high likelihood of infection were identified in the herd either. White shows incidents with no WGS available and where there were no cattle movements with a high likelihood of infection were identified in the herd either. A breakdown of the incidents by group is provided in the text.

Genotyping was replaced with WGS of *M. bovis* isolates at APHA in 2021.

Most new OTF-W incidents in 2023 were located in the west of the county, the majority were identified as WGS clade B6-62.

In the north-west of the county close to the Oxfordshire and Northamptonshire border, there were 4 OTF-W incidents with WGS clade B6-62. Since 2020, incidents with WGS clade B6-62 have occurred in the same area, as shown in Figure 11. Similar to 2022, there were no identified direct movements of cattle between holdings in this cluster, suggesting there was a potential common source of infection within the local wildlife. As mentioned previously, this is likely to be spread from the North Banbury B6-62 cluster.

In 2021, a cluster of incidents with WGS clade B6-11 (genotype 17:b) emerged in the east of the county close to Leighton Buzzard, on the Bedfordshire (LRA) border. There was one incident with WGS clade B6-11 in both 2022 and 2023 disclosed in the same area and all closely related to each other genetically. These isolates have very similar WGS to isolates from 2 cattle incidents in 2017 located to the west of this area that is indicative of local spread of infection over several years.

There was one incident disclosed in the north-west of the county with WGS clade B6-85, there was no local transmission event identified, and no cattle movements associated with a high likelihood of infection. This clade is normally found in the south-west HRA, although there is a small cluster developing in south-east Oxfordshire. No links between the Oxfordshire cluster and this incident were found.

Another incident outside of the homerange B4-11 clade has been disclosed west of Aylesbury. Cattle movements were associated with high likelihood of infection in this breakdown.

