Animal &
Plant Health
Agency

Year End Descriptive Epidemiology Report: Bovine TB in the Edge Area of England 2022

County: Buckinghamshire

Contents

Introduction

The Edge Area was originally established in 2013. In 2014, the bovine tuberculosis (TB) surveillance strategy for this area was incorporated into the UK Government's Strategy to achieve Officially Bovine Tuberculosis-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 vary the approach to control 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 2022. 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 'breakdowns', this report will use the term 'incidents' throughout.

This report is intended for individuals involved in the control of TB, both locally and nationally. This includes, but it is not limited to, farmers, 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 2022.

Types of TB incident

Unless otherwise specified, this report includes all new TB incidents detected during the reporting period (1 January to 31 December 2022). This includes both 'Officially Tuberculosis-Free Status Withdrawn' (OTF-W) and 'Officially Tuberculosis-Free Status Suspended' (OTF-S) incidents.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 positive to the Single Intradermal Comparative Cervical Tuberculin or SICCT test, in addition to either typical lesions of TB identified at post-mortem (PM) meat inspection, or at least one animal with an *M. bovis*-positive culture result from tissue samples collected from carcases during the PM inspection (or both).

OTF-S incidents are triggered by reactors to the skin test, but without subsequent detection of TB lesions or positive 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

Appendix 1 provides cattle industry demographics in Buckinghamshire. Beef herds are the predominant cattle enterprise, with a large proportion (41%) of herds with fewer than 50 cattle.

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, Low Risk Area (LRA), but also from the High Risk Area (HRA) counties with more abundant cattle. There was a total of 6 active non-grazing AFUs in Buckinghamshire during 2022, a reduction of one since 2021.

New TB incidents

Figure 1 shows that in 2022 there was an increase in the number of new TB incidents in Buckinghamshire compared to 2021 (from 27 to 31). This was the second consecutive year in which the number of new TB incidents increased in Buckinghamshire.

Compared to 2021, the number of OTF-W incidents doubled in 2022 (from 7 to 14), whereas the number of OTF-S incidents decreased slightly from 20 to 17.

The number of new TB incidents increased dramatically from 2016 to 2017 (from 13 to 37). Since the peak of new TB incidents in 2017, 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 then reversed by increases in numbers of incidents from 2020 to 2022. The latter reflects areas of developing local spread of infection across the county.

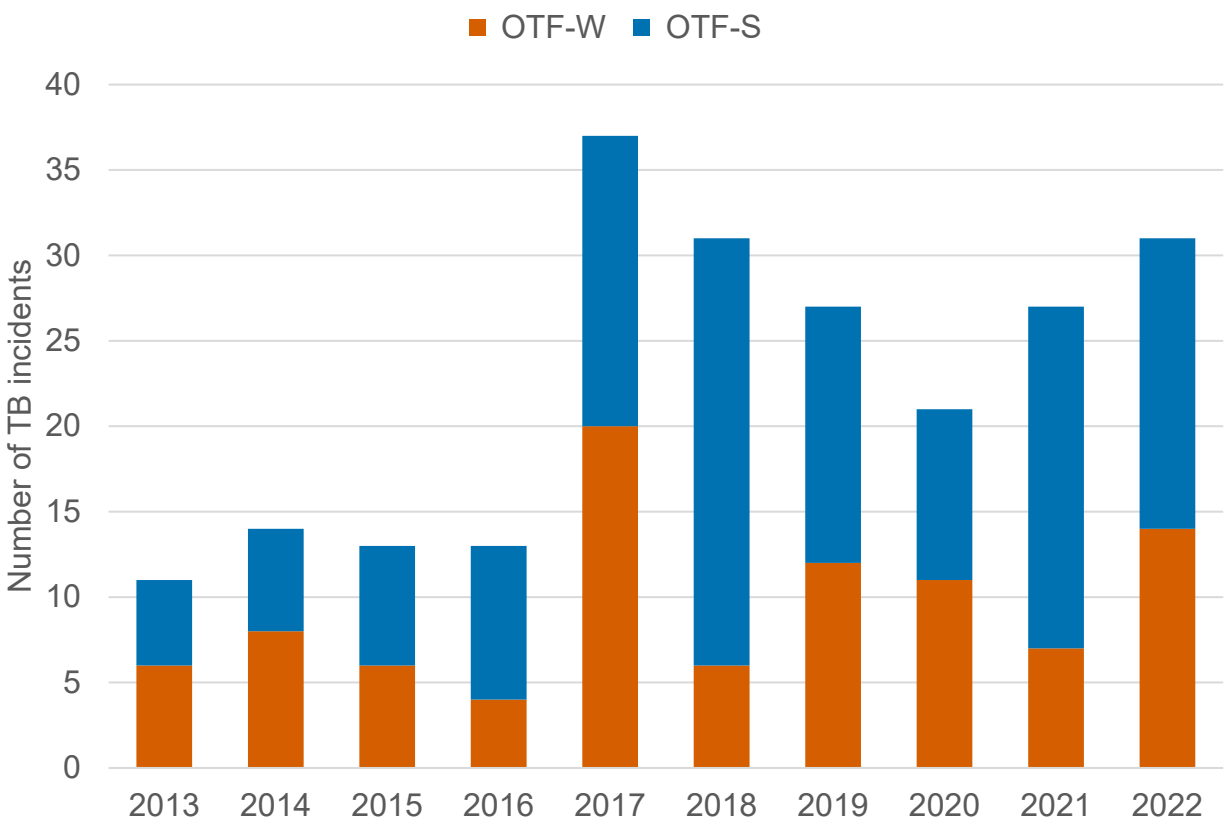

Figure 1: Annual number of new TB incidents in Buckinghamshire, from 2013 to 2022.

Disclosing test types

As in previous years, whole-herd (annual routine surveillance) testing continued to detect the most incidents of TB in Buckinghamshire in 2022 (13). This was followed by radial testing (10), as shown in Figure 2.

