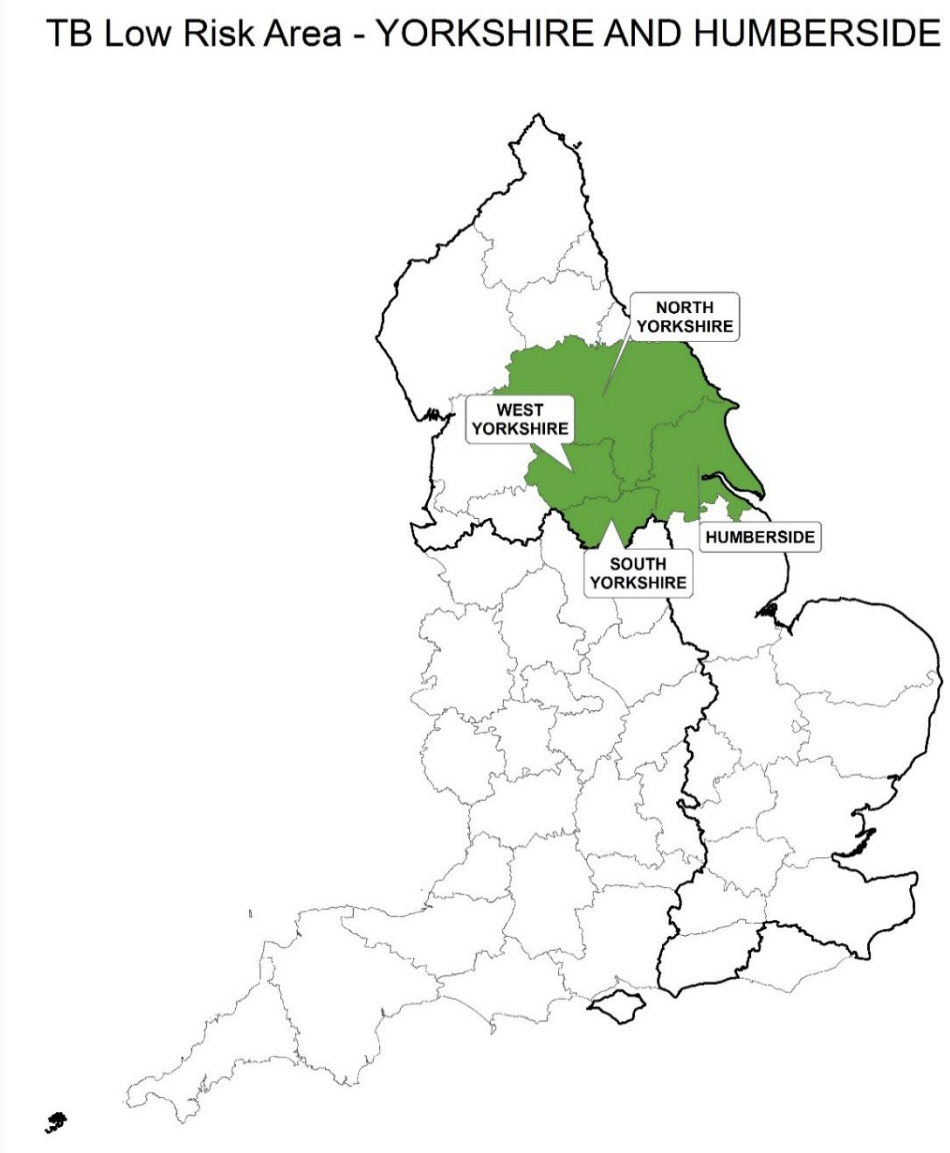
Animal & Plant Health Agency

Year-end descriptive epidemiology report: Bovine TB in the Low Risk Area of England

County coverage: Yorkshire and Humberside (including North Yorkshire, West Yorkshire, South Yorkshire, and Humberside)

Year-end report for: 2020



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Executive summary

Reporting area

Yorkshire and Humberside (including the counties of North Yorkshire, West Yorkshire, South Yorkshire, and Humberside) is part of the Low Risk Area (LRA) that was established in 2013. This area was later incorporated into the Government's strategy to achieve Officially Tuberculosis Free (OTF) status for England by 2038. Overall, the LRA has a very low and stable incidence of infected herds. This end of year report describes bovine TB (bTB) in the specified reporting area only.

Local cattle industry

The cattle industry in this region is large and diverse. The greatest proportion of herds and animals are found in North Yorkshire where several different herd sizes and production types are seen. Across the rest of the region, smaller herds generally predominate. Nearly two thirds of the animals seen across the region are beef animals, however there are a slightly larger proportion of dairy animals in North Yorkshire. The different topographical characteristics of the region mean different farming enterprises predominate in different areas, developed to maximise the efficiency of productivity in these areas. This usually results in the more intensive enterprises being found in the lowland areas, and more extensive in upland areas. The flow of animals through the region often then reflects these production types, with a faster production rate, and so more regular turnover of cattle seen in the intensive enterprises in the lowlands. This often involves the movement of cheaper animals from areas of higher TB risk. This is reflected in the distribution of livestock markets throughout the region.

There are 16 markets across the region, 12 of which are in North Yorkshire. Of these 12 markets, four have TB Approved Slaughter Gatherings and one has authorisation as a TB Exempt market. This further demonstrates the potentially high-risk routes of TB introduction into the region.

There are currently 24 Licensed Finishing Units (LFUs) across the region, of which 18 are in North Yorkshire, five in South Yorkshire and one in Humberside.

New incidents of TB

There was a total of 36 new incidents disclosed across the region during 2020 (14 OTF-W and 22 OTF-S). This was an increase from the 30 incidents disclosed during 2019 (seven OTF-W and 23 OTF-S).

In North Yorkshire there were nine OTF-W and nine OTF-S incidents disclosed during 2020, compared to four OTF-W and 12 OTF-S incidents in 2019. This adds to the increasing trend seen since 2016.

In West Yorkshire there were three OTF-W and eight OTF-S incidents disclosed during 2020. This is a large increase compared to the three OTF-S incidents disclosed during 2019. This is an area that will require further monitoring and investigation.

In Humberside there was one OTF-W and three OTF-S incidents disclosed during 2020. This is a slight increase compared to the one OTF-W incident recorded in 2019, but the overall incidence of infected herds remains stable.

In South Yorkshire, one OTF-W and two OTF-S incidents were disclosed during 2020. This is a reduction compared to what was seen in 2019 when two OTF-W and eight OTF-S incidents were recorded. During 2019 there was concern that this could represent the development of a new cluster of incidents, however the evidence from 2020 is suggestive that this is not the case, but it remains an area to monitor.

Due to the measures put in place to ensure public health safety during the COVID-19 pandemic, a substantial increase in the number of overdue TB tests was seen during 2020. This resulted in fewer animals being tested during 2020, and as such may result in larger numbers of reactors being disclosed as these overdue tests are carried out.

Potential or confirmed TB hotspot areas

Only one potential TB hotspot area was active during the reporting period in the region. HS27 was instated in January 2020 in the south-western corner of North Yorkshire along the county boundary with Lancashire, following the disclosure of several incidents in the area with an undetermined origin of infection. Since its implementation only one wild deer carcase has been submitted, with negative culture results for *M. bovis*. The additional surveillance for cattle herds in the hotspot area has also not resulted in any new TB incidents or demonstrated evidence of infection in potential wildlife reservoirs.

The development of HS28 in Lincolnshire during 2020 could pose a potential risk to the region. A very small area of this potential hotspot area spans the county boundary into Humberside. Several incidents have been identified in cattle herds in this potential hotspot area in Lincolnshire, but nothing has been disclosed in Humberside. There has also yet to be confirmation of TB in wildlife reservoirs. This however remains an area of key concern to the region.

Unusual TB incidents

An incident initially disclosed as a culture positive slaughterhouse (SLH) case resulted in an explosive outbreak, involving a herd that was grazed on common land. The animals were routinely moved from the main premises to the common land during spring/summer. The grazing is let annually to multiple cattle farmers, who may change year on year. Once on the common land, the cattle from different herds can roam freely and potentially mix and share resources. Given the extent of potential mixing of animals on the common land, following the confirmation of TB APHA traced all animals that had grazed there during the period when the reactors from the affected farm were present. APHA then instigated a skin check test of their

herds, which identified no further reactors. A radial testing zone was established around the incident premises, which, again, did not lead to any further reactors or evidence of established infection in this area. The strain of *M. bovis* isolated from the original SLH incident was genotype 65:a. This is a rare genotype nationally, but particularly in the LRA. There was no clear source of infection established or strong links with any other local incidents of this genotype.

Suspected sources and risk pathways for TB infection

From the outputs of the veterinary assessments carried out by APHA for every TB incident, the overarching conclusion is that the movement of cattle from areas outside of the region was responsible for the largest proportion of incidents during 2020. This was seen across OTF-W and OTF-S incidents.

Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement.

Disclosing tests

Across the region, both routine and targeted surveillance methods played a role in the disclosure of TB incidents. In North Yorkshire, post-movement testing led to the disclosure of the largest number of incidents. Radial testing, slaughterhouse surveillance, traced bovine testing, routine herd testing, 12-month testing, new herd testing and post-import testing all also played a role in incident disclosure in North Yorkshire.

In West Yorkshire, radial testing played the most significant role in incident detection. Post-movement and post-import testing were however also involved in detecting incidents.

Routine herd testing and slaughterhouse surveillance were key in incident detection in Humberside. Targeted surveillance through post-movement testing was also involved.

In South Yorkshire, targeted surveillance was key, with incidents being disclosed at 12-month tests, post-movement tests and traced bovine tests.

Reactor numbers

A total of 99 reactors were removed during 2020, 59 as skin test reactors and 40 as interferon gamma (IFN-γ) test positive animals. In North Yorkshire, there were 34 skin test reactors and 26 IFN-γ positive animals removed. In West Yorkshire, there were 17 skin test reactors and four IFN-γ positive animals removed. In Humberside, there were four skin test reactors and 10 IFN-γ positive animals removed. In South Yorkshire, there were only four skin test reactor animals removed.

Risks to the reporting area

Most of the boundary of the region is onto other counties of the LRA. The areas of potential concern are the southern boundary of South Yorkshire and south Humberside's boundary onto Lincolnshire. The boundary in the south of South Yorkshire onto the Edge Area counties of Nottinghamshire and Derbyshire has been an area of concern in the past. This appears to have settled down during 2020, but the proximity to areas of higher risk means this area should continue to be monitored to ensure there is no lateral spread of infection. The development of potential hotspot HS28 in Lincolnshire could pose a risk to the very south of the region. Ongoing monitoring of the development of the situation in HS28 will provide key information as to the potential risk of infection introduction into Humberside.

Several TB incidents in the region during 2020 were attributed to the movement of infected cattle from higher TB risk areas of GB. Multiple incidents involved the same routes, via the same markets. Whilst there are likely to be lots of markets involved in facilitating the movement of these animals from areas of higher risk into this region, the drivers behind the behaviours leading to such purchases should be considered and how these may be altered to limit the introduction of infection into the region.

Risks posed by the reporting area

A large proportion of confirmed incidents in the region were concluded to involve the introduction of TB through the movement of animals into the region. There has been limited evidence to suggest any lateral spread of infection from these incidents and so the likelihood of an endemic reservoir developing, that could pose a risk to neighbouring regions is very low. The apparent cluster of incidents developing in West Yorkshire could potentially pose a risk to neighbouring regions if firm epidemiological links are detected, or a wildlife reservoir is found to be involved. There is however no evidence to suggest this at this time.

The overall risk of TB spread posed from the region to neighbouring regions is therefore negligible.

Forward look

The ongoing implementation of routine and targeted surveillance methods is critical in enabling Yorkshire and Humberside to maintain its low incidence of TB. Radial testing, post-movement and traced bovine tests remain key in the prompt disclosure of incidents and limitation of potential further spread. The combination of these different testing regimes alongside routine surveillance through four-yearly testing of herds and SLH surveillance of all the cattle entering the human food chain is vital in order to monitor the incidence of infected herds and effectively control the introduction and spread of infection across the region. This annual report highlights that the major risk factor to the introduction of infection into this region is through the purchase of animals from higher risk areas of the country. This is something that needs continued publicity and education to the industry to ensure that everyone is equally aware of, and aims to minimise, the risk from purchasing animals. This,

coupled with further education on good biosecurity practice, will help to maintain and reduce the low incidence of TB we currently enjoy across the region.

Introduction

This report describes the level of bovine tuberculosis in cattle herds in Yorkshire and Humberside (including the counties of North Yorkshire, West Yorkshire, South Yorkshire, and Humberside) in 2020. Bovine tuberculosis is caused by the bacterium *Mycobacterium bovis* (*M. bovis*) and will subsequently be referred to as TB. This report explores the spatial and temporal distribution of TB in cattle herds. It examines what is likely to be driving TB in this area, and the risks the disease in this area may pose to neighbouring cattle. Although other sources may refer to TB 'breakdown(s)', this report will use the term 'incident(s)' throughout. This report is intended for individuals involved in the control of TB, both in the local area and nationally. This includes, but is not limited to: farmers, veterinarians, policy makers and the scientific community.

In 2014 the Government published its 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. To this end three management areas were established (see Appendix 1). Yorkshire and Humberside forms part of the Low Risk Area (LRA). Overall, the LRA has a very low and stable incidence of infected herds. The current strategy seeks to rapidly control infection when it arises through high sensitivity testing of affected herds and temporarily enhanced local surveillance (radial and hotspot testing). Mandatory pre- and post-movement testing of cattle entering the LRA from higher risk areas of the UK is also performed to reduce the risk of TB introduction. The aim is to preserve the favourable disease status of this area so that its counties can be declared OTF as soon as possible.

Changes due to COVID-19

During 2020, public health measures adopted by the government to contain the COVID-19 outbreak impacted the ability to carry out some TB testing due to social distancing and self-isolation guidelines, affecting both veterinarians and farmers. In particular, from 23 March 2020, routine or targeted TB skin tests were not mandatory for cattle under 180 days old where, in the official veterinarian's judgement, the young stock could not be tested safely in line with social distancing guidelines. The temporary amendment allowing calves under 180 days old to be excluded from TB testing did not apply to short interval tests in TB incident herds (required to restore a herds OTF status) or pre- and post-movement testing.

