FMD 2007. Summary Epidemiology Report
Situation at 16:00 Monday 13th August. Day 10 of the outbreak.

Executive Summary
1. Two confirmed cases of Foot and Mouth Disease (FMD) have been confirmed in Surrey since 9pm on Friday 3rd August 2007.

2. The strain of virus has been identified as Type O1 BFS, which is the strain recovered from the 1967 FMD epidemic in Great Britain. This strain is used by both of the enterprises on the nearby Pirbright site. Current evidence indicates that this site is the likely source of infection for the outbreak.

3. The potential mechanism of spread from the Pirbright site is under investigation; possibilities include
   - Windborne spread, as winds were in a suitable direction at times during the risk period
   - Via effluent released from the laboratory, possibly aided by local flooding
   - Deliberate or accidental fomite transmission from one of the laboratory containment areas

4. Investigations to date have revealed little evidence for windborne spread, and are currently focussing on escape via contaminated flood water or contaminated articles such as clothing, equipment or vehicles.

5. Investigations into whether the source for IP 2 was the Pirbright site, or IP 1, continue.

6. Review of the risk of spread of infection to the rest of the country, through movements of cattle, pigs or silently infected sheep out of the PZ/SZ during the risk period is considered to be very low.

Descriptive Epidemiology FMD2007/0001 (IP 1)
(see annex 4 for an explanatory note on incubation period etc)

7. The infected farm is a small, family run, beef finishing enterprise. There are three associated land parcels in addition to the main premises, a total of 64 cattle were present on three of these premises. A fourth associated premises, other fields at Springfield near Elstead, are used for grazing horses, hay and silage production, and these contained no FMD susceptible animals. Disease was confirmed on two of the associated premises, IP 1A at Normandy, and IP 1C at Elstead; these are described in detail in the first epidemiology report. No evidence of disease was found at the home farm premises, IP 1B at Elstead.
8. Clinical signs of FMD were found in all 38 cattle at IP 1A. The age of lesions ranged from three to nine days (see Annex 3). No lesions were observed during post-mortem examination of all the other cattle on IP 1B and IP 1C.

9. Foot and mouth disease was confirmed by laboratory tests in cattle from IP 1A. There was an inconclusive FMD laboratory test result from one of the cattle on IP 1B, which has since been conclusively re-tested negative. One of the 22 cattle on IP 1C was laboratory test (RT-PCR) positive, although no clinical signs were observed.

10. Key dates for IP 1:
   1. Source window: Thursday 12 July (later amended to Monday 16 July following evidence of the timing of virus handling at the Pirbright site) to Wednesday 25 July.
   3. Date of 1\textsuperscript{st} lesion: Thursday 26 July.
   4. FMD confirmed: Friday 03 August.
   5. Primary C&D completed: 1A and 1C - 05 August, 1B – 06 August.

11. Source: The most likely source remains a release of virus from the Pirbright site. All other source tracings have been followed up and negated.

12. Spread: No FMD susceptible animals have been moved from any of the premises associated with the farm enterprise this year, except to slaughter. The last animals moved off were to slaughter on 10 July 2007. Two dangerous contact (DC) premises have been identified, one each for IP 1A and IP 1C. All laboratory test results have been confirmed negative from both sites, indicating that although highly likely to have been exposed, infection had not progressed to the stage when virus can be detected by the tests in use.

**Descriptive Epidemiology FMD2007/0002 (IP 2)**

13. IP 2 is a beef suckler herd run over approximately 300 acres. Suckler calves are reared and fattened and sent direct to slaughter. The enterprise comprises four premises. All breeding, rearing and fattening takes place separately at each premises, but some movement of stock takes place between them. This IP is situated within the protection zone of IP 1A and was identified as a report case. Disease was confirmed on two of the associated premises (IP 2A and IP 2B).

14. Clinical signs were present in 44 of the cattle on IP 2A and FMD was confirmed by laboratory tests to detect the presence of virus (RT-PCR); all were serologically negative (SPC ELISA). The lesion ages ranged from 1 to 7 days (see annex 2).