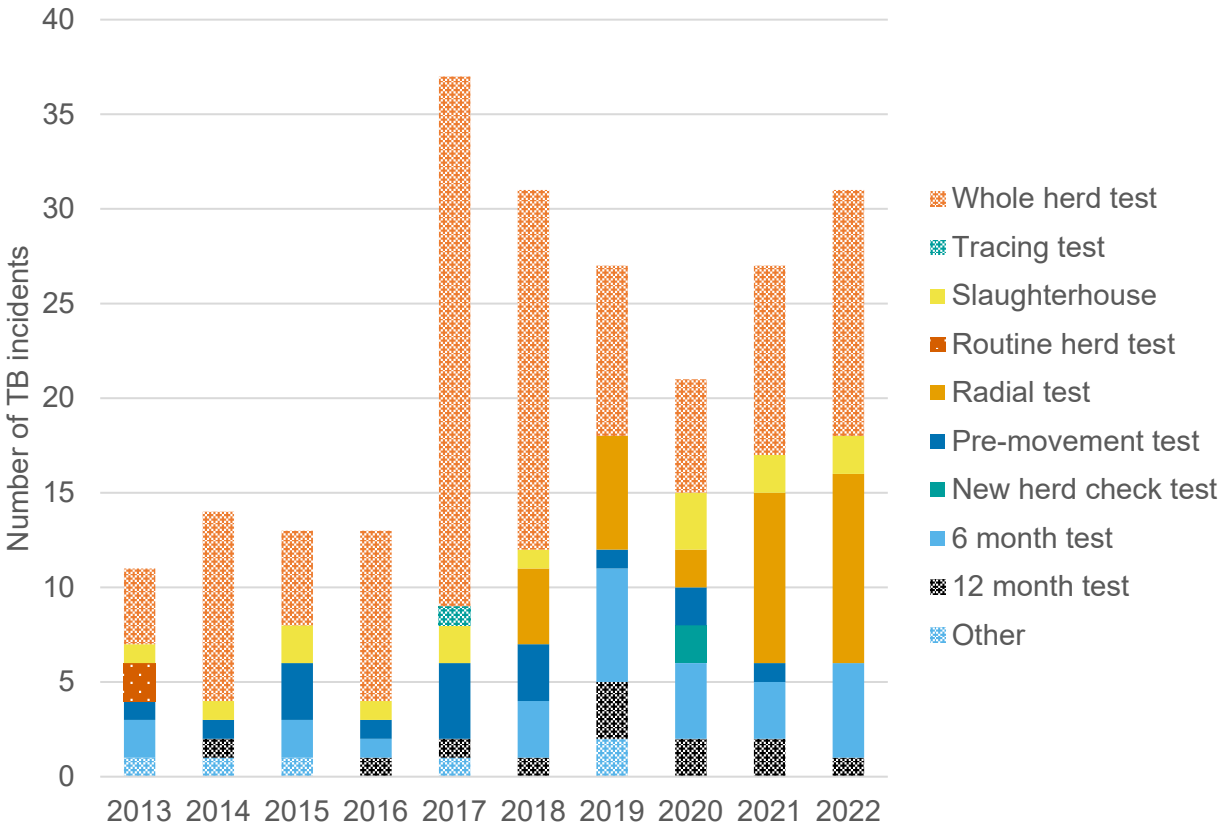

Figure 2: Number of new TB incidents (OTF-W and OTF-S) in Buckinghamshire in 2022, according to the surveillance methods that detected them.

Duration of TB incidents

A total of 26 TB incidents were resolved in Buckinghamshire during 2022. Of these, 9 were new TB incidents that started in 2022, 15 started in 2021, and 2 were from 2020.

The median duration of OTF-W incidents that ended in 2022 was 259 days (interquartile range (IQR) 227 to 402). All 7 OTF-W incidents that ended in 2022 were resolved within 550 days.

Most OTF-S incidents ending in 2022 (14 out of 19) were resolved within 240 days, however 5 took between 241 and 550 days to resolve and the median was 176 days (IQR 159 to 260).

There were no persistent TB incidents at the end of 2022 (under movement restrictions for more than 550 days).

The median duration of all incidents that were resolved in 2022 was 190.5 days (IQR 166 to 272). This was shorter than the duration of incidents that ended in 2021; 231 days (IQR 173 to 322), but a slightly higher duration than the total Edge Area in 2022. For the whole

Edge Area, the median duration of TB incidents that ended in 2022 was 182 days (IQR 157 to 286).

Unusual TB incidents

There were no individual TB incident investigations in Buckinghamshire in 2022 to explore unusual TB incidents.

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 with laboratory confirmed *M. bovis* infection, and in specific herds of camelids, goats and captive deer at an elevated risk of infection.

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 carcases. 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 carcases of badgers found dead per county, most likely those killed in road traffic accidents (RTAs). Once 100 carcases 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) analyses have been completed. Its results will help develop a picture of the disease situation in the Southern Edge Area.

There were no new incidents of TB in other non-bovine species in Buckinghamshire in 2022.

Incidence of TB

Buckinghamshire had the fifth highest incidence of TB per 100 herd-years at risk (8.5) out of the 11 Edge Area counties. This was higher than the Edge Area overall (7.6).

Figure 3 shows that the annual incidence rate of TB (incidents per 100 herd-years at risk) in Buckinghamshire increased from 6.9 in 2021 to 8.5 in 2022. This is the second consecutive year that the incidence has increased, reflecting the rise in the number of new incidents in 2022.