Routine TB skin tests are required within a pre-defined window of time to maintain a herds OTF status. From 23 March 2020, for tests that were allocated until 30 June 2020, APHA permitted an extension to the TB skin testing windows on a case-by-case basis, where testing had not been completed due to valid reasons associated with COVID-19. The testing window for short interval tests was also extended by up to 30 days, where tests were unable to be completed due to COVID-19.

Furthermore, on-farm epidemiological assessments carried out to establish the route of infection for a TB incident herd were carried out remotely, by telephone, for the majority of 2020.

Cattle industry

Herd types

The cattle industry across Yorkshire and Humberside is large and diverse. Over 60% of the registered holdings across the region are found in North Yorkshire (Table A2.1). After this, 19% of registered holdings are found in West Yorkshire, 13% in Humberside and 8% in South Yorkshire. Smaller holdings, of less than 50 animals, are the most common herd structure across all counties in the region (Figure 1), with the median herd size across Humberside, South Yorkshire and West Yorkshire all being 50 animals or fewer (Table A2.1). In North Yorkshire a wider variety of herd structures are seen and although the most common herd size is 1-50 animals, there is a greater number of larger herds, making the mean herd size 120 animals. The geographical proportion of the region that North Yorkshire occupies is considerably larger than other counties in the region. This in part accounts for the larger number of herds, and animals, seen in the North Yorkshire, however there is also a greater density of cattle in this county compared to much of the rest of the region.

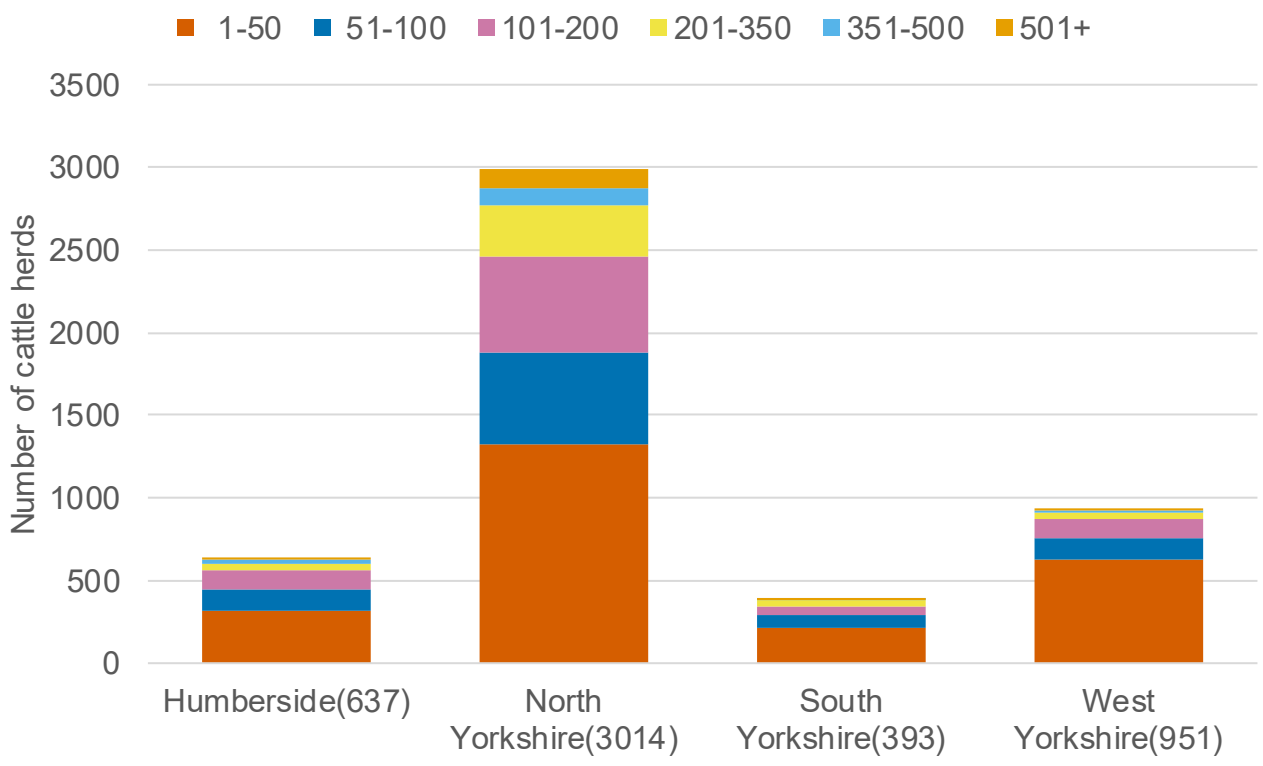

Figure 1: Proportion of cattle holdings in Yorkshire and Humberside, by herd size and county in 2020.

Across the region, the total number of registered cattle holdings has fallen since 2019, with 67 fewer herds registered at the end of 2020. This is seen across the region, with a reduction of approximately 1% in registered herds in Humberside, North Yorkshire, and West

Yorkshire. The number of registered herds in South Yorkshire has however remained more stable, with only one additional herd registered during 2020. Despite these minor changes, the average herd sizes have remained stable across the region. This represents an ongoing steady decline in overall numbers of registered herds across the region, but with the structure of the herds remaining constant.

Over two thirds of animals across the region are registered as beef breeds and just under one third registered as dairy breeds. The remaining animals are registered as dual-purpose breeds (Table A2.2). The proportions of beef and dairy animals seen in specific counties of the region changes slightly. In Humberside, South Yorkshire, and West Yorkshire almost three quarters of animals are beef breeds and just under one quarter dairy. In North Yorkshire, however, a higher proportion of dairy animals are seen, with 34% of animals registered as dairy breeds and 62% as beef breeds. These numbers are in line with what was seen in 2019, indicating stability in the type of production across the region.

The variation in herd structure and function seen across the region is likely to represent its geographical and topographical diversity. Traditional farming practices involve housing cattle during winter, followed by the turnout onto pastureland during summer, allowing farmers to maximise the use of grassland. This is however highly weather dependant, and many of these more traditional enterprises must absorb the additional costs of bedding and feed required during prolonged winter periods, reducing potential profits.

Frequently, larger beef enterprises have developed alongside arable enterprises in the lowland areas of the region. This allows them to take advantage of the abundant by-products of the arable industry (e.g., straw) and rear beef in a more intensive manner, often with the animals remaining housed all year round. The faster production times of these enterprises results in more rapid turnover of stock and these enterprises are often responsible for a large proportion of the movement of animals into the region, particularly those from areas of higher risk with regards to TB infection status. The animals brought in from areas of higher risk are often cheaper than animals of the same production status from local farms and are either purchased from markets in the Edge/High Risk Area (HRA) or are brought from these areas to markets in this region.

The areas of higher ground across the region (e.g., moorland) are often less productive and require more extensive management. Large proportions of these upland areas are used for common grazing. Although these areas represent a small proportion of the overall grazing land across the region, the potential mixing of multiple herds presents a risk to the spread of TB.

Markets and abattoirs

There are 16 livestock markets across the region. Of these, 12 are in North Yorkshire, two in Humberside and two in West Yorkshire. This is a likely representation of the flow of animals into and around the region, and highlights where in the region the more intensive production enterprises are likely to be found.

Of the livestock markets in the region, there are four TB Approved Slaughter Gatherings and one TB Exempt Market, all of which are found in North Yorkshire. The regulations around TB Approved Slaughter Gatherings in the LRA were amended on 31 August 2020 to gain better control over the movement of TB-restricted animals into markets in the LRA.

This means that since this change, TB Approved Slaughter Gatherings in the LRA are now only permitted to accept animals from LFUs and can no longer accept animals from Approved Finishing Units (AFUs) or from TB incident herds, irrespective of their location in GB. This amendment should help to minimise the risk of these markets acting as a potential route of TB introduction and spread in the region, as LFUs are only permitted to exist in the LRA and must only source animals from OTF herds.

There are no slaughterhouses in Yorkshire and Humberside contracted to process TB reactor animals. This eliminates the risk of potential transmission of disease posed by transporting TB infected animals through the region, even when the final destination is the slaughterhouse.

Licensed Finishing Units

There are 24 LFUs located across Yorkshire and Humberside, 18 in North Yorkshire, five in South Yorkshire and one in Humberside. These units aim to provide bio-secure conditions for the indoor rearing of particularly risky cattle from OTF herds, where the sole output is fattening animals direct to slaughter.

During 2020, there were two culture positive slaughterhouse cases (SLH) that originated from LFUs. Due to the requirement for these units to be completely wildlife proof and bio-secure, no further disease investigation was carried out at these units or in the locality surrounding them.

Common land

There are 773 parcels of common land located across the region. These can present a risk to the spread of TB as there are often cattle from several different holdings mixing freely on the land. Due to the location in the LRA, there is not usually a requirement for animals to be pre-movement tested prior to going to the common land. This combined with the routine testing interval of 48 months across the region, means the current TB infection status of the animals is often not known at the time when they enter the common land. This can present as a significant challenge and require substantial additional testing if a reactor is confirmed having been present on the common land.

During 2020 there was one OTF-W incident where the reactor had recently grazed on common land.

Descriptive epidemiology of TB

Temporal TB trends

Unless otherwise specified, this report includes all new TB incidents detected during the reporting period. This includes 'officially tuberculosis free status withdrawn' (OTF-W) incidents and 'officially tuberculosis free status suspended' (OTF-S) incidents. OTF-W incidents are those involving one or more test reactors with typical lesions of TB identified at post-mortem, and/or one or more animals with *M. bovis*-positive culture results from tissue samples. OTF-S incidents are triggered by reactors to the Single Intradermal Comparative Cervical Tuberculin (SICCT) skin test, but without subsequent detection of lesions or positive culture results in any of those animals.

There was a total of 36 incidents (14 OTF-W and 22 OTF-S) across the region in 2020 (Table A3.1). This was a slight increase from what was seen for the same reporting period of 2019, when a total of 30 incidents (seven OTF-W and 23 OTF-S) were reported.

During 2020, the largest number of incidents (18) were reported in North Yorkshire (nine OTF-W and nine OTF-S). This is a slight increase from what was seen in 2019, when a total of 16 incidents were reported (four OTF-W and 12 OTF-S). It also adds to an increasing trend has been emerging since 2016 (Figure 2a). Whilst this increasing trend is an area of potential concern, and one that will be monitored, the overall higher incidence of infected herds seen in North Yorkshire, relative to other counties in the region is likely to be due to the greater numbers of herds and higher cattle density in North Yorkshire.

There was a total of four (one OTF-W and three OTF-S) incidents in Humberside during 2020. Whilst this is higher than what was seen in 2019, when only one OTF-W incident was reported, it is in line with what has been seen over recent years (Figure 2a).

In West Yorkshire, 11 (three OTF-W and eight OTF-S) incidents were recorded during 2020. This is a large increase compared to what was seen in 2019 across the region. It also demonstrates an increasing trend in the incidence of infected herds since 2016 (Figure 2b). The OTF-W incidents recorded during 2020 were the first confirmed incidents recorded in this county since 2016 and represents an area of concern in the region. This sharp increase in incidents will require ongoing monitoring to ensure that this upward trend does not continue, and that incident numbers, especially OTF-W ones, are reduced.

There were only three (one OTF-W and two OTF-S) incidents reported in South Yorkshire. This was the lowest incidence of infected herds at county level seen across the region in 2020. This is a considerable reduction from what was seen in 2019, when ten incidents were reported (two OTF-W and eight OTF-S). Longer term, it represents a slight downward trend, with occasional peaks, seen since 2015 (Figure 2b). This is something requiring ongoing monitoring, to ensure that this downward trend remains and that any further incident spikes, such as that seen in 2019, are avoided.

During 2020, measures were put in place (including reduced requirements to test younger animals and changes in the process of referral to the paying agencies for overdue tests) to

maintain human health and safety during the COVID-19 pandemic. This resulted in fewer animals being tested during 2020 and a substantial increase in the number of overdue TB tests was seen. As such a larger number of animals are likely to be tested to overcome these overdue tests and so there is the potential that a larger number of reactors will be disclosed as these overdue tests are carried out.

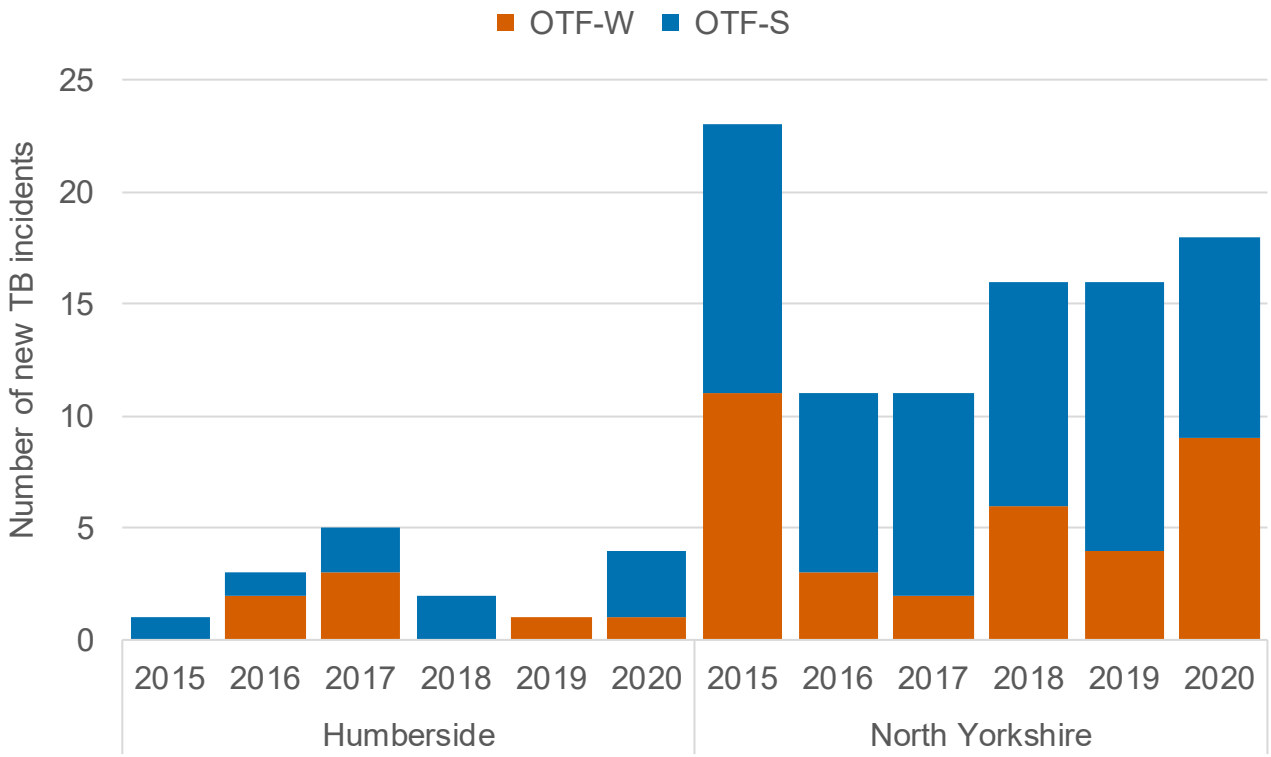

Figure 2a: Annual number of new TB incidents in Humberside and North Yorkshire, from 2015 to 2020.