15. Key dates
2. Spread window: Friday 27 July to Thursday 09 August.
3. Date of 1st lesion: Tuesday 31 July.
4. FMD confirmed: Monday 06 August.
5. Primary C&D completed: 2A and 2B – 08 August, 2C - 09 August

16. Source: No movements onto the holding, of a type that could introduce infection, have been identified for IP 2 during the source risk period (which overlaps the spread risk period from IP 1A). The source for IP 2 could be either IP1A or the Pirbright site. Investigation is on-going.

17. Spread: No FMD susceptible stock have been moved off the premises during the spread risk period. A single holding that is highly likely to have been exposed to infection through a personnel contact, was investigated as a possible dangerous contact but was assessed as to be a ‘high risk tracing’. The stock on this premises are adjacent to the IP and only separated from it by a farm track and a lane. This holding has been under intensive surveillance and to date no evidence of FMD has been detected.

Hypotheses for source

18. The virus strain that has been identified on the IPs is Type O1 BFS, which is the strain recovered from the 1967 FMD epidemic in Great Britain. This strain only exists in FMD reference laboratories and pharmaceutical manufacturing plants, and is not in circulation anywhere in the world.

19. The closest such facilities to the IPs are at Pirbright in Surrey; the next closest location where the virus is held is in Belgium. It is therefore very highly likely that the virus in this outbreak derived from one of the two facilities on the Pirbright site. The commercial pharmaceutical plant cultures virus to make vaccine; the virus strain involved in the August 2007 outbreak was last used to make vaccine in the week commencing 16 July 2007. The Reference Laboratory use smaller amounts of the virus to provide reagents for diagnostic tests and disinfectant testing on a continuous basis.

20. Two investigations into the potential breaches of biosecurity at the Pirbright site are in progress; one is led by officials of the Health and Safety Executive (HSE). The second is an independent investigation led by Professor Brian Spratt. These investigations are being aided by the NEEG, the Veterinary Medicines Directorate and the Environment Agency. The interim report published by the HSE team on 7th August identified that there was large scale production of this strain of the virus within the likely period of infection (12th-30th July 2007, see Annex 1).

21. Five isolates of Type O1 BFS are currently being sequenced. These include 2 isolates stored at the research facility with different lineages, 1 MSV (Master Stock Virus) isolate maintained at commercial premises for vaccine production and a single isolate from each of IP1 and IP2. Results are pending but might reveal the origin of the outbreak (research laboratory or vaccine manufacturer) and whether IP2 became infected as a result of spread from IP1 or from a common source.
22. The virus may have reached one or both of the IPs either directly from the Pirbright site or by onward transmission of infection from another source, itself infected either directly or indirectly from the Pirbright site.

23. Investigations into the possibility of aerosol transmission from the Pirbright site and spread via the sewer to IP 1 have provided little evidence for these means of transmission. Investigations into effluent released onto the site and subsequent contamination of personnel, equipment or vehicles, and other fomite transmission routes off the Pirbright site continue.

RISK OF SPREAD

Protection Zone

24. Specific routes from the IPs: Aerosolised FMD virus is only excreted in significant amounts by cattle on days 1, 2 and 3 after the first lesions appear. Lesions on the feet or in the mouth may also shed virus into the environment e.g. water courses during this time. Annex 2 shows the total amount of aerosolised virus produced by the affected cattle on the two IPs on each day. By Wednesday 08 August 2007 aerosol shedding would have fallen to insignificant levels. The quantity and duration of non-aerosol shedding into the environment is being determined, as there is a possibility of spread via a stream that runs north from IP 1 to IP 2; this is being investigated further.

25. Until we have this information and on a precautionary basis, additional investigations have been carried out to identify all holdings where susceptible stock may have had access to the water downstream of the IPs and the Pirbright site. Susceptible stock have been subject to the routine PZ clinical inspections and serological sampling and no evidence of disease or infection has been found.

26. Rest of Protection Zone: As part of the measures to control disease in the PZ, all premises were put under restrictions, a census of all holdings with susceptible species was carried out and approximately 113 such holdings were identified. Premises were visited to confirm the stock present and clinical inspections were carried out of cattle every second day and pigs every day. Sheep and goats on 51 premises were clinically inspected and serologically sampled to look for evidence of current disease and/or previous exposure to infection. Results from 50 of these premises have given negative results and results are pending on the final one.

27. The frequency of these inspections is under review and is likely to be reduced as there is no evidence of further disease spread.