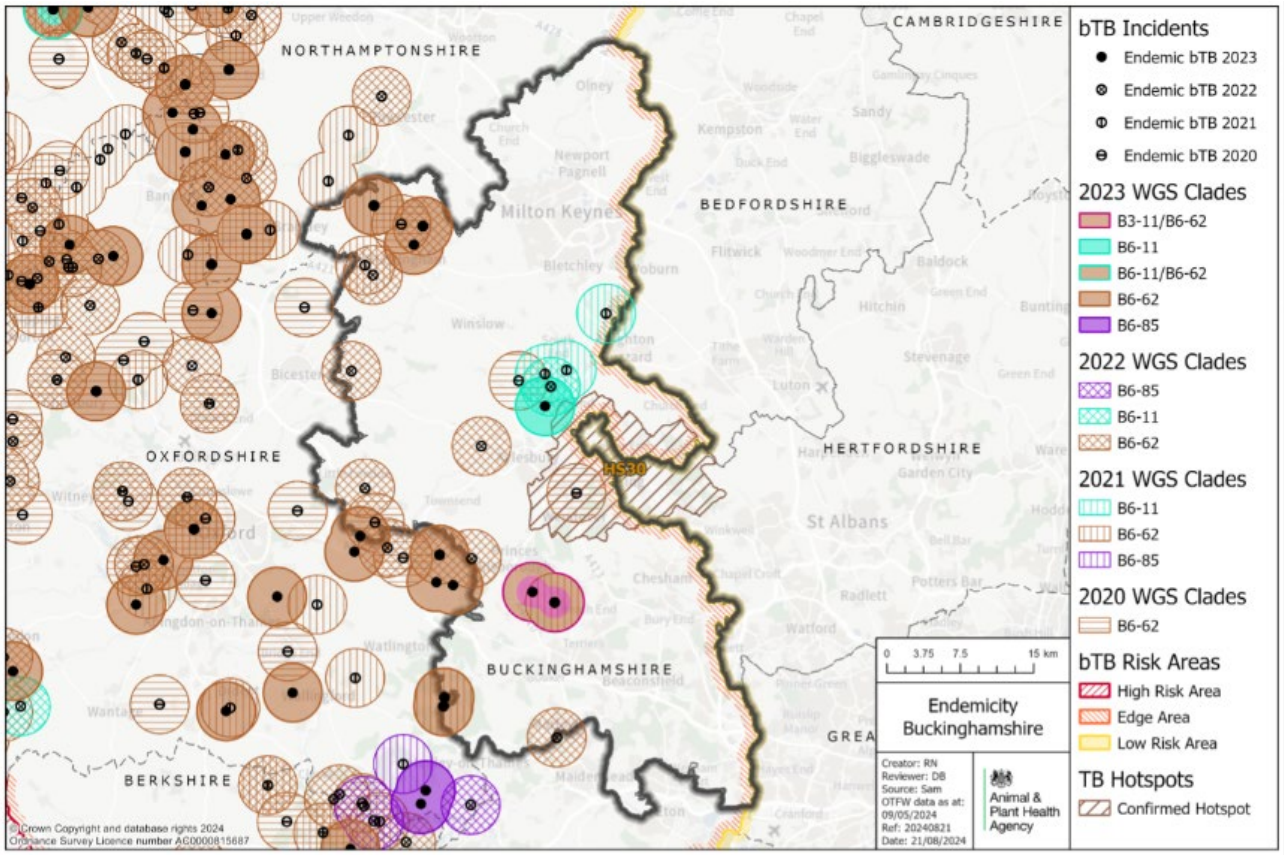


Figure 11: WGS clades of *M. bovis* detected in Buckinghamshire between 2020 and 2023, where the WGS identified in the infected herd was within 3 SNPs of another TB incident in the past 4 years and 9km (OTF-W incidents only).

Figure 11 description: Map of Buckinghamshire showing the WGS clades of *M. bovis* detected in Berkshire between 2020 and 2023, where the WGS identified in the infected herd was within 3 SNPs of another OTF-W incident in the past 4 years and within 9km of it. Clades are shown as circles on the map with each clade represented by a different colour. The year, from which the clade was identified is shown by either having the colour be solid (2023) or different types of hash (2022 to 2020). All incidents show in the north-west, south-west and east of Buckinghamshire. Further detail is provided in the text.

Forward look

The number of new TB incidents has decreased in 2023, with OTF-W incidents slightly decreasing from 15 in 2022 to 13 in 2023. OTF-S incidents have markedly decreased, from 16 in 2022 to 6 in 2023.

Recent evidence suggests the increasing role that local wildlife infection may be playing in certain areas of the county, with spread of infection from neighbouring counties, especially Oxfordshire. There are 2 clusters of infection, one on the border with Oxfordshire near

North Banbury, where incidents on farms were within 3 SNPs difference from badger, deer and alpaca cases. The other cluster near HS30 occurred in 3 farms in close proximity, with incidents within 1-2 SNPs difference. Therefore, the introduction of active wildlife surveillance and monitoring, to prevent spread, especially from Oxfordshire and current clusters of incidents within the county, are needed. Purchasing of cattle from herds with undisclosed TB infection into Buckinghamshire has been, and continues to be, one of the major routes of infection into this county. The introduction on 1 August 2023 of mandatory post-movement skin testing of cattle entering herds in the section of the Edge Area under annual TB surveillance (including Buckinghamshire) should help with the early detection of cattle moved into the county with undisclosed TB. This in turn should reduce the risk of further spread of TB within the receiving herds and the potential subsequent spread to the local wildlife in Buckinghamshire. Further practical measures to help address the main risk pathways include:

- the use of non-grazing AFUs for cattle purchased from the HRA and other parts of the Edge Area. Encourage farms to consider setting up an AFU for particular groups of purchased cattle and reduce the risk they present by preventing exposure of infected cattle to cattle on other farms and to wildlife

- better informed purchasing of cattle

- to encourage implementation of effective on-farm biosecurity measures

- to incentivise ways of reducing badger to cattle interactions on farms to prevent the spread of TB to and from wildlife

- to encourage measures to prevent or reduce TB infection in wildlife, such as badger culling or vaccination, and local control of the wild deer population, where appropriate

Appendix 1: cattle industry demographics

Table 1: Number of cattle herds by size category in Buckinghamshire as of 31 December 2023 (RADAR data on number of holdings in the report year)

Size of herds	Number of herds in Buckinghamshire
Undetermined	6
1 to 50	155
51 to 100	73
101 to 200	71
201 to 350	40
351 to 500	13
Greater than 500	20
Total number of herds	378
Mean herd size	130
Median herd size	68

Table 2: Number (and percentage of total) of animals by breed purpose in Buckinghamshire as of 31 December 2023 (Sam data showing the number of herds flagged as active at the end of the report year)

Breed purpose	Number (and percentage of total) cattle in Buckinghamshire
Beef	39,812 (80%)
Dairy	8,776 (17%)
Dual purpose	603 (1%)
Unknown	2 (0.004%)
Total	49,193

Appendix 2: summary of headline cattle TB statistics

Table 3: Herd-level summary statistics for TB in cattle in Buckinghamshire between 2021 and 2023

Herd-level statistics	2021	2022	2023
(a) Total number of cattle herds live on Sam at the end of the reporting period	476	469	450
(b) Total number of whole herd skin tests carried out at any time in the period	552	494	444
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	400	374	346
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of TB movement restrictions)	438	427	411
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	457	445	432
(f.1) Total number of new OTF-S TB incidents detected in cattle herds during the report period	20	16	6
(f.2) Total number of new OTF-W TB incidents detected in cattle herds during the report period	7	15	13
(g.1) Of the new OTF-W herd incidents, how many can be considered the result of movement, purchase or contact from or with an existing incident based on current evidence?	2	2	1
(g.2) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or twice-inconclusive reactors (2xIRs) at routine herd tests?	2	5	5