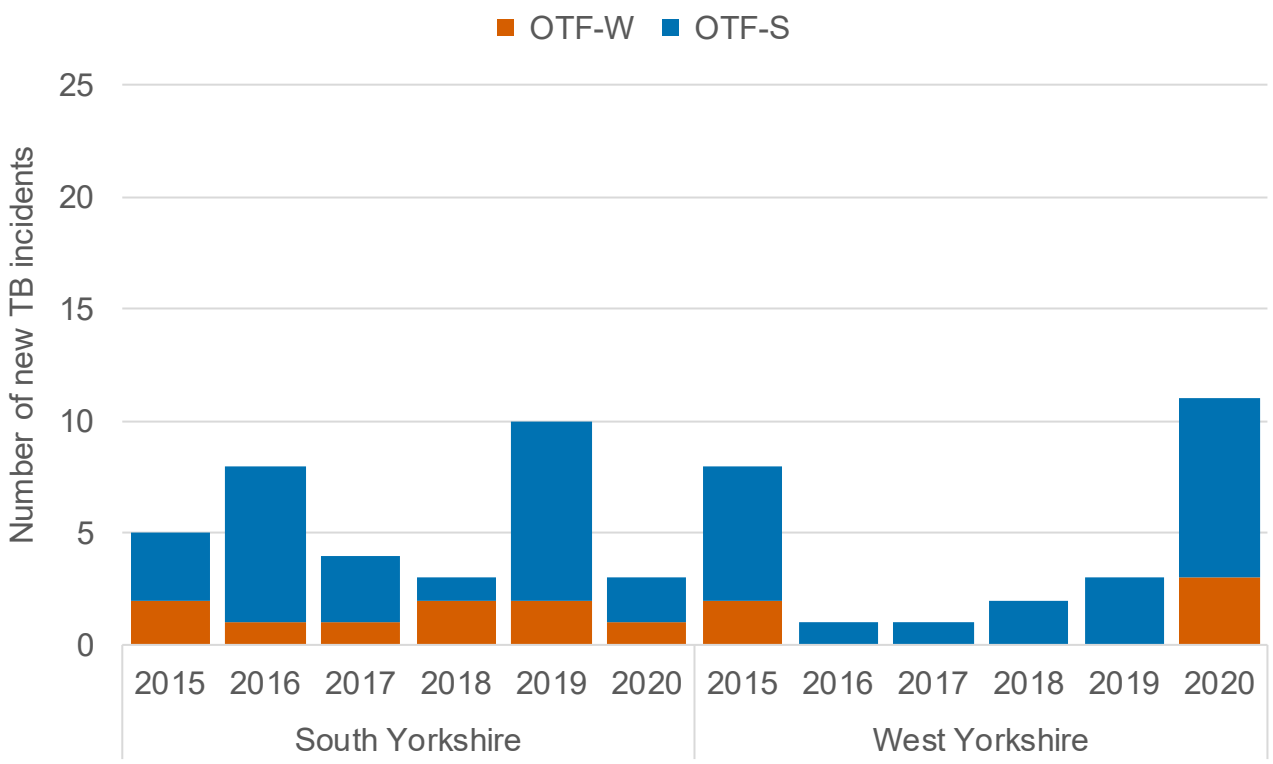

Figure 2b: Annual number of new TB incidents in South Yorkshire and West Yorkshire, from 2015 to 2020.

Geographical distribution of TB incidents

Across the region, the overall distribution of incidents is similar to what has been seen in previous years, and generally mirrors the areas of greater cattle density.

North Yorkshire

The highest number of incidents was detected in North Yorkshire. As shown in Figure 3, the overall size of North Yorkshire and larger areas of higher cattle density in this county are likely to account for the large number of incidents. Importantly, there has not been a marked change in the distribution of incidents across North Yorkshire, with most incidents occurring in the areas of higher cattle density.

Figure 3 demonstrates that in all except one incident in North Yorkshire it has been concluded that infection was likely to have been introduced through the movement of cattle into the region. The areas of higher cattle density are likely to be home to enterprises with more intensive cattle businesses (e.g., contract rearing young stock, fattening cattle), which often involve a more rapid turnover of stock and the purchase of a large number of animals. This often results in the movement of a large number of animals from the higher TB risk areas of GB and the subsequent increased risk of TB introduction.

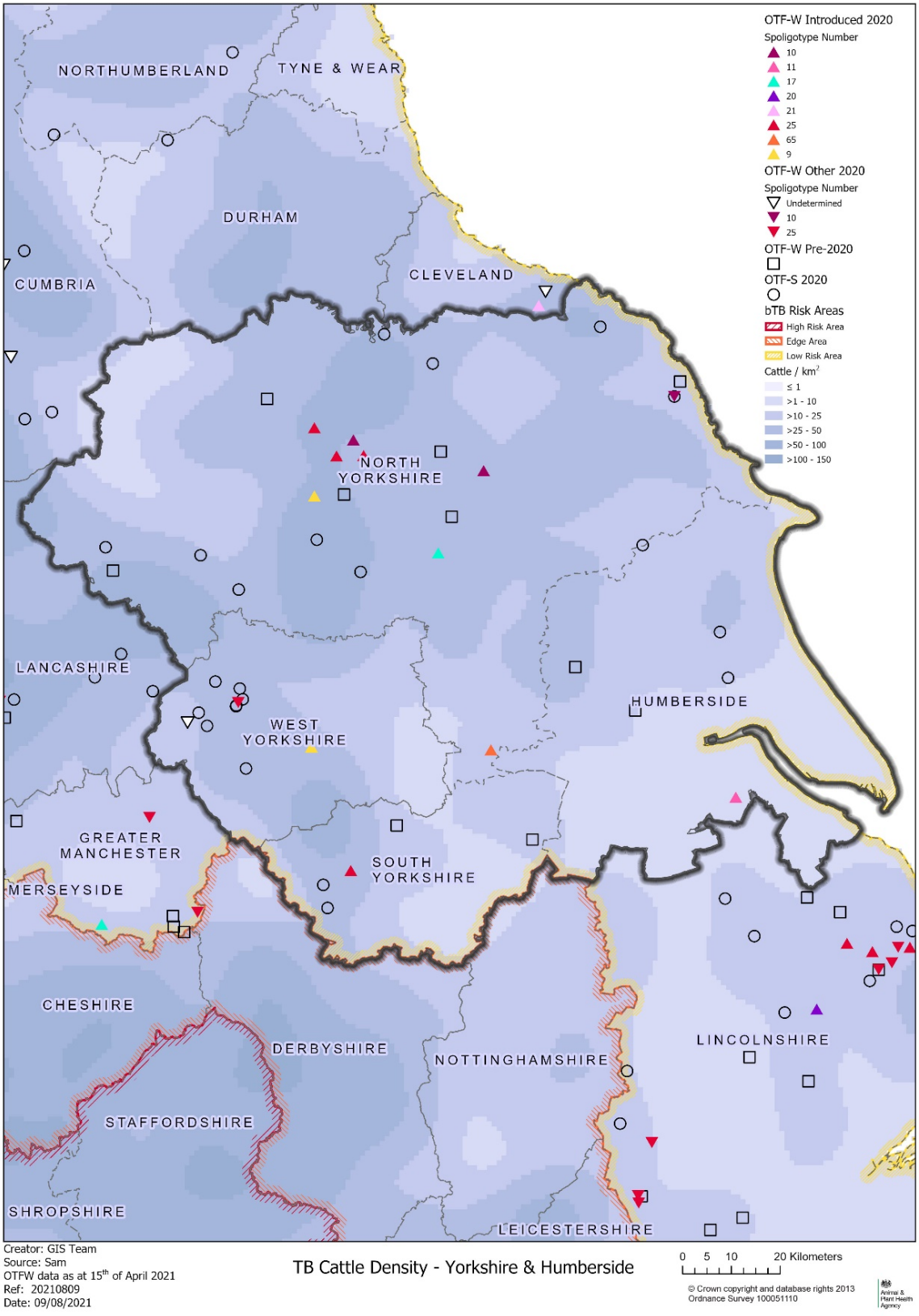

Figure 3: Location of cattle holdings in Yorkshire and Humberside with new TB incidents (OTF-W and OTF-S) in 2020, and cattle holdings with pre-2020 OTF-W incidents still ongoing at the beginning of 2020, overlaid on a cattle density map. Note: 'OTF-W Introduced 2020' refers to OTF-W incidents in which introduction of infection through cattle movements was the most likely source identified.

It is vital that in situations where infection has been introduced into an area it is promptly detected and necessary control measures put in place to ensure any potential lateral spread is contained. As can be seen from Figure 3, there have been no further incidents detected around the OTF-W incidents that were attributed to the introduction of infected cattle. This is very positive and helps to maintain the OTF nature of the county.

There was one incident in the east of North Yorkshire where TB was not considered to be introduced through the movement of cattle but was thought to potentially have a more local origin. This incident was initially detected through a radial (RAD) test, initiated by an OTF-W incident in 2019. The genotype detected from the index incident in 2019 was however different to that detected in the 2020 incident, and so there is limited epidemiological evidence to link the two incidents.

There was also a subsequent OTF-S incident detected on a cattle holding that was included in the RAD testing zone for the 2019 and 2020 incidents. This OTF-S herd was contiguous to the 2020 incident and so additional testing requirements were put in place to ensure an accurate picture of TB status was established. Despite the presence of reactors, disease was not confirmed at this contiguous premises and there was no strong epidemiological evidence to suggest further local spread of infection. This remains an area to monitor to ensure that no further incidents are detected from the ongoing RAD testing.

West Yorkshire

Whilst the incident distribution seen in North Yorkshire is largely in line with what would be expected, there have been changes in the geographical distribution of incidents occurring across other parts of the region during 2020.

In West Yorkshire there were three OTF-W incidents and eight OTF-S incidents. In one of the OTF-W incidents, it was concluded that infection was introduced through the movement of cattle. RAD testing was put in place around this incident and no subsequent incidents have been detected. This demonstrates the importance of RAD testing to ensure there is no lateral spread of infection.

The remaining two OTF-W incidents, near the county boundary with Lancashire, are of greater concern as there is limited evidence to suggest that these incidents originated from the introduction of infection through the movement of cattle into the area. From the RAD testing implemented around these two incidents, seven subsequent incidents have been detected (Figure 3). This highlights an area of increasing concern in this county.

South Yorkshire

In South Yorkshire, the geographical distribution of incidents has reduced. During 2019 there was concerns about a potential cluster of incidents developing close to the county border with Derbyshire, which is part of the Edge Area. However, those concerns have not materialised, with only two OTF-S incidents detected in this region during 2020 (Figure 3). The one OTF-W incident disclosed during 2020 in this county was likely to have been triggered by the introduction of infection through the movement of cattle into the area. There have also been

no subsequent incidents detected through RAD testing and so limited evidence of lateral spread of infection. This further adds to the evidence that the potential for a reservoir of infection to have developed in this area is low.

Humberside

In Humberside, the one OTF-W incident in the county was in an area of low cattle density. It was however concluded that the most likely route of the introduction of infection was through the movement of cattle into the area. Importantly RAD testing around this incident has not led to the disclosure of any subsequent incidents.

The other three OTF-S incidents detected in this county were in areas of higher cattle density. It is of note that one of these OTF-S incidents had close epidemiological links to an OTF-W incident in North Yorkshire. There was limited evidence to suggest the incident in North Yorkshire was attributed to the movement of cattle into the area, but there were regular movements of animals between the holdings in North Yorkshire and Humberside, so the two premises could not be considered as epidemiologically distinct. Whilst *M. bovis* infection was only confirmed on the premises in North Yorkshire, due to the regularity of movements between the premises and the lack of distinction in farming practices, 3km RAD zones were put in place around both premises. This has not led to the disclosure of any further incidents in Humberside.

Across the region, RAD testing has remained in place for confirmed incidents from 2019. As can be seen from Figure 3, other than the incident already discussed in North Yorkshire, there have not been any clusters of new incidents around these 2019 incidents. This provides further evidence of very limited lateral spread of infection in the region.

Potential or confirmed TB hotspot areas

Radial zones were established around most OTF-W incidents in the region during 2020. These zones involve additional surveillance of all cattle premises within 3km of the holding affected by the confirmed incident. This targeted enhanced TB surveillance is vital to detect any potential lateral spread of and gain control where necessary of TB following a confirmed incident.

In most parts of the region no new incidents have been detected from RAD zones put in place around 2020 incidents, but RAD testing from zones that were initiated in 2019 have led to the disclosure of incidents. In West Yorkshire, however, two of the RAD zones activated in 2020 near the county boundary with Lancashire (Figure 4) have led to the disclosure of seven OTF-S incidents. This remains an area of key focus in the region to fully establish any potential epidemiological relationships between these incidents.