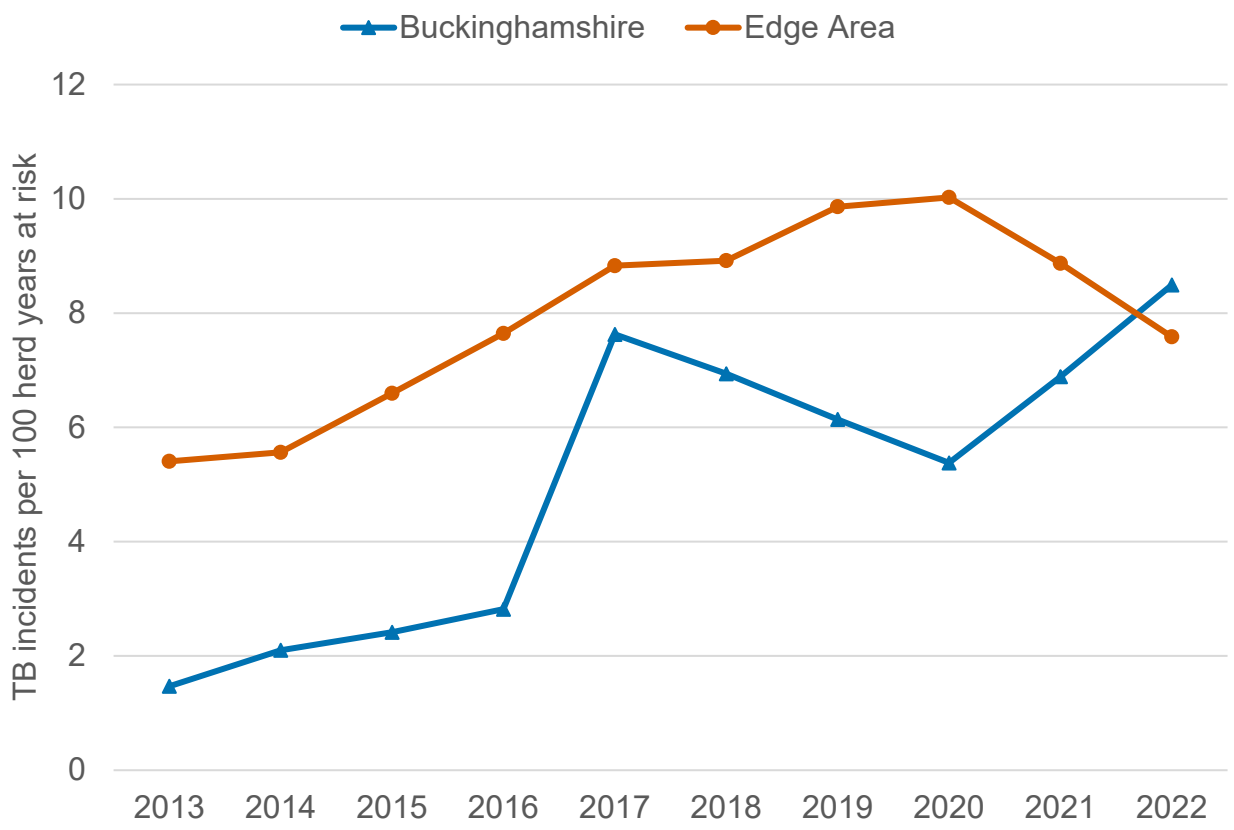

Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Buckinghamshire from 2013 to 2022.

Prevalence of TB

In 2022, the end-of-year herd prevalence in Buckinghamshire increased to 4.8% from 3.6% in 2021, as shown in Figure 4. This was the highest prevalence reported in the county over the past decade. Also, 2022 was the first year since before 2013 that the prevalence in Buckinghamshire was higher than the whole of the Edge Area (3.6%). Until 2022, the prevalence in Buckinghamshire had been relatively stable since 2018.

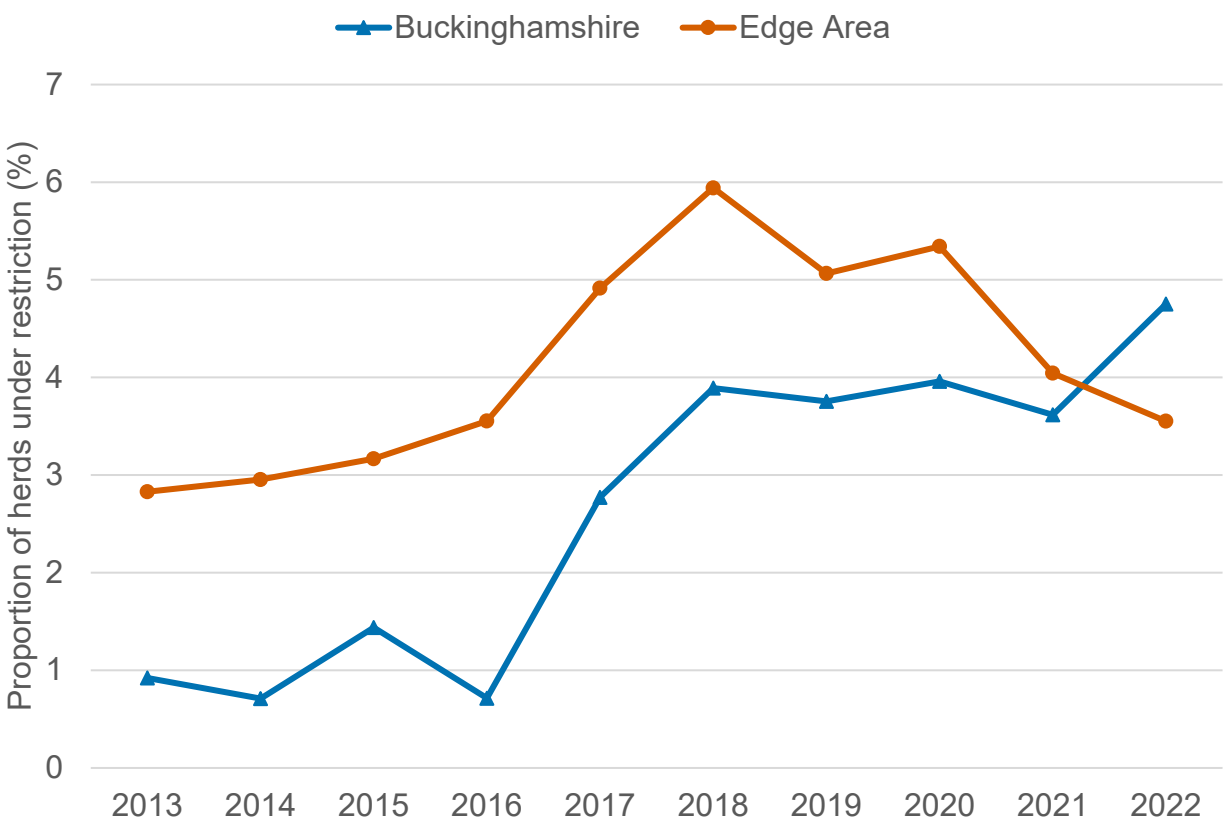

Figure 4: Annual end of year prevalence in Buckinghamshire, from 2013 to 2022.

Re-occurring TB incidents

Of the 31 new TB incidents in Buckinghamshire in 2022, 11 (35%) occurred in herds that had experienced another TB incident in the previous 3 years, see Figure 5. This was lower compared to neighbouring Edge Area counties where re-occurring TB incidents contributed a much higher proportion of their new TB incidents in 2022, Berkshire (67%), Oxfordshire (55%) and Northamptonshire (53%). Compared to the whole of the Edge Area where 50% of herds experienced re-occurring incidents, Buckinghamshire had 35% re-occurrence.

The re-occurrent 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.