28. In addition to the checks and controls on livestock in the both zones, there are also requirements for increased levels of biosecurity on farms and for cleansing and disinfection of vehicles, people and machinery moving on and off farms. Movement of animals, animal products, feed and bedding are prohibited, except under license, and products from animals in these zones are subject to treatment to ensure destruction of the FMD virus.
Risk of spread out of PZ and SZ

29. Movement of susceptible animals out of the PZ and SZ presents the greatest risk of spread of disease. Sheep and goats provide the most likely route of silent spread of infection given that clinical signs of FMD are least obvious in these species. In order to assess the risk of spread, sheep and goats were serologically sampled to look for evidence that they had been exposed to infection and all movements of susceptible animals out of the PZ/SZ during the risk period were investigated.

30. Anyone moving sheep, goats or pigs is required to report the movements to their Local Authority within 3 days of the move. The Local Authority are then required to add the data to the Animal Movement Licensing System (AMLS) within a further 3 days.

31. Animal movements have been banned since 3\textsuperscript{rd} August so those moved before this date will now have been entered onto the system. Discussions with Local Authorities indicate that this assumption is correct and the information on the system is as current as possible.

32. Cattle movements are reported onto the British Cattle Movement Service and are recorded on the Cattle Tracing System (CTS). Again movements have to be reported within 3 days of the move taking place so again the information on the system is as current as possible.

33. Data was extracted from both systems in order to assess the possible risk of wider spread to show movements of susceptible stock out of the PZ and SZ during the risk period of 16\textsuperscript{th} July to 3\textsuperscript{rd} August.

34. Of the total of 31 movements of susceptible livestock from within the PZ during the risk period, approximately half of these were to agricultural premises with the remainder mainly going to slaughter. These movements are being investigated further to identify the current location of any animal remaining alive. Additional restrictions are being applied to these locations and the traced animals and their contacts will be clinically inspected (cattle and pigs) or serologically sampled (sheep and goats).

35. One movement of cattle was made to market and is being onward traced. Investigations have confirmed that no sheep from the PZ or SZ were moved to or sold through markets during the risk period.

36. There are no livestock markets located in the PZ or SZ and of the 27 sale days held during the risk period at the 5 market premises closest to the PZ and SZ, there was only one movement of cattle. There were no other movements to markets in GB from within the PZ during the period of risk.

37. The counties that received movements of stock from within the PZ during the period of risk are shown in the map below.
38. A census of holdings in the SZ is underway and susceptible species on these holdings will also be subject to clinical inspections and serological sampling in accordance with the measures as laid down in the Council Directive.

39. In summary, the risk of spread of infection out of the PZ/SZ through movements of cattle, pigs or silently infected sheep during the risk period is very low.

Risk of spread out of Surrey (other than out of PZ/SZ)

40. Sheep and goats provide the most likely route of silent spread of infection given that clinical signs of FMD are least obvious in these species. Initial data from the Animal Movement Licensing System (AML) indicate that 88 movements involving 1659 sheep and goats were recorded from premises in Surrey in July 2007. This represents fewer than 0.1% of movements in GB. Most of these animals were moved out of Surrey.

41. Investigations have confirmed that no sheep from Surrey or from the surveillance zone that overlapped into the neighbouring county of Hampshire were moved to or sold through Bicester sheep fair at Thame market on 3rd August.

42. In summary, the risk of spread of infection out of Surrey through movements of silently infected sheep and goats during the risk period is very low.
Wider Surveillance

43. From 2nd August 2007 to mid-day on 13 August 2007, suspicion of FMD had been reported on 56 holdings, in the counties shown in the table below.