Potential hotspot area (HS27)

During 2020, there was only one potential hotspot area active in the region. HS27 was located across the western boundary of North Yorkshire, spanning into Lancashire (Figure 4).

This potential hotspot area was initiated in January 2020 for 12 months, following the disclosure of a series of incidents around this area with an undetermined origin of infection. The establishment of this potential hotspot area has meant ongoing surveillance of cattle herds, with additional wildlife surveillance measures in place.

Since its implementation only one wild deer carcase has been submitted for post-mortem examination and *M. bovis* culture at APHA, with negative results. The additional surveillance of cattle herds in the area has also not resulted in any new TB incidents or demonstrated any further evidence of potentially infected wildlife reservoirs.

Potential hotspot area (HS28)

Potential hotspot HS28 was initiated in October 2020 in north-east Lincolnshire. Its northern perimeter barely spans the boundary into the far south of the Humberside.

Whilst there have been several new incidents in cattle herds in the Lincolnshire portion of HS28, *M. bovis* infection has yet to be confirmed in local badgers or wild deer.

There have not been any incidents disclosed in the small area of this potential hotspot in Humberside. This is however an area that could become a potential threat to the region.

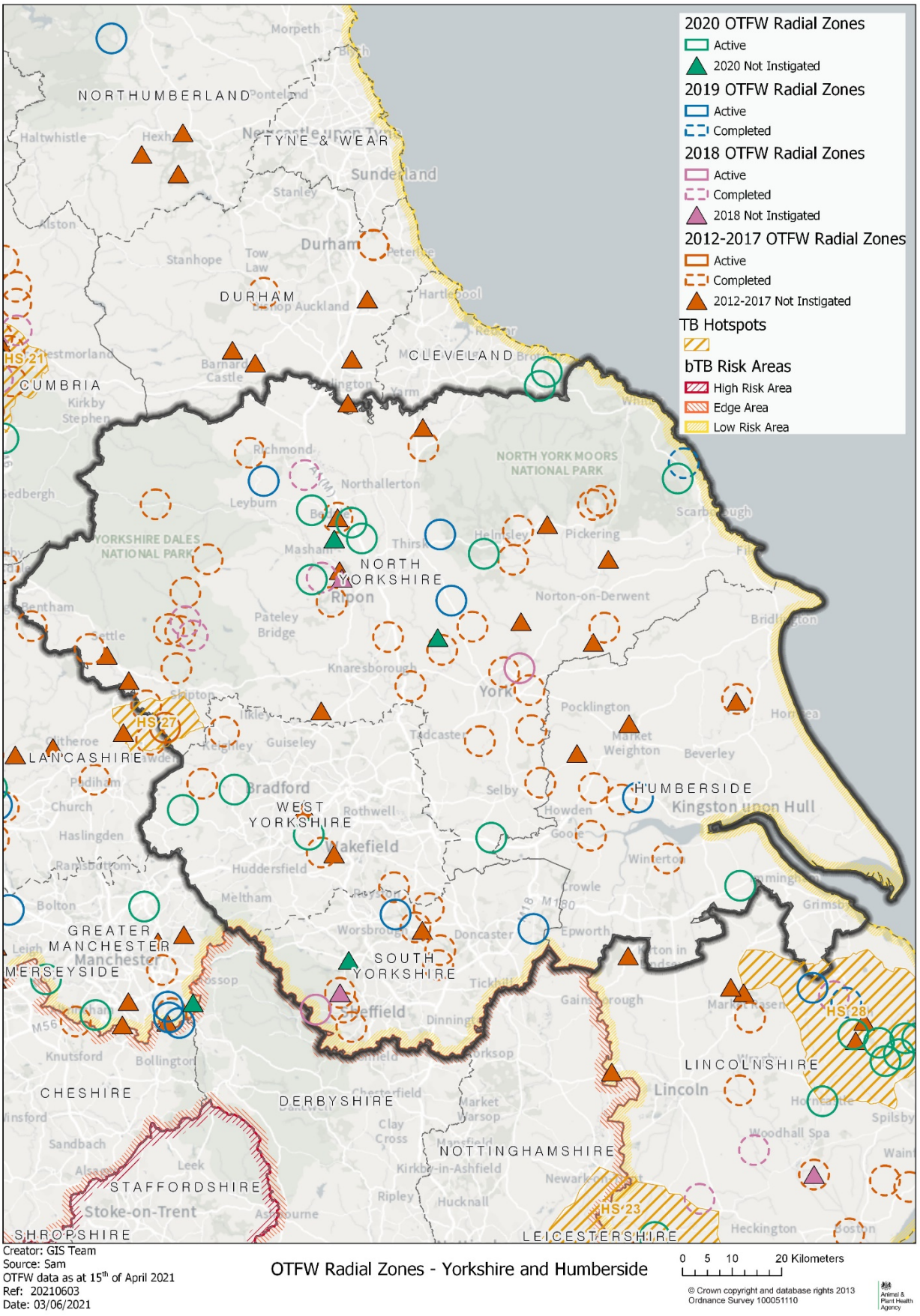

Figure 4: Potential hotspot areas and OTF-W radial surveillance zones that were active, completed or not instigated in Yorkshire and Humberside during 2020, by year of initiation.

Other characteristics of TB incidents

Unusual TB incidents

During 2020 a TB incident occurred in North Yorkshire involving a particularly large number of reactors. The incident was initially disclosed as a culture positive SLH case, which led to the herd having its OTF status withdrawn. At the initial short interval test (SIT), a total of nine skin test reactors and one inconclusive reactor (IR) were disclosed out of 39 animals tested (23% of the herd). Of these initial reactors, six were found to have visible lesions of TB at post-mortem examination (PME). A further eight animals were found to be positive on the initial supplementary IFN-γ test. The herd in question was a small-scale beef fattening enterprise, with regular movements on and off farm. Cattle were generally purchased from markets between 42 days old to 15 months old, predominantly from the LRA. The culture from the initial SLH case revealed a rare genotype of *M. bovis* in GB (65:a).

As well as the large number of reactors disclosed in this incident, the herd also routinely used common land in Humberside from Spring to mid-Autumn. The common land is run by a graziers committee, who employ a stockman to oversee the day-to-day care of the animals on the common. The grazing is let annually to multiple farmers, but the group of farmers that graze cattle on the common each year is not consistent. Once on the common land, the cattle from different herds can roam freely and mix and share resources.

During 2020 grazing season there were approximately 250 cattle from six herds across North Yorkshire, West Yorkshire, and Humberside present alongside the reactors on the common land. In the LRA there is no requirement to pre-movement test animals before they are moved to common land, or before they return to their permanent holdings, and all the cattle originated from holdings on a 48-month routine testing interval. The TB status of the animals before turnout on the common was therefore unknown. As the reactor animals had been both housed and grazed on the common land prior to disclosure, it could not be confirmed if infection was likely to have occurred on the main premises or during grazing on the common. Due to the risk of disease transmission at the common land, APHA instructed a check test (CT) on all the herds that had shared the common land with the reactors. This did not lead to the disclosure of any further reactors. A RAD zone was put in place around the TB incident holding in North Yorkshire, which did not lead to the disclosure of any further reactors.

Limitations in epidemiological evidence available makes it difficult to confirm the route of infection, especially when a rare genotype is involved. However, given the farming practices in place, alongside the use of common land, the most likely route of infection introduction was concluded to be through the movement of animals from the LRA or contiguous contact with other cattle. This incident helps to highlight several risks to TB control in the region. Due to the location in the LRA, there is no requirement for cattle to be pre-movement tested, including prior to moving onto the common land (unless the herd of origin is under a permanent or temporary annual testing regime). When this is combined with a routine herd testing interval of 48 months, it can sometimes be nearly four years since the TB status of an animal going onto the common land was last established. The groups of cattle which use the common land are also not stable, so year on year there may be different groups mixing. The

lack of clarity around the disease status of these animals prior to grazing is of concern and could result in dissemination of infection in the worst-case scenario.

Duration of TB restrictions

The duration of TB restrictions for an incident depends on the disclosure of subsequent reactors or inconclusive reactors and any evidence of lateral spread of infection within the herd detected through incident investigation testing. Follow-up herd testing cannot take place until a specific time period has elapsed following the removal of the reactor(s). This deferral ensures that most animals that may have been exposed to *M. bovis* from the reactor(s) have had enough time to develop an immune response to allow them to react to the skin test. In the LRA, all OTF-W incidents are required to undertake a minimum of two consecutive clear skin tests as well as an IFN-γ blood test before the restrictions can be removed. This requirement for additional testing therefore means that OTF-W incidents generally take longer to resolve than OTF-S incidents. This is still however dependent on the degree of lateral transmission in the herd, and so the more complex incidents with additional reactors take longer to resolve.

During 2020, the average duration of restrictions that were in place for in North Yorkshire for an OTF-S incident was 97 days (Figure 5a). This compared to 122 days in South Yorkshire and 103 days in Humberside (Figure 5b). Although OTF-S incidents were disclosed in West Yorkshire, none of these had had restrictions removed by the end of 2020, and so the incident duration could not be established.

As expected, the duration of restrictions on OTF-W incidents across the region was consistently longer than OTF-S incidents. The longer durations of OTF-W incidents mean many of those disclosed during 2020 remained open at the end of the year, and so these durations will reflect incidents that may have been initiated in 2019. The duration of restrictions for OTF-W incidents was longest in West Yorkshire.

As can be seen from Figure 5b, there was only one OTF-W incident that resolved during 2020, and restrictions in this case had been in place for 298 days. This OTF-W incident involved the detection of additional skin test reactors and gamma positive animals. Additional testing would therefore have been scheduled which would have prolonged the incident.

The duration of incidents in North Yorkshire and Humberside was very similar (Figure 5a), although only one incident was closed in Humberside in 2020, compared to four in North Yorkshire. The similarity in durations of these incidents is likely to reflect the overall nature of the incident with limited evidence of lateral spread.

This is demonstrated by the similarity in reactors disclosed per incident in Table A3.1, where an average of 3.50 reactors were seen per incident in Humberside, compare to 3.33 in North Yorkshire. There is no information about incident duration for South Yorkshire as no OTF-W incidents were resolved during 2020.

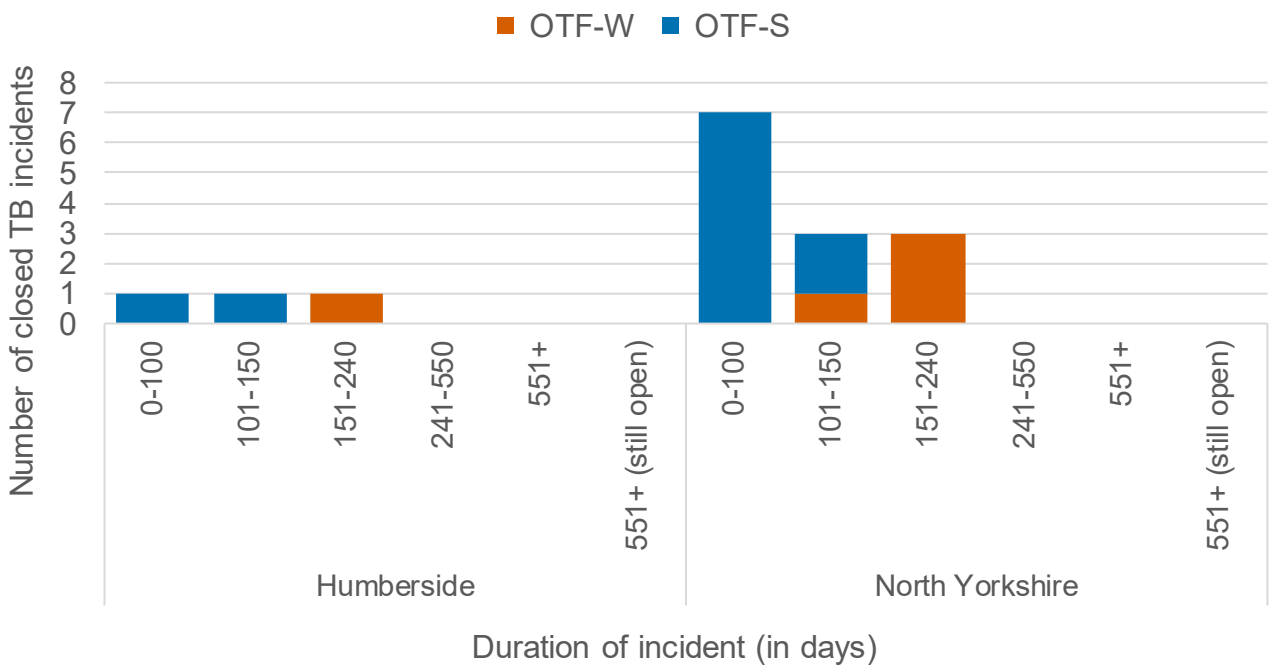

Figure 5a: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2020, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2020 in Humberside and North Yorkshire. Note that Licensed Finishing Units (LFUs) have been excluded.