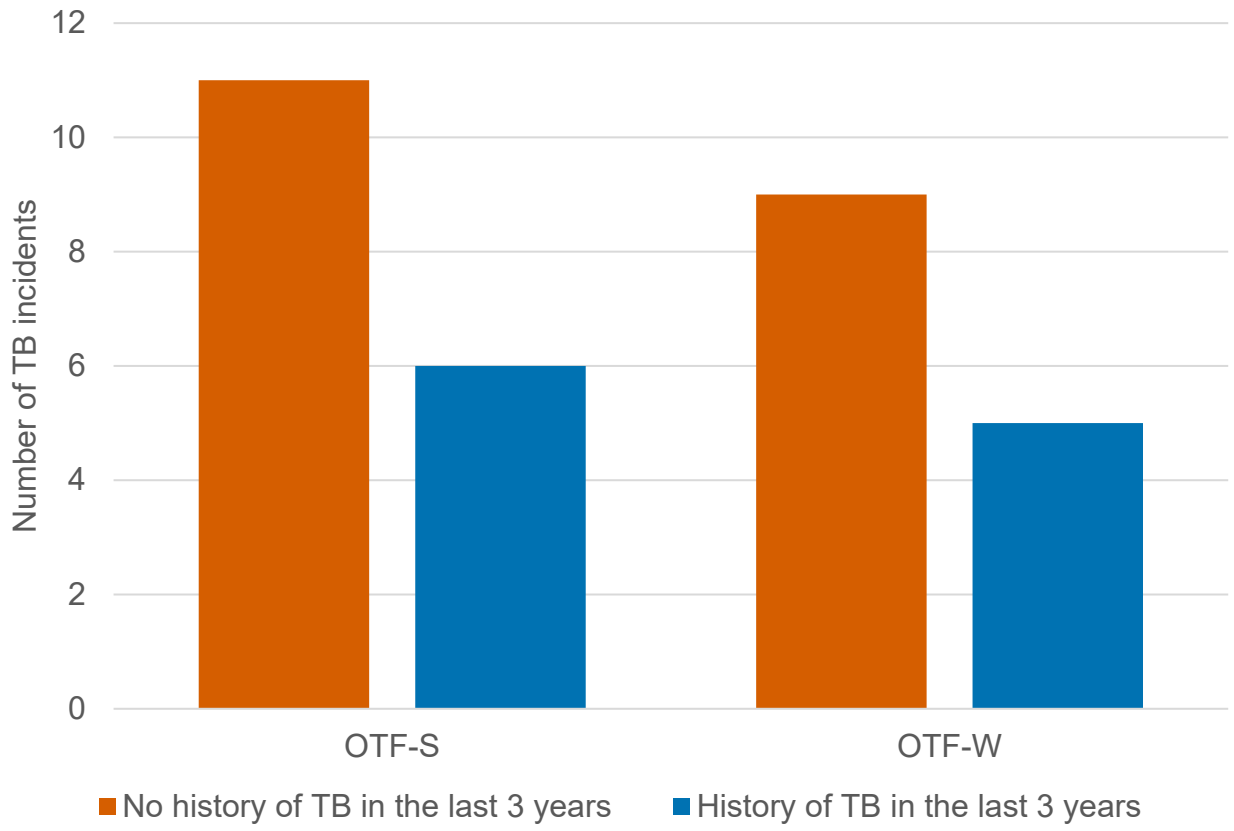

Figure 5: Number of herds with a TB incident (by OTF-W and OTF-S) in Buckinghamshire in 2022, with and without a history of any TB incident in the previous 3 years, and holdings without a history of TB in the previous 3 years.

Geographical distribution of TB incidents

Figure 6 shows that most new TB incidents were in the areas of Buckinghamshire with higher cattle density. Most new OTF-W incidents in Buckinghamshire during 2022 were in the west of the county, whereas OTF-S incidents were spread across the county. Previously, new TB incidents have been more concentrated in the north-west of the county.

As in previous years, most OTF-W incidents were associated with WGS clade B6-62 of *M. bovis*. There were 2 incidents identified as clade B6-11 and one as clade B3-11.

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 herds years at risk) in 2022. Oxfordshire to the west had the highest incidence of TB out of all of the Edge Area counties (15.1), Berkshire (11.3) also had a higher incidence than Buckinghamshire in 2022, whereas Northamptonshire had a lower incidence at 4.5. The LRA to the east of Buckinghamshire

had a much lower incidence rate of 1.1. There were more new TB incidents in 2022 along the Buckinghamshire/Oxfordshire border than there has been in previous years.

To the east of Princes Risborough, close to the Oxfordshire border, there were 2 new OTF-W incidents close to each other, both whole genome sequenced as clade B6-62. Whole genome sequences of *M. bovis* from these 2 incidents were genetically the same. They were also genetically linked within 3 single nucleotide polymorphisms (SNPs) of multiple incidents within 5 miles across the Oxfordshire border, associated with the Chinnor-Thame cluster. With a lack of epidemiological links between these herds, wildlife is likely to be a common source of infection.

Slightly further north also near to the Oxfordshire border, *M. bovis* from another incident was genetically similar (within 3 SNPs) to other incidents linked with the Chinnor-Thame cluster. In 2022, there has been lateral spread eastwards of TB from Oxfordshire into Buckinghamshire.

Other OTF-W incidents in 2022 along the county border with Oxfordshire had cattle movements associated with a medium-high likelihood of being the source of the TB infection. One incident had the same genetic strain of *M. bovis* WGS clade B6-62 as a previous incident located a couple of miles away, close to Bicester in Oxfordshire. A local source of infection, such as shared wildlife was a possible route of infection. However, cattle movements and residual infection within the herd were also possible routes of infection for this incident.

There was one OTF-W incident in the east of the county, within close proximity to Leighton Buzzard. *M. bovis* WGS clade B6-11 was isolated.