Herd-level statistics	2021	2022	2023
(g.3) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or 2xIRs at other TB test types (such as forward and back-tracings, contiguous or check tests)?	5	10	8
(g.4) Of the new OTF-W herd incidents, how many were first detected through routine slaughterhouse TB surveillance?	2	2	2
(h.1) Number of new OTF-W incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	0	0	0
(h.2) Number of new OTF-S incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	0	0	0
(i) Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W incidents that began in a previous reporting period)	6	14	13
(j) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	0	1 (alpaca)	0
(k.1) Number of grazing approved finishing units active at end of the period	0	0	0
(k.2) Number of non-grazing approved finishing units active at end of the period	6	6	6
(k.3) Number of grazing exempt finishing units active at end of the period	0	0	0
(k.4) Number of non-grazing exempt finishing units active at end of the period	0	0	0

Table 4: Animal-level summary statistics for TB in cattle in Buckinghamshire between 2021 and 2023

Animal-level statistics (cattle)	**2021**	**2022**	**2023**
(a) Total number of cattle tested with tuberculin skin tests or additional IFN-γ blood tests in the period (animal tests)	82,938	73,506	76,392
(b.1) Reactors detected by tuberculin skin tests during the year	92	96	113
(b.2) Reactors detected by additional IFN-γ blood tests (skin-test negative or IR animals) during the year	62	53	127
(c) Reactors detected during year per incidents disclosed during year	5.7	4.8	12.6
(d) Reactors per 1,000 animal tests	1.9	2.0	3.1
(e.1) Additional animals slaughtered during the year for TB control reasons (dangerous contacts, including any first time IRs)	11	4	0
(e.2) Additional animals slaughtered during the year for TB control reasons (private slaughters)	1	3	0
(f) Slaughterhouse (SLH) cases (suspect tuberculous carcasses) reported by Food Standards Agency (FSA) during routine meat inspection	3	4	8
(g) SLH cases confirmed by *M. bovis* PCR testing or bacteriological culture	3	3	3

Note (c) Reactors detected during year per incidents disclosed during year - reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count here.

Note (g) SLH cases confirmed by culture of *M. bovis* - not all incidents reported are submitted for culture analysis. All incidents reported are from any period prior to or during restrictions.

Appendix 3: suspected sources of *M. bovis* infection for all the new OTF-W and OTF-S incidents identified in the report period

In 2023, 12 out of 19 (63%) new TB incidents in Buckinghamshire received a preliminary or final APHA veterinary investigation to identify the source of infection. Not all Disease Report Form (DRF) investigations were carried out in 2023. This was due to the continued impact and diversion of field resources as part of the 2022 to 2023 highly pathogenic avian influenza outbreak which continued into spring 2023, in addition to the Bluetongue Virus outbreak from summer 2023 onwards. Each TB incident could have up to 3 potential risk pathways identified. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd. The score is recorded as either:

- definite (score 8)
- most likely (score 6)
- likely (score 4)
- possible (score 1)

The sources for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely, or possible can contribute towards the overall picture for possible routes of introduction into a herd. If the overall score for a herd is less than 6, then the score is made up to 6 using the ‘Other or unknown source’ option. Buffering up to 6 in this way helps to reflect the uncertainty in assessments where only ‘likely’ or ‘possible’ sources are identified.

Table 5 combines the data from multiple herds and provides the proportion of pathways in which each source was identified, weighted by the certainty that each source caused the introduction of TB. The output does not show the proportion of herds where each pathway was identified (this is skewed by the certainty calculation). WGS of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however WGS clades are not determined for OTF-S herds. As a result of varying levels of uncertainty, only broad generalisations should be made from these data. A more detailed description of this methodology is provided in the explanatory supplement for the annual reports 2023.

Table 5: Suspected sources of *M. bovis* infection for the 12 incidents with a preliminary or a final veterinary assessment in Buckinghamshire, in 2023

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	4	6	2	0	41.5%
Cattle movements	2	0	3	0	22.1%
Contiguous	0	0	0	0	0.0%
Residual cattle infection	2	3	1	1	28.8%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	0	0	0	0	0.0%
Other wildlife	2	0	0	0	2.1%
Other or unknown source	0	0	0	0	5.6%

Please note that each TB incident could have up to 3 potential pathways, so totals may not equate to the number of actual incidents that have occurred.

Data Protection:
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