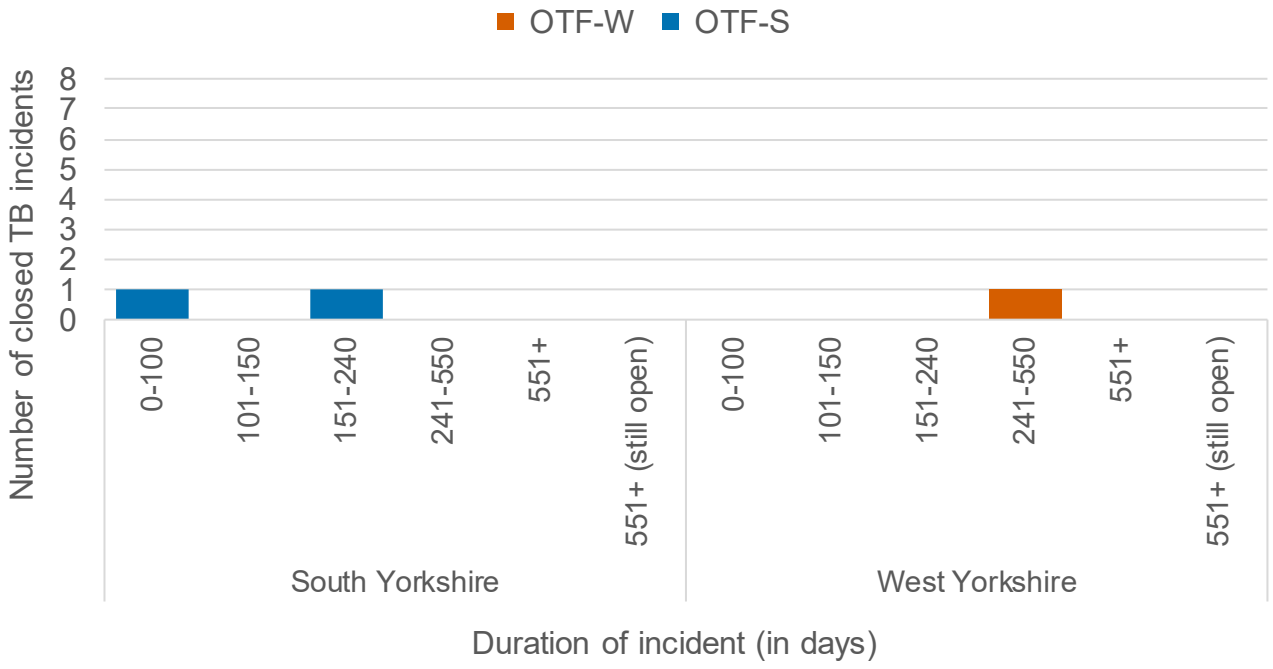

Figure 5b: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2020, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2020 in South Yorkshire and West Yorkshire. Note that Licensed Finishing Units (LFUs) have been excluded.

Genotypes associated with TB incidents

Genotyping of *M. bovis* isolates is used to trace the origin of TB infection. It is particularly useful in identifying where spread has occurred through cattle movements. Stable genotype clusters tend to be found in areas where there is a persistent local reservoir of infection. APHA implemented whole genome sequencing (WGS) in place of genotyping in April 2021. During 2020 however, genotyping was still attempted for all OTF-W herds in the LRA.

In incidents where a positive *M. bovis* culture result is obtained, genotyping is carried out to allow for further epidemiological investigation into the source of infection. Due to the need for a positive culture result, genotyping information is only available for OTF-W incidents. During 2020, there were seven different genotypes detected across the region (Figure 6). As would be expected, due to the larger number of incidents in North Yorkshire, a larger number of genotypes were detected here than in other counties in the region.

North Yorkshire

As can be seen in Figure 3 (see Geographical distribution of TB incidents), eight of the incidents in North Yorkshire were attributed to infection having been introduced from the movement of animals into the region. The genotyping information provided is key evidence in being able to establish this as a source of infection.

Two incidents were found to be caused by *M. bovis* genotype 25:a (Figure 6), the predominant strain of the bacterium across Staffordshire, Derbyshire, Cheshire, and north-east Shropshire. Investigation into both incidents identified they had come from the same holding of origin in Cheshire, which had sustained a TB incident caused by the same genotype. No epidemiological evidence was found to directly link the two holdings in North Yorkshire.

Two other incidents with a clear relationship to the movement of cattle into the region was due to genotype 10:h. Again, these two incidents started with animals from the same previous holding in Warwickshire. Whilst this specific genotype is much rarer than 25:a, incidents involving *M. bovis* of the same spoligotype were detected on previous holdings of origin of both animals. No epidemiological evidence was found to directly link the two holdings in North Yorkshire. The individual movement of these animals through the same pathways demonstrates a potentially significant pathway of infection introduction into the region.

Another incident in North Yorkshire was found to involve *M. bovis* genotype 9:7-5-5-4*-3-2.1. The animal involved in this incident was detected following a recent import direct from Ireland. This genotype is suggestive of an Irish origin, again providing evidence that infection was likely introduced through the movement of animals into the region.

One incident involved *M. bovis* genotype 17:a. Whilst this genotype is less common in the LRA, the evidence from the farming practices in place attributed that the movement of animals was the most likely route of infection introduction.

A different incident in North Yorkshire was found to involve *M. bovis* genotype 65:a. This is a particularly rare genotype, with very few cases nationally. In 2020, there was only one other incident involving *M. bovis* genotype 65:a. This can make drawing firm epidemiological conclusions difficult. In this case, whilst the movement of animals was thought to be a potentially contributing factor, the same level of certainty could not be used as for other incidents seen.

There was only one OTF-W incident in North Yorkshire where there was insufficient evidence to say that the movement of animals was involved. This incident involved *M. bovis* genotype 10:a. This genotype has a homerange across Warwickshire, Oxfordshire, and east Gloucestershire. The herd involved was a closed herd with no movements other than groups of heifers that were sent within the region for winter housing. There was insufficient evidence to confirm any significant epidemiological links with the homerange of this genotype and so the potential involvement of local introduction of infection was considered.

West Yorkshire

In West Yorkshire only two different genotypes of *M. bovis* were detected (Figure 6). An incident involving *M. bovis* genotype 9:d concluded that TB had been introduced through the movement of cattle into the region. This incident involved an animal that had been recently imported directly from Ireland. There is a known epidemiological relationship between this genotype and TB incidents in Ireland, providing evidence of the route of introduction.

The other *M. bovis* genotype detected in West Yorkshire was 25:a. As discussed previously, this has a homerange in the northern counties of the HRA and Edge Area. Unlike the incidents detected in North Yorkshire however, there were no strong epidemiological links between this incident and the homerange areas of 25:a, meaning that firm conclusions over the origin of infection in this incident could not be drawn.

South Yorkshire

In South Yorkshire only one OTF-W incident occurred during 2020, involving *M. bovis* genotype 25:a (Figure 6). As with the incidents in North Yorkshire, the most likely route of infection introduction was concluded to be from the movement of animals into the area.

Humberside

There were no genotypes identified from incidents in Humberside in 2020.

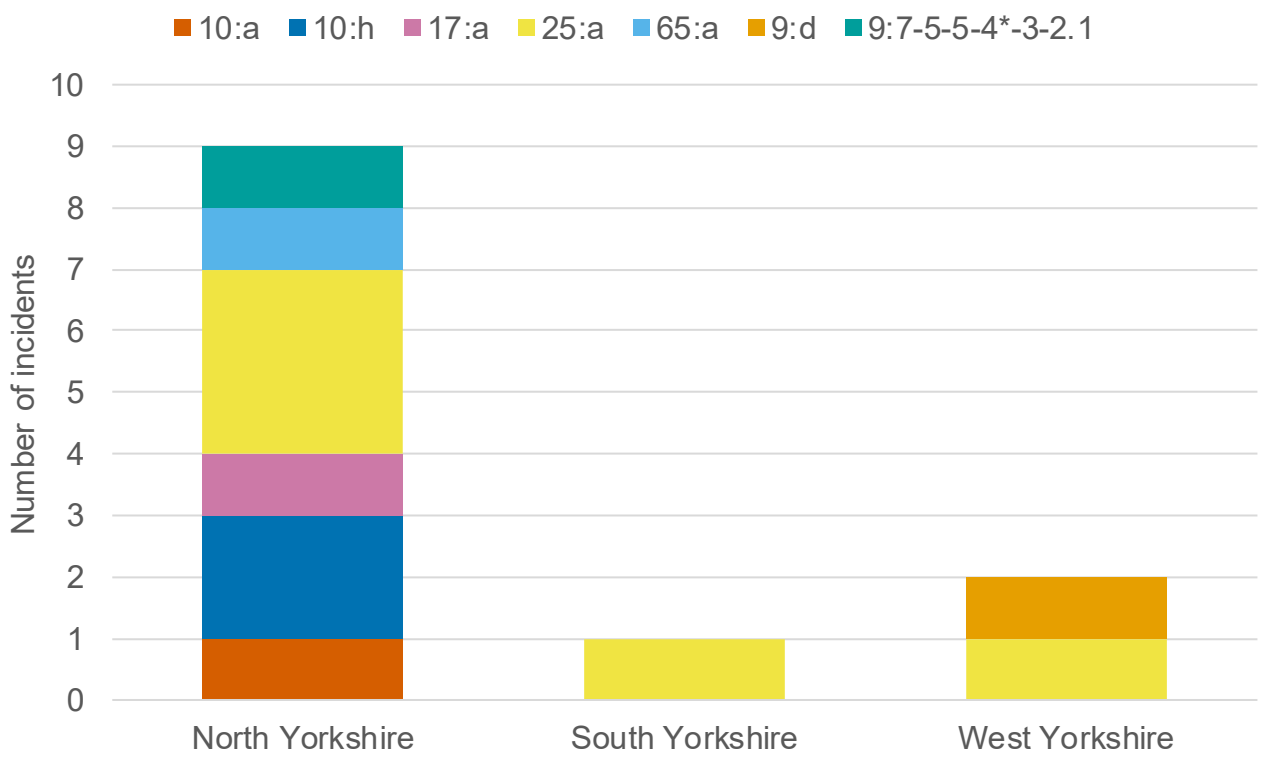

Figure 6: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Yorkshire and Humberside that began in 2020, by county.

Suspected sources, risk pathways and key drivers for TB infection

The key drivers of the TB epidemic within the reporting area were as follows:

- Purchasing practices resulting in the buying in of animals from areas of higher risk
- Movement of animals from areas of higher risk through livestock markets
- Spread of infection from surrounding counties with higher incidence levels

It can be challenging to retrospectively establish the route of infection for a TB incident herd. APHA aims to complete an epidemiological assessment for all TB incidents in the LRA (both OTF-W and OTF-S). This includes a thorough on-farm investigation and scrutiny of routinely collected data, such as cattle movement records, and the results of molecular analyses where available (OTF-W incidents only).

During the APHA veterinary assessment, up to three risk pathways of infection are selected for each herd. Figure 7 shows the risk pathways identified with the highest level of certainty for OTF-W incidents only. Further details of all the risk pathways identified in both OTF-W and OTF-S incidents can be found in Appendix 4.

The risk pathways generated from APHA veterinary assessments of each incident can provide vital evidence and early indicators of areas of concern. Nearly half of all the weighted risk pathways concluded that cattle movements were involved in some way in the

introduction of infection (Table A4.1). This is reflected further in Figure 7, where the overriding source of infection in OTF-W incidents across the region was from cattle purchased from outside of the region.

The potential drivers behind the movement of cattle as the primary source of infection introduction has already been discussed within this report, but this helps to add evidence to the areas that should be of focus with regards to minimising infection introduction in the region. It is important to recognise that these movements of cattle are coming from outside of the region, and we are not seeing any patterns of infection moving within the region.

One incident in West Yorkshire was attributed to movements of local cattle, however uncertainty remained around the confirmed source of infection in this incident, and so further disease monitoring in this area will be necessary to ascertain the true involvement of this.

The lack of incidents attributed to local cattle (Figure 7) helps to confirm the importance and success of radial testing in ensuring that no lateral spread of infection has occurred.

Nearly a quarter of all incidents in the region were involved an 'other or unknown' source. This reflects the difficulties in confirming a route of infection introduction in all incidents. As has already been discussed, the use of genotyping data can help to provide valuable epidemiological evidence regarding the source of infection introduction. This is however only available when a positive culture has been established, and so is not available for OTF-S incidents. This, combined with lack of strong evidence suggesting a wildlife or potential fomite involvement, can make drawing solid epidemiological conclusions difficult. In such circumstances, the source of infection is often referred to as undetermined. The data from Table A4.1 reflects this, and the challenges faced.

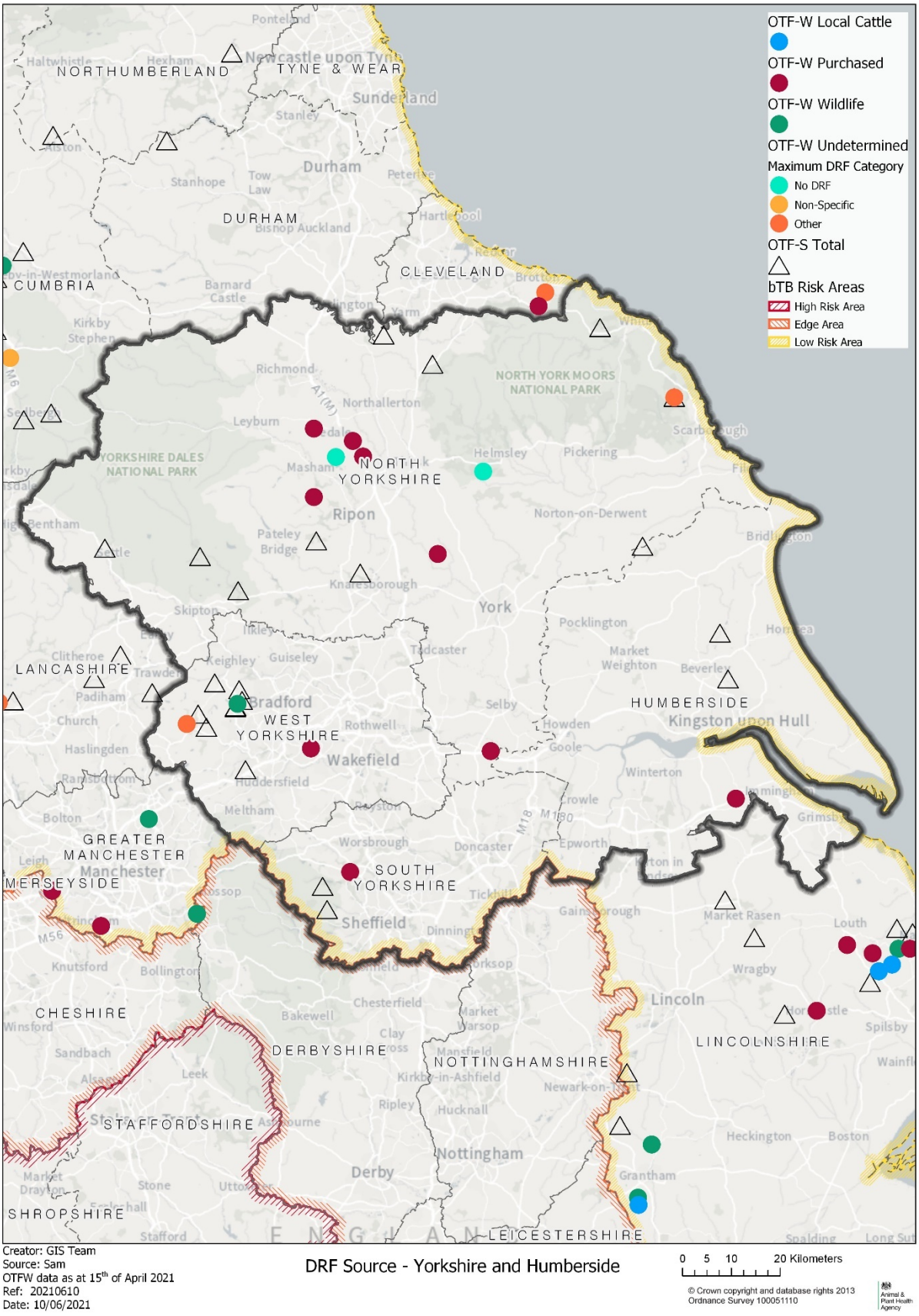

Figure 7: Map of the source of infection pathway recorded with the highest level of certainty, for OTF-W TB incidents, and the location of OTF-S incidents in Yorkshire and Humberside which started in 2020.