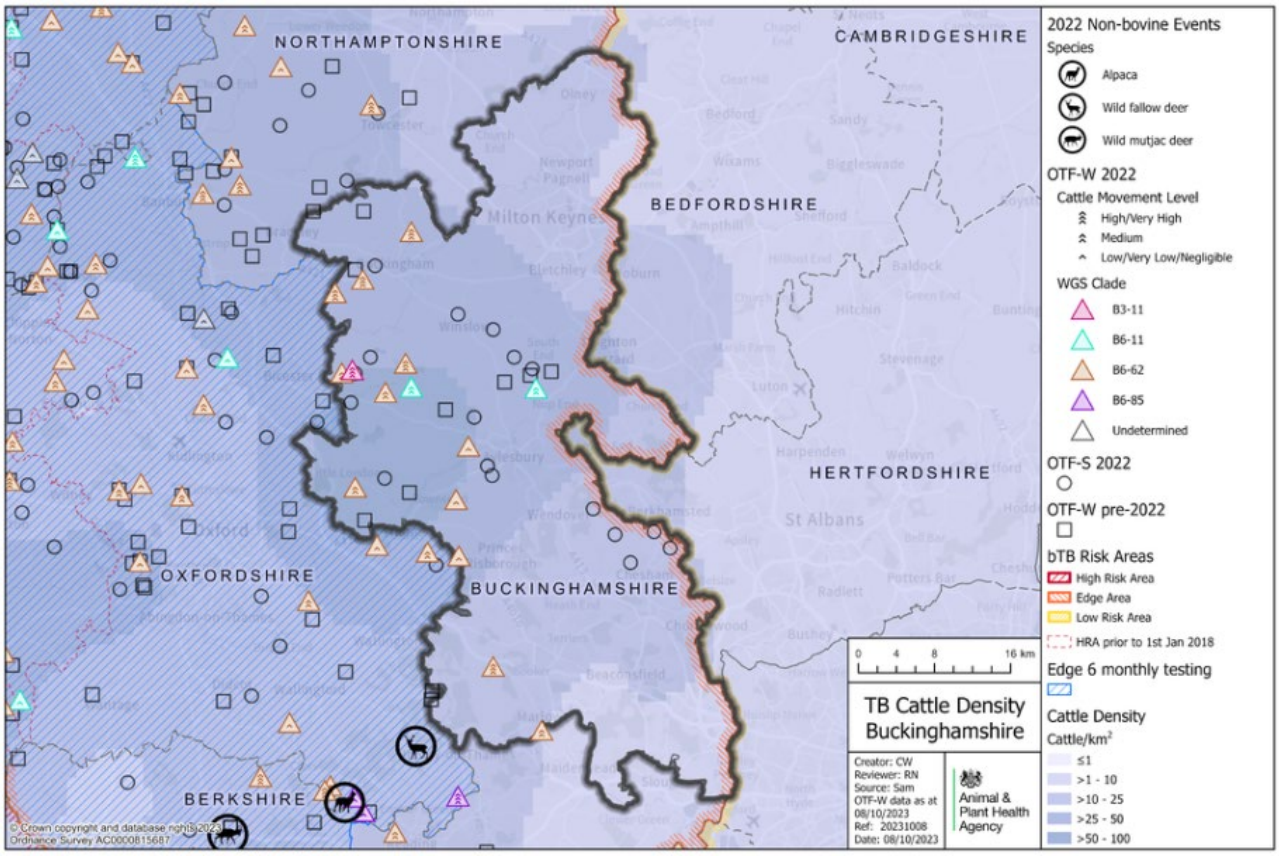

Figure 6: Location of cattle holdings in Buckinghamshire with new TB incidents (OTF-W and OTF-S) in 2022 and cattle holdings with pre-2022 OTF-W incidents still ongoing at the beginning of 2022, overlaid on a cattle density map. The movement score for each farm is symbolised with 3 chevrons for cattle movements associated with a high likelihood of infection, 2 chevrons for a medium likelihood and one chevron for a low likelihood.

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 149 cattle were removed from TB incidents in Buckinghamshire during 2022, as shown in Figure 7. The tuberculin skin test detected 96 infected animals and 53 were detected through the interferon gamma (IFN-γ) blood test. This is a marginal decrease of 5 cattle since 2021.

The proportion of skin (64%) to IFN-γ blood (34%) test reactors remained similar to 2020 and 2021.

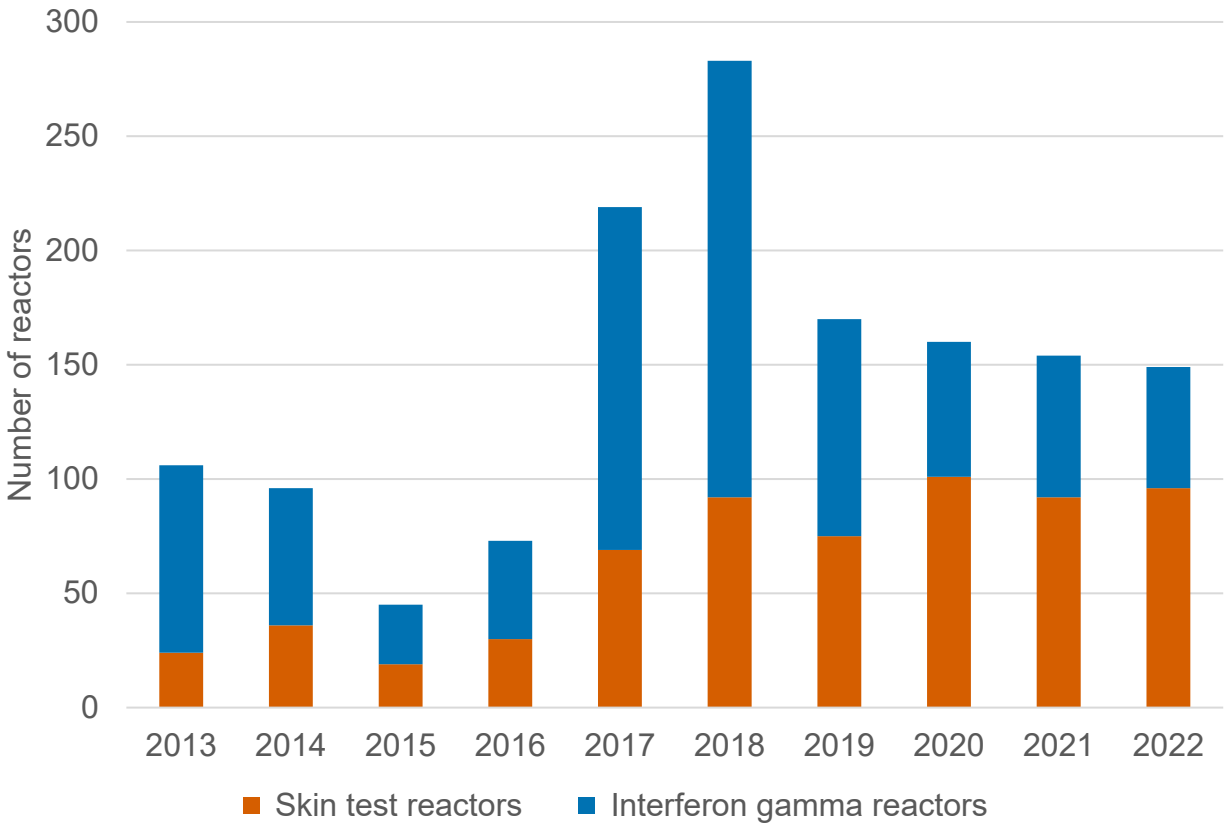

Figure 7: Number of skin test reactors (SICCT) and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Buckinghamshire, from 2013 to 2022.