TB in other species

During 2020, there were no incidents of *M. bovis* infection reported in domestic non-bovine farm animals (camelids, goats, sheep, pigs), pets, zoo animal collections, captive (farmed/park) deer holdings and captive wild boar farms.

Detection of incidents

Across the region nine different surveillance methods were involved in the detection of incidents during 2020 (Figure 8). Whilst there was slight variation in the involvement of different tests types in the different counties, it highlights the significance of different surveillance methods in controlling TB in the region.

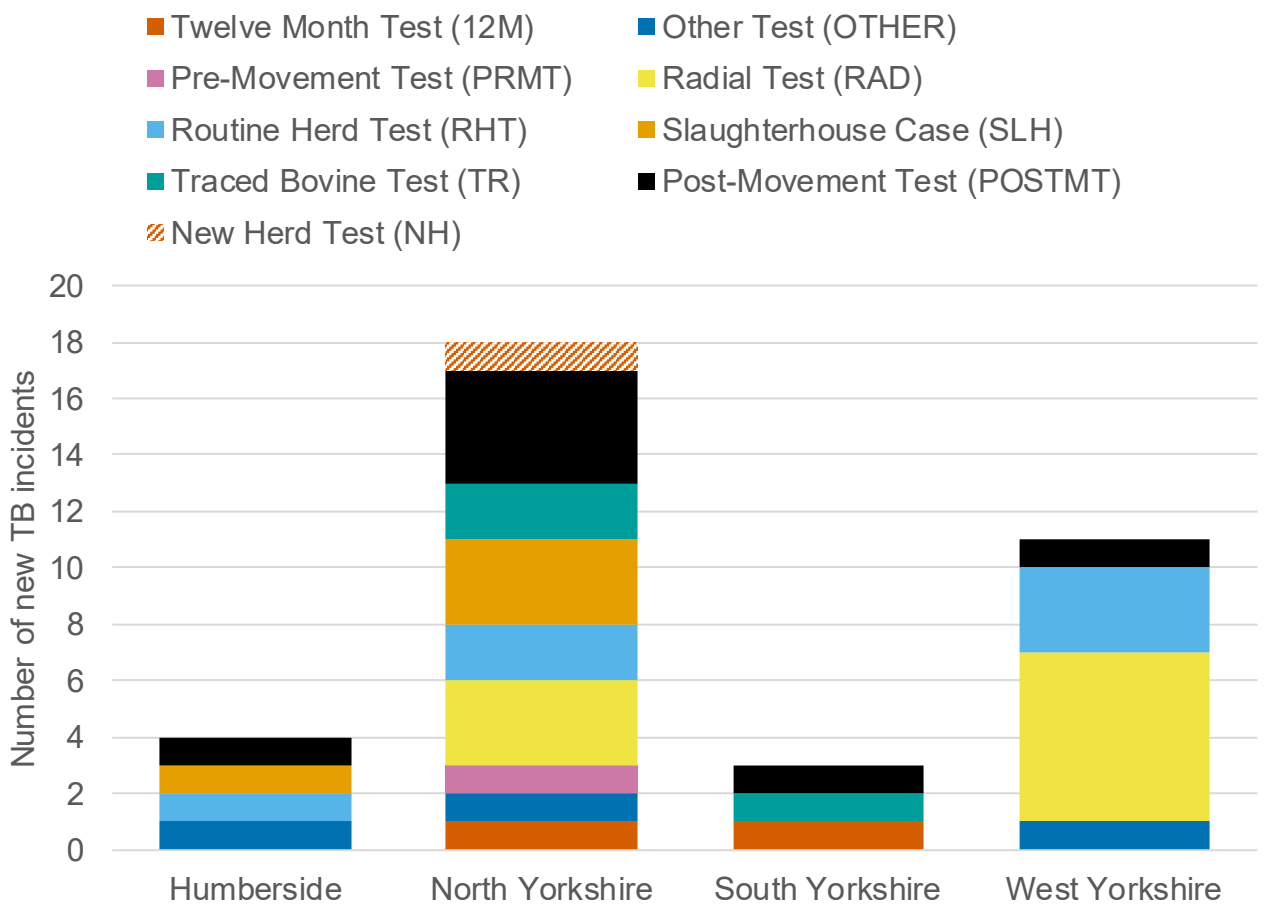

Figure 8: Number of TB incidents (OTF-W and OTF-S) in Yorkshire and Humberside in 2020, disclosed by different surveillance methods in each county.

North Yorkshire

In North Yorkshire, post-movement testing led to the detection of nearly 24% of all the incidents (Figure 8). This testing type was introduced in the LRA in 2016 on all animals moving from the annual (or more frequent) TB testing areas in England and Wales. The test must be carried out 60-120 days after the animal has arrived on the holding. The purpose of this testing regime is to supplement pre-movement testing animals moving into the LRA from areas of higher TB risk, and to prevent any further transmission of TB. The significant proportion of animals detected through this test type in 2020 highlights the importance of such a testing regime.

Radial testing also played a key role in detecting three new incidents in 2020 (Figure 8). All these incidents however came from RAD testing regimes triggered by OTF-W incidents from 2019. There have been no incidents detected in the RAD zones put in place during 2020. This helps to highlight the requirement for ongoing surveillance in these zones, to be confident that any lateral spread of infection will be detected.

Two incidents were detected through traced bovine tests in 2020. These tests are initiated on all animals that left a holding during a specified risk window before the onset of a new OTF-W incident. The ability of the traced tests to detect animals promptly following an incident on the holding of origin is key in limiting their circulation and capability to transmit TB to other herds. The traced tests detected two OTF-W incidents, and so were key to disease control in the county in 2020.

Slaughterhouse (SLH) case surveillance also played a key role, leading to the detection of two OTF-W incidents in the county. SLH surveillance is carried out in by Food Standards Agency (FSA) meat inspectors and official veterinarians on all cattle carcases passing through slaughterhouses. This method of detection plays a key role in disease identification by supplementing live TB testing of cattle on farms.

Routine herd tests (RHT) were also involved in the disclosure of two incidents during 2020. This highlights the importance of ongoing routine surveillance as well as the more targeted surveillance measures.

Other test types that were involved in the disclosure of incidents in North Yorkshire included a twelve-month test, a new herd test and a post-import test (Figure 8). Twelve-month tests take place following the resolution of an incident to allow ongoing surveillance and ensure complete freedom of disease. New herd tests are used to establish a baseline of infection status on all newly established cattle herds. This ensures that such herds are free from infection or, if any infection is present, it is detected promptly.

Post-import tests are carried out on all animals imported into the UK from non-OTF countries. These are like post-movement tests (except that they are organised by APHA) and are carried out 60-120 days following the arrival of the cattle into the UK. The aim is to ensure that all animals arriving are free from infection, and if not, that are detected promptly to limit any lateral spread.

West Yorkshire

In West Yorkshire RAD testing played a much more significant role in 2020 than in previous years, leading to the disclosure of over 50% of incidents (Figure 8). Unlike in North Yorkshire, where it was historic RAD testing regimes that led to reactor disclosure, in West Yorkshire it was the RAD testing regimes from OTF-W incidents identified in 2020 that have led to subsequent incident disclosure. This further highlights the importance of RAD testing regimes to allow the prompt detection of any potential lateral spread of infection in the area. The disclosure of such a significant number of incidents from the RAD testing has become an area of increased focus in the region and ongoing monitoring is in place.

As was the case in North Yorkshire, RHT also played a key role in incident disclosure in West Yorkshire during 2020, leading to the disclosure of three incidents.

Post-movement and post-import testing were also involved in the disclosure of incidents in West Yorkshire in 2020.

South Yorkshire

In South Yorkshire, targeted surveillance was key. One incident was identified through 12-month surveillance following a previous incident (Figure 8). The other two incidents were identified through post-movement and traced bovine testing. This again highlights the importance of the combination of routine and targeted surveillance to allow for ongoing and prompt identification of infection.

Humberside

In Humberside, routine (through RHT and SLH case detection) and targeted surveillance both contributed to the disclosure of incidents during 2020 (Figure 8). Post-movement testing was also involved in the disclosure of an incident in Humberside during 2020. One incident was disclosed following targeted surveillance put in place due to strong epidemiological links to a holding with an OTF-W incident in North Yorkshire. Due to the links, both holdings were placed under the same TB testing regime and subjected to additional skin tests and IFN-γ blood tests to regain OTF status. In this instance, it led to the disclosure of reactors at the holding in Humberside as well as the premises in North Yorkshire.

Skin test reactors and interferon gamma test positive animals removed

During an incident, reactors can be disclosed at either the skin test or at IFN-γ testing. All confirmed, OTF-W incidents in the LRA are subjected to at least one round of mandatory IFN-γ blood testing, while OTF-S incidents are managed solely though skin testing, unless exceptional circumstances are found. During 2020, a total of 99 animals were removed as TB test reactors, 59 as skin test reactors and 40 as IFN-γ positive animals (Table A3.2). The largest number of reactors were removed from North Yorkshire (Figure 9a), this would be expected as it was the county where the largest number of incidents were observed.

Likewise, the smallest number of reactors were removed from South Yorkshire (Figure 9b), where the smallest number of incidents were seen.

Apart from Humberside, the number of reactors removed in each county reduced, compared to what was observed in 2019, and in many counties shows a general downward trend. Whilst this reduced number of reactors may genuinely reflect fewer reactors being disclosed over the course of an incident, it may be that the incidents were disclosed later in the reporting year, and so subsequent testing and potential reactor disclosure has occurred into 2021, for the incidents that started in 2020. Overall, however, the number of reactors disclosed across the region demonstrates a generally stable picture of infection.

The number of incidents and subsequent number of reactors removed can provide a proxy for the economic impacts of TB in different regions. The number of incidents is representative of the costs to the taxpayer, primarily through the requirement for subsequent skin and IFN-γ testing and the direct costs associated with compensation paid to farmers for reactor removal, all of which is carried out at the taxpayer's expense.

As already discussed, the number of incidents in 2020 was highest in North Yorkshire and was slightly increased from the number of incidents seen in 2019 (see Figure 2). The additional testing associated with this is likely to therefore have incurred additional costs. The reduction in number of reactors disclosed since 2019 however reflects a reduction in the cost of TB to the region, as there have been fewer animals to pay compensation for.

In Humberside, the associated costs with TB are likely to have increased from what was seen in 2019. There have not only been additional incidents, but more reactors disclosed through both skin testing and IFN-γ tests (Figure 9a). In South Yorkshire, the associated costs with TB are likely to have reduced since 2019. There have been both fewer incidents, and overall fewer reactors disclosed and paints an overall positive picture for TB control in the area (Figure 9b).

Despite the increased number of incidents in disclosed in West Yorkshire during 2020, the overall number of reactors disclosed has reduced from what was seen during 2019. This is likely due to one particularly explosive incident in 2019 which led to the disclosure of a significant number of reactors. Although the increasing number of incidents in the county is an area of concern, the reduction in number of reactors disclosed during 2020 is positive with regards to the financial impacts of TB in the county.

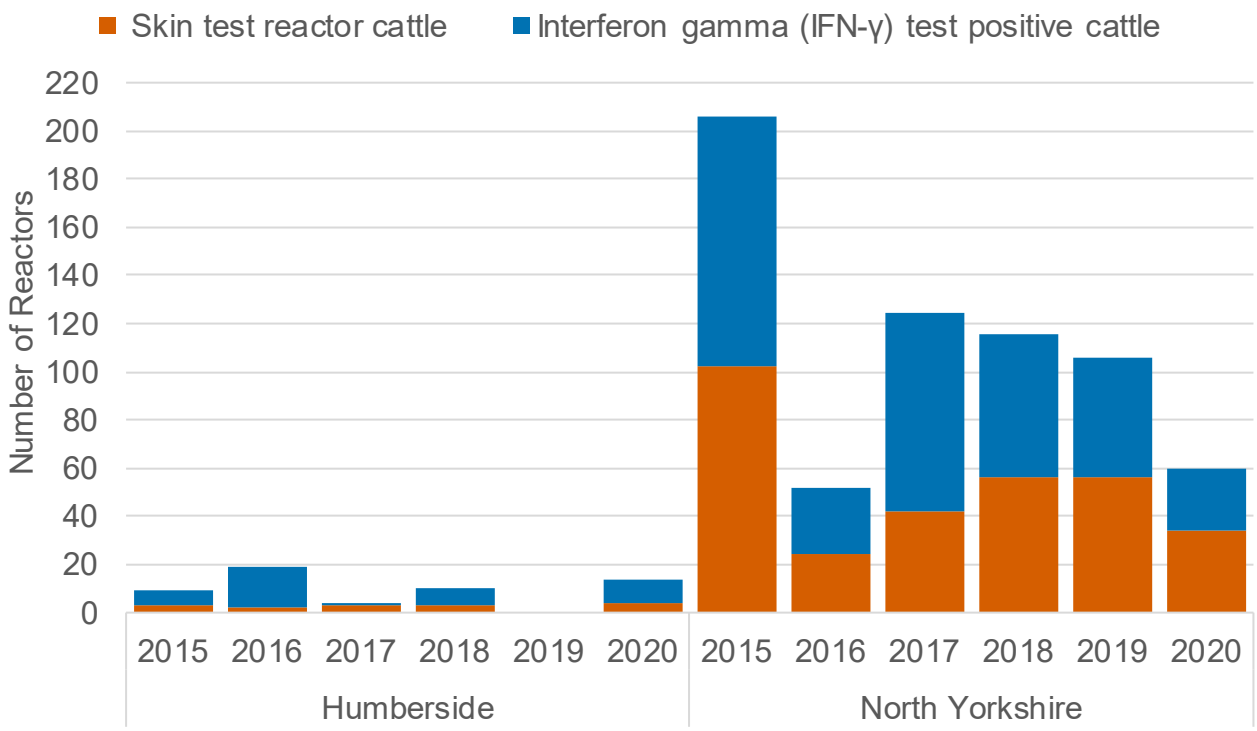

Figure 9a: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Humberside and North Yorkshire, 2015 to 2020, by county.