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 mitigations that may reduce 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 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 2022, 9 out of 31 (29%) new TB incidents in Buckinghamshire received a preliminary or final APHA veterinary investigation to identify the source of infection. The results of these investigations are reported in Appendix 3. The small number of investigations carried out in 2022 was mainly due to the diversion of field resource to the large avian influenza (AI) outbreaks which occurred in 2021 and 2022.

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 Reservoir 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 risk score is dictated by the highest risk animal 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 Reservoir Indicator uses whole-genome sequence (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 reservoir of infection:

- 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 2022.

There is always a degree of uncertainty about the estimated routes of TB infection into a herd. The absence of a local reservoir, 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 8 provides the percentage of herds where each risk pathway combination was identified. The spatial distribution of these categories are presented in Figure 9. Each category is described in greater detail in the following text.

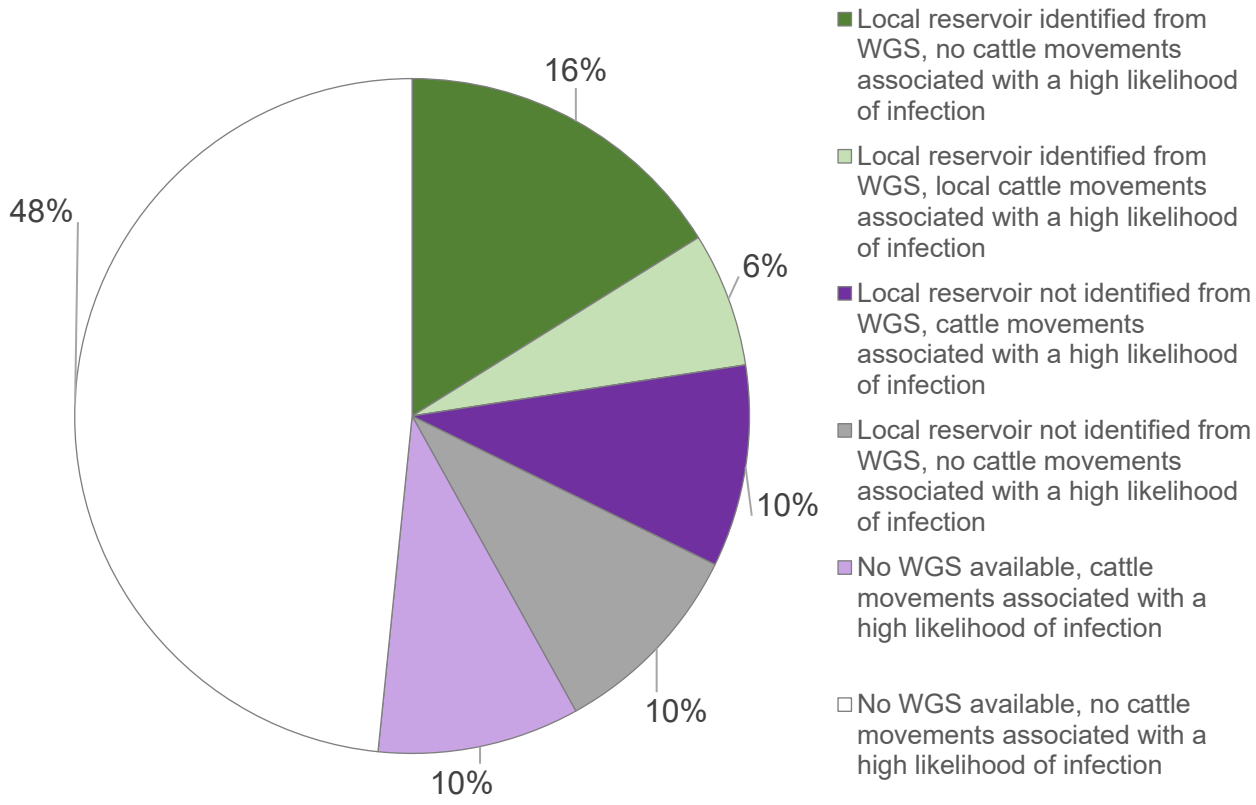

Figure 8. Risk pathway combinations identified by the WGS local reservoir indicator and cattle movement algorithm for all 31 new TB incidents starting in Buckinghamshire in 2022.

WGS data was available for 13 (42%) of all new TB incidents in Buckinghamshire. The WGS Local Reservoir Indicator identified a local reservoir of infection for 7 (22%) new TB incidents in 2022.

Of the 13 TB incidents with WGS data available, 5 had a local reservoir identified without strong evidence of cattle movements (dark green symbols, Figure 9).

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.

A further 2 TB incidents with WGS data available had evidence of both a local reservoir and local cattle movements (within 25km) associated with a high likelihood of TB infection. For these TB incidents, local cattle movements may have played a part in the spread of this local infection, in addition to the previously listed local pathways (symbolised in light green, Figure 9).

In Buckinghamshire, 3 (10%) TB incidents had evidence of cattle movements associated with a high or very high likelihood of TB infection, and no evidence of a local reservoir where WGS was available. For those herds it was considered more likely than not that

cattle movements played a part in the introduction of infection (dark purple symbols, Figure 9).

A further 3 (10%) TB incidents had cattle movements associated with a high likelihood of TB infection, but WGS data was not available to look for a local reservoir. These are depicted in light purple in Figure 9 due to the lack of genetic evidence.

For 3 (10%) other TB incidents the WGS Local Reservoir Indicator did not find evidence of a local reservoir and there was no evidence of cattle movements associated with a high likelihood of TB infection. There is uncertainty about the risk pathway for these incidents (grey symbols in Figure 9).

There was no evidence of cattle movements associated with a high likelihood of TB infiection, and no WGS available to explore the presence of a local reservoir for 15 of the 31 (48%) TB incidents. These are shown as white dots in Figure 9, as there is insufficient evidence to determine a likely infection pathway.