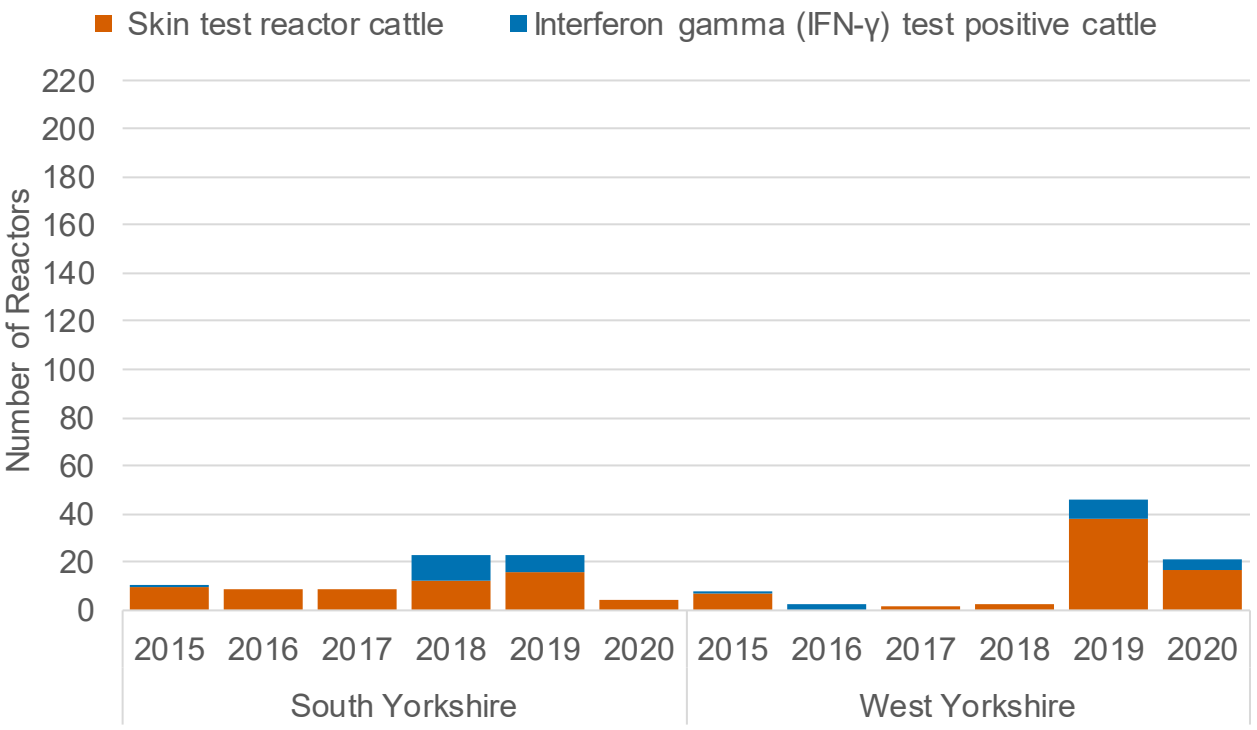

Figure 9b: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in South Yorkshire and West Yorkshire, 2015 to 2020, by county.

An incident can also have significant financial implications to the associated farming business. Following the disclosure of reactors, premises are placed under movement restrictions and so TB incidents can have substantial impacts on the ability to move cattle onto and off a premise. This can have considerable consequences for breeding stock, weaned beef calves, store animals and dairy calves not normally reared on farm.

Likewise, it can be difficult to source stock to replace reactor animals which have been removed, especially in the case of pedigree animals or organic herds. Cattle can also only be brought onto the holding during an incident in specific circumstances and must have a licence granted by APHA. This can therefore have consequences on the overall productivity of a farm.

The associated economic loss to dairy farms can also be significant in the form of reduced milk yields seen around testing and further implications in financial penalties imposed by the milk processors. The requirements for additional staffing, and in some circumstance's additional equipment, required to complete necessary testing during an outbreak can also come at considerable cost to the farmer.

Finally, the time taken to carry out the testing is labour hours lost from other work on the farm, and so the indirect costs of this to the overall farming business should not be overlooked.

North Yorkshire

In North Yorkshire, incidents took place on a variety of different enterprises and so a wide range of the implications discussed above will have been felt across the county.

One incident involved a closed dairy herd. The movement restrictions imposed during an incident such as this can present challenges with animals not suited to the production system as well as issues around moving animals to different sites for winter housing.

Multiple incidents in North Yorkshire involved reactors that were disclosed in young animals where the production system was designed to rear them to a specific size/age before selling them on for further fattening at a subsequent premise. This presents a challenge to the farmer as the facilities on farm were often not suitable to keep animals for extended durations, without significant welfare compromises occurring.

Once TB was disclosed, and the holdings were under movement restrictions, the only way for these animals to leave the holding was under specific licences to AFUs in the HRA or Edge Area. There are several financial implications associated with this. The value of the animals to an AFU, compared to expected market values, are often significantly reduced and there is the additional costs of feed and bedding, at a time when commodities such as these are of particularly high value.

For farmers whose usual output is fat cattle, direct to slaughter, the implications of restrictions imposed due to a TB incident are less onerous, as a general licence to an approved slaughterhouse is usually permitted.

Alterations to the structure of TB approved slaughter gatherings in the LRA during 2020 have however limited their options by preventing them from selling stock through these markets.

For all farming businesses rearing stock, the restrictions also limit their ability to bring stock onto the holding. This can also cause subsequent financial implications and has been of concern in several incidents in North Yorkshire. In certain circumstances, stock can be brought on if severe financial detriment is a risk, but the animals must be sourced responsibly and can only take place under licence from APHA.

West Yorkshire

In West Yorkshire, the financial implications seen were like North Yorkshire with regards to incidents involving farming businesses focused on rearing stock. Several of the incidents in this county however involved smaller scale enterprises, where stock was bred and reared to fat on the same premises. The limitations of restrictions can therefore be minimal.

South Yorkshire

In South Yorkshire the output of all the units where TB incidents were identified in 2020 was fattening stock. As outlined above, the initial implications of TB restrictions are limited, as animals can still be sent to the slaughterhouse. The financial impacts on these units are usually more long term and due to issues with limitations on bringing new stock onto the holding.

Humberside

In Humberside, there was a split of herds with TB incidents in 2020, involving two heifer rearing units and two fattening units. The initial implications of movement restrictions are likely to have been greater in the heifer rearing units, as there will be limitations in moving animals off the units. Whilst fattening units are often better set up with the capability to still send animals to the slaughterhouse, the limitations on re-stocking can pose issues.

Summary of risks to Yorkshire and Humberside

The overall incidence of TB across Yorkshire and Humberside remains low, with a large proportion of incidents involving the movement of animals into the region from areas of higher risk. This is promising with regards to protecting the favourable TB status across the region, but TB remains something we should monitor closely to ensure this is maintained.

As can be seen from Figure 4 (see Potential or confirmed TB hotspot areas), whilst Yorkshire and Humberside remain in the LRA, parts of region have direct boundaries with areas of higher risk. During 2019 a cluster of incidents was seen to be developing along the southern boundary of South Yorkshire. There were concerns at the time that this may indicate increasing incidence in that area with the potential for endemic infection to develop. The

proximity of this part of the region to counties in the Edge Area was of concern as a potential route of ongoing infection introduction and the potential involvement of wildlife reservoirs. As has been discussed in this report and can be seen in Figure 3 (see Geographic distribution of TB incidents), the cluster of incidents in this region appears to have settled down over 2020 with no evidence of endemic infection developing. Due to its proximity to areas of higher risk, this will remain an area to monitor going forward.

The development of potential hot spot HS28 in northeast Lincolnshire is another area that could pose a risk to the region. A very small part of this potential hot spot area spans the county boundary into Humberside. To date, there have been several incidents involving cattle herds that appear to have epidemiological links to each other, indicating a likely local spread of infection. Infection has however not yet been confirmed in wildlife populations, although ongoing monitoring remains in place to truly establish this relationship. If a wildlife reservoir of infection is detected, this could present a significant risk to Yorkshire and Humberside, and close monitoring of the region in the south of Humberside would be necessary to ensure that any further spread is limited.

The remainder of the region adjoins other regions the LRA where there is limited risk posed from geographical spread of infection.

As discussed previously, the structure of many units in the region involves the regular purchasing of stock to maintain production. The purchasing practices often result in the movement of animals into the region from areas of higher risk. Of the confirmed OTF-W incidents in the region 11 were attributed to the movement of TB-infected cattle. Most of these movements were from areas of higher TB risk, and importantly none of these movements came from areas directly adjacent to Yorkshire & Humberside.

In North Yorkshire, there were two instances where two incidents involved animals that had originated from the same source farms. One set involved the movements of calves from a farm in the HRA and the other, the movement of yearling animals from a farm in the Edge Area. In both instances, the animals did not arrive on the holdings in North Yorkshire at the same time, but within a couple of weeks of each other, and all had passed through markets in the HRA or Edge Area. This would indicate that they were not necessarily purchased by the same person or dealer, but that similar routes of cattle purchasing, and subsequent movement of animals into the region, is occurring. Whilst there are no doubt many other livestock markets acting as similar routes to the introduction of infection into the region, the behaviours around such purchases are of interest, and potentially an area of focus to prevent subsequent incidents in the region.

Summary of risks from Yorkshire and Humberside to surrounding areas

Most of the OTF-W incidents in this region during 2020 involved the movement of animals in the introduction of infection. There is also limited evidence to suggest any lateral spread from

these incidents, suggesting that the likelihood of an endemic reservoir of infection developing is very low.

The development of a potential cluster of incidents in West Yorkshire could present a potential risk if firm epidemiological evidence is found to link the incidents and any potential wildlife involvement.

The overall risk of TB spread posed from Yorkshire and Humberside to neighbouring regions is negligible.

Assessment of effectiveness of controls and forward look

Effectiveness of controls

Throughout this review we have assessed the TB situation across Yorkshire and Humberside during 2020. We have demonstrated that the rate of reactor identification, relative to the number of animals tested and the number of reactors disclosed per incident, has remained relatively stable across the different counties. In the situations were there has been an incident of concern, such as the OTF-W incident in North Yorkshire where a particularly large number of reactors were disclosed and common land was involved, we have demonstrated how effective and thorough testing has limited the potential impact of the incident. This combined with the lack of evidence of persistently infected herds, and often relatively quick time to resolution of incidents in the region, indicates that the current control measures in place are largely effective at controlling infection in the region.

We have highlighted that many of the OTF-W incidents in the region are due to the purchase of animals from an area of higher risk, which remains the key area of focus to TB control in the region. These incidents have resulted in the instigation of radial testing zones around these premises to aid the detection of any undisclosed infection and investigation of any local lateral transmission and potential wildlife involvement. We have demonstrated that radial testing plays a vital role in establishing the extent of OTF-W incidents and detecting any potential lateral spread promptly, leading to the detection of several OTF-S incidents during 2020. These radial testing zones for the OTF-W incidents disclosed during 2020 will remain in place in 2021 to maintain the heightened surveillance levels in those specific areas.

The effectiveness of post-movement testing has also been demonstrated. Several incidents, including two confirmed OTF-W incidents were detected through post-movement testing. The ongoing implementation of post-movement testing will be vital in allowing us to rapidly detect any purchased infection and prevent any further spread. Tests of individual animals traced from incident herds have also been key in the prompt detection of infection in the region during 2020. Without these targeted tests, these animals may remain on the holding for prolonged periods before TB is detected. Early detection therefore helps to limit the impact and costs of incidents.

As well as targeted testing, routine surveillance on farm and during commercial slaughter of cattle continues to play a key role in TB control in the region. RHT remains a solid backbone of TB testing and allows us to maintain an ongoing picture of the incidence of infected herds in the region. The requirements of RHT in the LRA mean that fattening animals are not normally included in such tests. Ongoing passive surveillance at slaughter is therefore key to allow us to detect any infected animals that may not have been skin tested. The importance of SLH surveillance has continued to be demonstrated this year.

Forward look

The combined effects of targeted and routine surveillance measures that are in place, along with controls in TB incident herds, appear to be working effectively in controlling the epidemic in this part of the LRA. Small clusters of incidents appear to develop periodically, but thorough epidemiological investigations and the implementation of effective control measures, seems to bring these under control in a timely and effective manner, preventing the development of endemic reservoirs.