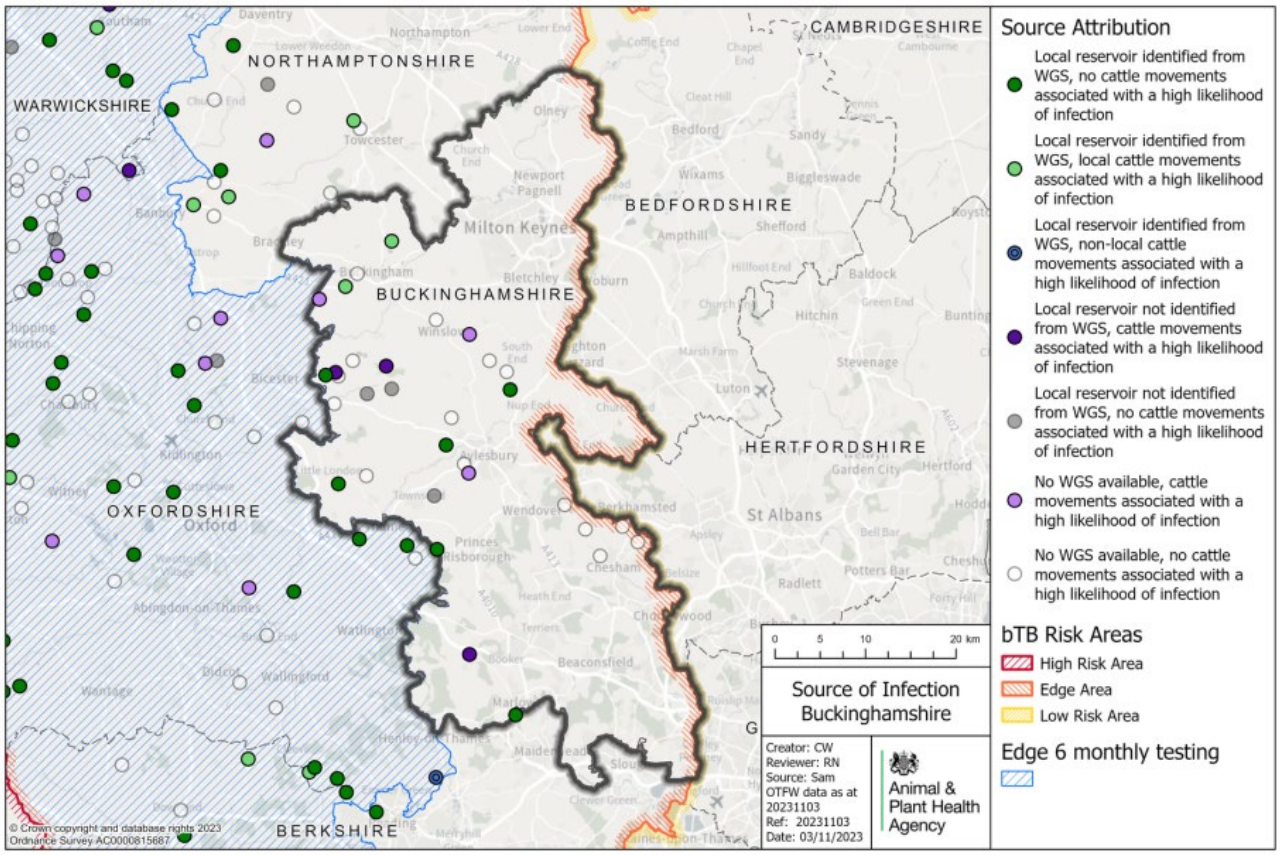

Figure 9: Map of the available evidence for risk pathways of TB infection into the herd, for all TB incidents (OTF-W and OTF-S) in Buckinghamshire that started in 2022.

Most new OTF-W incidents in 2022 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 3 OTF-W incidents with WGS clade B6-62. In both 2020 and 2021, there were also TB incidents with WGS clade B6-62 in the same area. WGS investigations have shown that at least 4 of the incidents within a 5 mile radius are closely linked genetically (within 3 SNPs), as shown in Figure 10. There were no identified direct movements of cattle between holdings in this cluster, which suggests there was a common source of infection within the local wildlife. However, indirect movement of cattle with undetected infection (cattle moved via another holding) and residual infection within the herd are plausible risk pathways for these incidents disclosed in 2022.

The new OTF-W incidents in 2022 in Buckinghamshire of WGS clade B6-62 within close proximity to the Thame-Chinnor cluster in Oxfordshire indicate that there has been spread eastwards of this cluster into this county. Adding weight to the likelihood of local wildlife being a probable source of infection is the absence of cattle movements associated with a high likelihood of infection for 2 of these holdings.

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. Previously, in 2017, a cluster of 5 OTF-W incidents with genotype 17:b of *M. bovis* was located just to the west of the 2021 cluster and, at the time, suggested possible wildlife infection within Buckinghamshire. Of these 5 incidents from 2017, WGS was carried out on 2 *M. bovis* isolates, and identified them as WGS clade B6-11. These 2 isolates were genetically very similar (within 2 SNPs) to those from the more recent incidents in 2021 located in the new cluster slightly further east. In 2022, one further OTF-W incident with WGS clade B6-11 was disclosed in the same area. This more recent isolate of *M. bovis* was very closely related to both the 2021 and 2017 isolates (0 to 2 SNPs). Cattle movements between holdings could explain some of the spread, but it is likely local wildlife also played a role.

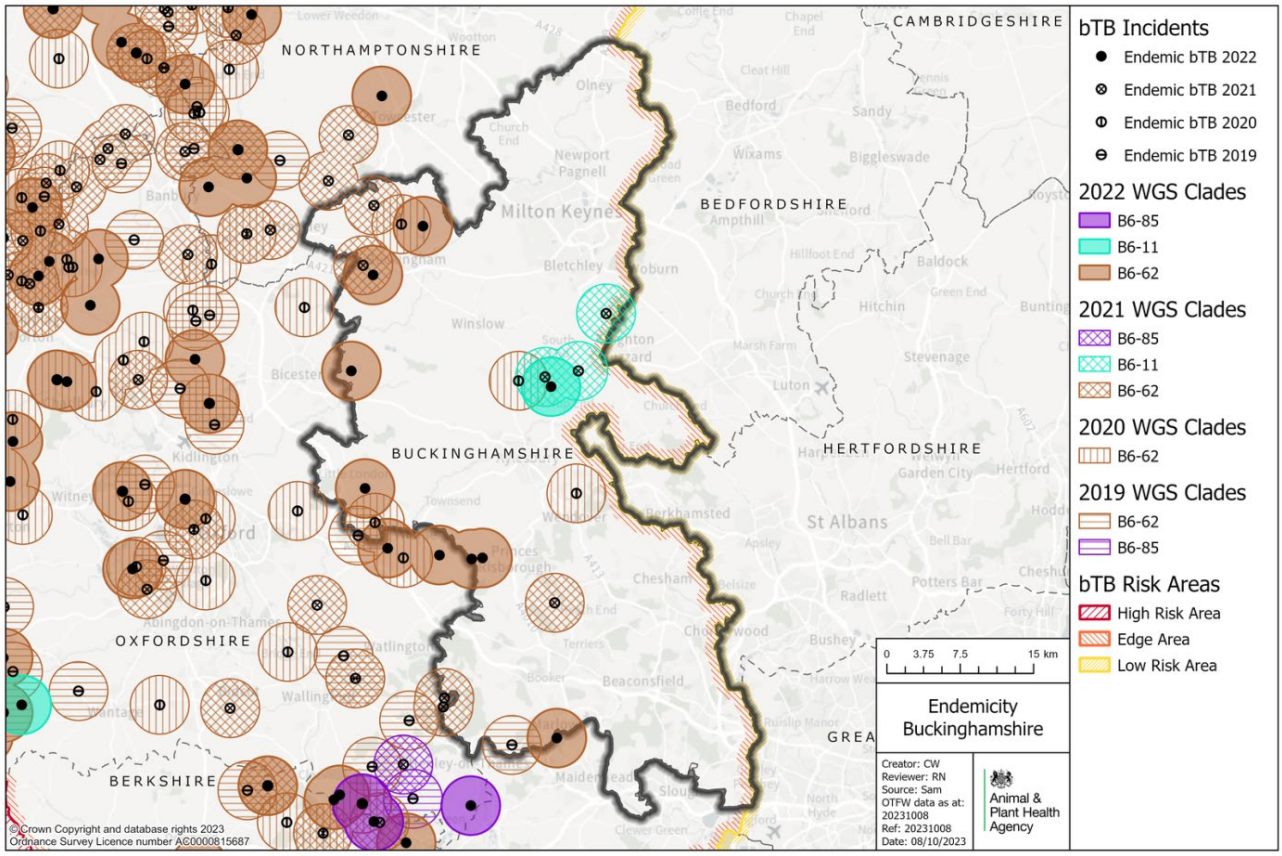

Figure 10: WGS clades of *M. bovis* detected in Buckinghamshire between 2019 and 2022, where the WGS identified in the infected herd was within 3 SNPs of another TB incident in the past 4 years and 9km (OTF-W incidents only).

Forward look

The number of new TB incidents has increased for the second consecutive year in Buckinghamshire, with OTF-W incidents doubling in 2022. Currently Buckinghamshire is not on track to achieve the target of less than 1% OTF-W herd incidence by 2025.

Purchasing of cattle from herds with undisclosed TB infection into Buckinghamshire has been, and continues to be, a major route of infection into this county. 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. Therefore, the introduction of effective wildlife interventions to prevent spread, especially from Oxfordshire and current clusters of incidents within the county, are needed. Cattle movements associated with a high likelihood of TB infection into the county also need to be addressed.

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 farm 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 2022 (RADAR data)

Size of herds	Number of herds in Buckinghamshire
Undetermined	5
1 to 50	157
51 to 100	70
101 to 200	76
201 to 350	42
351 to 500	13
Greater than 500	20
Total number of herds	383
Mean herd size	131
Median herd size	75

Table 2: Number (and percentage of total) of animals by breed purpose in Buckinghamshire as of 31 December 2022

Breed purpose	Number (and percentage of total) cattle in Buckinghamshire
Beef	40,368 (80%)
Dairy	9,096 (18%)
Dual purpose	577 (1%)
Unknown	0 (0%)
Total	50,041

Appendix 2: summary of headline cattle TB statistics

Table 3: Herd-level summary statistics for TB in cattle in Buckinghamshire between 2020 and 2022

Herd-level statistics	2020	2021	2022
(a) Total number of cattle herds live on Sam at the end of the reporting period	512	476	469
(b) Total number of whole herd skin tests carried out at any time in the period	511	554	494
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	399	400	374
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of Notice Prohibiting the Movement of Bovine Animals (TB02) restrictions)	468	438	427
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	489	457	445
(f.1) Total number of new OTF-S TB incidents detected in cattle herds during the report period (including all Finishing Units)	10	20	17
(f.2) Total number of new OTF-W TB incidents detected in cattle herds during the report period (including all Finishing Units)	11	7	14
(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?	3	1	N/A
(g.2) Of the new OTF-W herd incidents, how many were triggered by skin test Reactors or 2xIRs at routine herd tests?	3	2	N/A

Herd-level statistics	2020	2021	2022
(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	0	N/A
(g.4) Of the new OTF-W herd incidents, how many were first detected through routine slaughterhouse TB surveillance?	3	2	2
(h.1) Number of new OTF-W incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	1	2	6
(h.2) Number of new OTF-S incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	1	7	4
(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, but not including non-grazing Approved Finishing Units)	9	6	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	7	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 2020 and 2022

Animal-level statistics (cattle)	**2020**	**2021**	**2022**
(a) Total number of cattle tested in the period (animal tests)	73,862	82,938	73,525
(b.1) Reactors detected by tuberculin skin tests during the year	101	92	96
(b.2) Reactors detected by additional IFN-γ blood tests (skin-test negative or IR animals) during the year	59	62	53
(c) Reactors detected during year per incidents disclosed during year	7.6	5.7	4.8
(d) Reactors per 1,000 animal tests	2.2	1.9	2.0
(e.1) Additional animals slaughtered during the year for TB control reasons (dangerous contacts, including any first time IRs)	3	11	4
(e.2) Additional animals slaughtered during the year for TB control reasons (private slaughters)	0	1	3
(f) Slaughterhouse (SLH) cases (suspect tuberculous carcases) reported by Food Standards Agency (FSA) during routine meat inspection	7	3	4
(g) SLH cases confirmed by culture of *M. bovis*	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 cases reported are submitted for culture analysis. All cases 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 2022, 9 out of 31 (29%) new TB incidents in Buckinghamshire received a preliminary or final APHA veterinary investigation to identify the source of infection. The small number of investigations carried out in 2022 was mainly due to the diversion of field resource to the large AI outbreaks which occurred in 2021 to 2022.

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 source(s) 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 2022.

Table 5: Suspected sources of *M. bovis* infection for the 9 incidents with a preliminary or a final veterinary assessment in Buckinghamshire, in 2022.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	5	3	1	0	36.4%
Cattle movements	2	3	1	0	30.1%
Contiguous	2	0	0	0	3.2%
Residual cattle infection	2	1	1	0	19.2%
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	1	0	0	0	1.9%
Other or unknown source	0	0	0	0	9.3%

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

Data Protection:
For information on how we handle personal data visit www.gov.uk and search Animal and Plant Health Agency Personal Information Charter.

This publication is available Bovine TB epidemiology and surveillance in Great Britain.

Any enquiries regarding this publication should be sent to us at the National TB Epi Mailbox.

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