Despite the availability of advice on safer purchasing practices (e.g., TB Hub www.tbhub.co.uk, ibTB www.ibtb.co.uk), there is continued introduction of TB into the county through the purchase of cattle with undisclosed TB infection. The structure of the cattle industry, in particular the beef sector, in this region, results in a fast production and high turnover of cattle. Whilst effort is made by many to source animals responsibly, some cattle keepers continue to purchase simply on price. There are also instances where high risk cattle are purchased through dealers and the origin premises, and therefore TB risk status, may not be known or properly considered. The requirement of post-movement testing aims to mitigate this risk and quickly establish the TB status of an animal following its arrival in the LRA.

The ongoing need for increased education about responsible sourcing practices and the importance of biosecurity to support the ongoing testing and surveillance control measures is paramount. Communication between farmers and their private veterinary care providers, the National Farmers' Union, other industry bodies and APHA is needed to instil these practices and the importance of ongoing TB control in this region. The combination of these strategies provides the best possible chance of success in reducing the overall incidence of TB in the region.

Appendices

Appendix 1: Overview of risk and surveillance areas of England and Low Risk Area objectives and controls

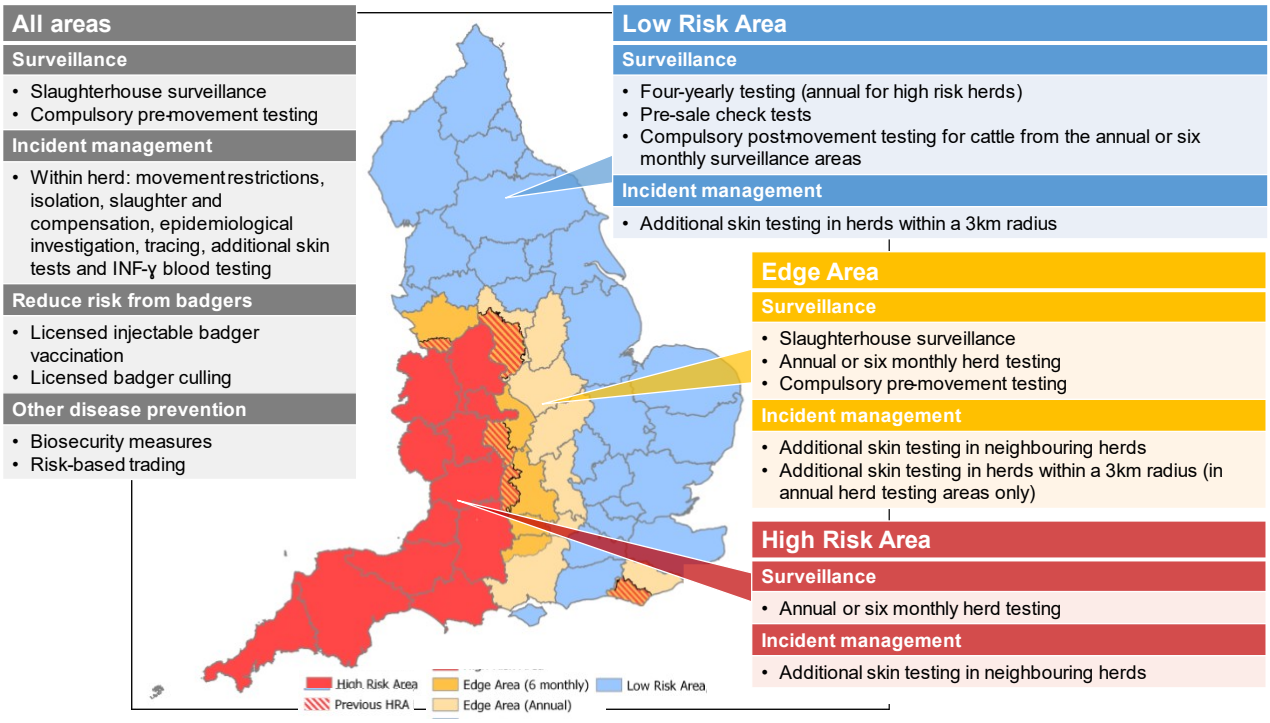

Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Tuberculosis-Free Status for England. The map is described in more detail in the Explanatory Supplement for England 2020 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2020).

Policy objectives for the LRA

Progressive attainment of OTF status for individual counties (or groups of counties) within the current LRA, with the declaration of OTF status for all LRA counties by 2025. For more information about the government's strategy for achieving Officially Bovine Tuberculosis Free status for England, published in 2014 and independently reviewed in 2018, see:

https://www.gov.uk/government/publications/a-strategy-for-achieving-officially-bovine-tuberculosis-free-status-for-england

https://www.gov.uk/government/news/government-sets-out-next-phase-of-strategy-to-combat-bovine-tuberculosis

Key Control Measures in the Low Risk Area

Surveillance:

- default four-yearly routine surveillance (skin) testing of cattle herds, with annual testing for a small proportion of high-risk herds
- voluntary pre-sale skin check tests
- compulsory pre- and post-movement testing for cattle entering farms in the LRA (to live) from the annual or six-monthly surveillance areas of England and Wales
- additional targeted surveillance (radial testing) of cattle herds located within a 3km radius of new incident herds with OTF status withdrawn (OTF-W) following the detection of lesion-positive test reactors and/or culture-positive animals
- slaughterhouse (SLH) surveillance (through PM meat inspection) of all cattle slaughtered for human consumption

Management of incidents:

- herd movement restrictions, isolation and rapid slaughter of TB test reactors and any direct contacts with statutory compensation payments to farmers, epidemiological investigation, tracing tests (at severe interpretation), and short interval skin testing supplemented in all herds affected by OTF-W incidents with mandatory interferon gamma (IFN-γ) blood testing

TB controls in the wildlife reservoir (badgers):

- licensed injectable badger vaccination
- licensed badger culling in exceptional circumstances, where *M. bovis* infection has been confirmed in badgers and it has a clear epidemiologically link with a local cluster of TB in cattle (e.g., East Cumbria TB hotspot)

Other measures:

- biosecurity measures
- promotion of responsible sourcing of cattle (e.g., through the use of the ibTB online (www.ibtb.co.uk) mapping application)

Summary of enhanced TB control measures in this reporting area

During 2020, the primary method of enhance TB control present in the reporting area one potential hotspot area. HS27 was located across the western boundary of North Yorkshire, spanning into Lancashire. This was initiated in January 2020 for 12 months, following the disclosure of a series of incidents around this area with an undetermined origin of infection. The establishment of this potential hotspot area has meant ongoing surveillance of cattle herds, with additional wildlife surveillance measures in place. Since its implementation only one wild deer carcase has been submitted for post-mortem examination and *M. bovis* culture at APHA, with negative results. The additional surveillance of cattle herds in the area has also not resulted in any new TB incidents or demonstrated any further evidence of potentially infected wildlife reservoirs.

Appendix 2: Cattle industry in the reporting area

Table A2.1 Number of cattle premises by size band in each county at 1 January 2020. (RADAR data)

Size of herds	Un*	1-50	51-100	101-200	201-350	351-500	501+	Total number of herds	Mean herd size	Median herd size
Number of herds in Humberside	6	314	130	115	48	16	8	637	86	50
Number of herds in North Yorkshire	27	1,326	558	575	305	115	108	3,014	120	60
Number of herds in South Yorkshire	0	212	76	59	29	12	5	393	83	40
Number of herds in West Yorkshire	10	621	141	104	49	15	11	951	66	26

*The number of herds with an undetermined size.

Table A2.2 Number of animals by breed purpose in each county at 1 January 2020.

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of cattle in Humberside	41,200 (80%)	8,841 (17%)	1,444 (2%)	3 (<0.01%)	51,488
Number of cattle in North Yorkshire	227,458 (62%)	123,765 (34%)	10,121 (2%)	23 (<0.01%)	361,367
Number of cattle in South Yorkshire	23,370 (71%)	8,100 (24%)	1,198 (3%)	1 (<0.01%)	32,669
Number of cattle in West Yorkshire	42,815 (67%)	17,705 (28%)	2,451 (3%)	6 (<0.01%)	62,977

Appendix 3: Summary of headline cattle TB statistics

Table A3.1 Herd-level summary statistics for TB in cattle in 2020.

Herd-level statistics	Humberside	North Yorkshire	South Yorkshire	West Yorkshire
(a) Total number of cattle herds live on Sam at the end of the reporting period	835	3,743	499	1,213
(b) Total number of cattle herds subject to annual TB testing (or more frequent) at the end of the reporting period (any reason)	40	333	61	206
(c) Total number of whole herd skin tests carried out at any time in the period	158	976	117	339
(d) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	142	852	112	311
(e) Total number of OTF cattle herds at the end of the report period (i.e., herds not under any type of TB2 restrictions)	825	3,669	475	1,167
(f) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period.	832	3,732	497	1,203
(g) Total number of new TB incidents detected in cattle herds during the report period	4	18	3	11
• OTF status suspended (OTF-S)	3	9	2	8
• OTF status withdrawn (OTF-W)	1	9	1	3
(h) Of the new OTF-W herd incidents, how many:				
• occurred in a holding affected by another OTF-W incident in the previous three years?	0	0	0	0

Herd-level statistics	Humberside	North Yorkshire	South Yorkshire	West Yorkshire
• could be considered secondary to a primary incident based on current evidence?	1	0	0	0
• were triggered by skin test reactors or 2xIRs at routine herd tests?	0	0	0	2
• were triggered by skin test reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, post-movement, etc.)?	0	6	1	1
• were first detected through routine slaughterhouse TB surveillance?	1	3	0	0
(i) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds				
• OTF-S	0	2	0	6
• OTF-W	0	1	0	0
(j) 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)	2	9	1	2
(k) Number of OTF-W herds still open at the end of the period that are within a finishing unit	1	3	0	0
(l) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	0	0	0	0

Table A3.2 Animal-level summary statistics for TB in cattle in 2020.

Animal-level statistics (cattle)	Humberside	North Yorkshire	South Yorkshire	West Yorkshire
(a) Total number of cattle tested in the period (animal tests, blood, and skin)	12,571	111,814	12,474	20,289
(b) Reactors detected in tests during the year:				
• tuberculin skin test	4	34	4	17
• additional IFN-γ blood test reactors (skin-test negative or IR animals)	10	26	0	4
(c) Reactors detected during year per incidents disclosed during year	3.50	3.33	1.33	1.91
(d) Reactors per 1000 animal tests	1.11	0.54	0.32	1.04
(e) Additional animals identified for slaughter for TB control reasons (DCs, including any first-time IRs)				
• DCs, including any first-time IRs	0	0	0	0
• Private slaughters	1	0	0	0
(f) SLH cases (tuberculous carcases) reported by the Food Standards Agency (FSA) during routine meat inspection.	1	11	0	2
(g) SLH cases confirmed by culture of *M. bovis*	1	4	0	0

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

Each TB incident could have up to three 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) or 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 six, then the score is made up to six using the 'Other/Unknown Source' option. Buffering up to six in this way helps to reflect the uncertainty in assessments where only 'likely' or 'possible' sources are identified.

Table A4.1 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). Genotyping of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however genotypes 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 to the 2020 bovine TB epidemiology report for England (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2020).

Table A4.1 Suspected sources of *M. bovis* infection for all the new OTF-W and OTF-S incidents identified in 2020.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	8	0	0	0	3.2%
Cattle Movements	6	6	11	2	46.7%
Contiguous	6	2	1	0	8.0%
Residual Infection	0	0	1	0	1.6%
Domestic Animals	0	0	0	0	0.0%
Non-specific Reactor	0	0	1	0	2.1%
Fomites	5	0	1	0	4.2%
Other Wildlife	9	2	1	0	9.3%
Other or Unknown Source	7	1	2	0	24.8%

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. Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement for England 2020 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2020).

Appendix 5: Assessment of the origin of (and potential for spread of infection from) all the new OTF-W incidents identified in the report period

A risk matrix was used to identify isolated incidents that were likely to have been introduced to the LRA by cattle movements, while not causing any onward local spread. The following two questions were considered for each incident, and a score attributed. TB incidents with a score of 1A, 1B or 2A may be removed from the county TB incidence calculations during an application for OTF status (but remain in the incidence calculations in this report).

What is the probability of *M. bovis* infection being introduced to the LRA via infected cattle movements?

1. Definite - for example, traced reactors found in the LRA OTF-W incident herd in question as a result of spread tracings from another TB incident herd, genotype/WGS linked.

2. Likely - for example, a Reactor or IR originated from a previous incident herd (and the genotype does not suggest otherwise), other cattle were moved into the herd from previous incident herd (but were subsequently slaughtered without testing), or the trading practice of herd provides likely evidence (purchasing large numbers of cattle from High Risk Area (HRA), or Edge Area, High and Intermediate TB areas of Wales, or from the island of Ireland).

3. Possible - not a closed herd, but cattle are purchased from the LRA, Scotland and/or EU Member States.

4. Not likely - indigenous infection is known in the locality, closed herd, genotype/WGS has been identified in local wildlife.

What is the probability of this being an isolated, sporadic ('one-off') incident, without secondary local spread from the index case?

A. Likely - no secondary incidents have been detected. There are **no** further incidents as a result of spread tracings anywhere and **no** genotype/WGS linked OTF-W incidents within 3km radial zone around the LRA OTF-W incident herd in question (or the 3km radial surveillance zone was not triggered).

B. Possible - no secondary incidents have been detected, but the dataset is incomplete. For example, incidents have occurred in the 3km radial zone, but only OTF-S ones, or, if OTF-W, they were of an unknown/different genotype.

C. Not likely - secondary spread from the index case, or exposure to a common wildlife source has occurred. For example, OTF-W incidents have occurred in the 3km zone linked by genotype or WGS, or there is known wildlife infection in the area with this genotype/close WGS.

Table A5.1 Risk matrix of the veterinary assessment of the origin of, and potential for spread of infection from, all the new OTF-W incidents identified in 2020.

	Probability of isolated, sporadic ('one-off') incident, without secondary local spread from the index case (A, B, C)		
Probability of *M. bovis* infection introduced through cattle movements (1, 2, 3, 4)	A. Likely	B. Possible	C. Not likely
1. Definite	4	2	
2. Likely	1	2	
3. Possible		2	
4. Not likely		2	1

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National.TBEpi@apha.gov.uk

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