<table>
<thead>
<tr>
<th>County</th>
<th>Number of notifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surrey</td>
<td>22</td>
</tr>
<tr>
<td>Devon</td>
<td>5</td>
</tr>
<tr>
<td>Somerset</td>
<td>4</td>
</tr>
<tr>
<td>Derbyshire</td>
<td>3</td>
</tr>
<tr>
<td>Kent</td>
<td>3</td>
</tr>
<tr>
<td>Hampshire</td>
<td>3</td>
</tr>
<tr>
<td>Cornwall</td>
<td>2</td>
</tr>
<tr>
<td>Aberdale</td>
<td>1</td>
</tr>
<tr>
<td>Berkshire</td>
<td>1</td>
</tr>
<tr>
<td>Caerphilly</td>
<td>1</td>
</tr>
<tr>
<td>Carmarthenshire</td>
<td>1</td>
</tr>
<tr>
<td>Denbighshire</td>
<td>1</td>
</tr>
<tr>
<td>Essex</td>
<td>1</td>
</tr>
<tr>
<td>Gloucestershire</td>
<td>1</td>
</tr>
<tr>
<td>Greater London</td>
<td>1</td>
</tr>
<tr>
<td>Oxfordshire</td>
<td>1</td>
</tr>
<tr>
<td>Suffolk</td>
<td>1</td>
</tr>
<tr>
<td>Sussex</td>
<td>1</td>
</tr>
<tr>
<td>Warwickshire</td>
<td>1</td>
</tr>
<tr>
<td>Worcestershire</td>
<td>1</td>
</tr>
<tr>
<td>Yorkshire</td>
<td>1</td>
</tr>
</tbody>
</table>

44. Disease has been confirmed on two of these as described in this report (IP 1 and IP 2). Laboratory results of one holding that has 42 sheep are still pending; disease has been ruled out on the remainder on clinical grounds or negative laboratory tests for FMD.

45. The table below summarises the outcome for report cases for which the possibility of FMD has been ruled out.

<table>
<thead>
<tr>
<th>Investigation of non-confirmed report cases</th>
<th>Number of premises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confirmed cases</td>
<td>2</td>
</tr>
<tr>
<td>Negated on clinical grounds</td>
<td>46</td>
</tr>
<tr>
<td>Samples sent to laboratory</td>
<td>8</td>
</tr>
<tr>
<td>Negated on laboratory results</td>
<td>7</td>
</tr>
<tr>
<td>Laboratory results outstanding</td>
<td>1</td>
</tr>
</tbody>
</table>
46. The temporal distribution of reports for FMD is shown in the figure below.

![Temporal distribution of reports for FMD](image)

47. In addition to wider surveillance for FMD, there have been two reports of suspected Blue tongue and four reports of avian notifiable disease.

**Modelling**

48. Results of modelling of the epidemic and its potential spread have been presented by six independent modelling groups. These were four British university groups, one from New Zealand and the British Meteorological Office.

49. All models agree that there is a low, but not negligible, risk of the spread of FMD from the area containing the Protection and Surveillance Zones. This is due to the relatively low density of susceptible animals in Surrey and the limited number of animal movements from the ‘at risk’ area to the rest of the country. Most model runs predicted no secondary spread; where spread was predicted, most iterations indicated that few (1-3) premises would be infected. In the few model runs (<10%) where more spread did occur, the epidemic was predicted to be small (i.e. fewer than 10-15 premises).

50. Specific airborne transmission of modelling from the ultimate source, the Pirbright complex, and the first and second IPs indicates that airborne transmission is possible, but of low risk. Long distance airborne transmission is unlikely.

51. In addition, a specific consideration of threshold scenarios to base a decision on whether to vaccinate, by Imperial College, concluded that the relevant trigger points have not been achieved and therefore there is no current evidence that vaccination is indicated in the current outbreak.
Forward look to assess risk of further outbreaks

52. This outbreak of FMD has very distinctive features which assist in both the establishment of the important epidemiological timelines and in the control of the disease. These can be summarised as follows:

- A known point source of infection, that is the Pirbright site, and a precise period of the likely release of the virus.
- Detailed clinical examination of, and laboratory testing of samples from, all susceptible species on premises slaughtered as infected premises and on suspicion (SOS) of FMD disease or infection.

This has resulted in an unusual precision of both the time of infection of IPs and the period of infectiousness of the IPs, which provides additional reassurance for the estimate of the risk of further cases of FMD.

53. In addition, the area in which infection of commercial farms occurred is of very low susceptible population density and movements of susceptible species from the farms in the ‘at risk’ area was notably low.

54. Slaughter of all stock on IP 2 was completed on 7th August and preliminary cleansing and disinfection was completed on 9th August. This is the last date on which virus is known to have been present in the field. It is unlikely that this virus could have been transmitted to other holdings after the imposition of the livestock movement ban and PZ restrictions on 3rd August, as this premises lies within the PZ. The possibility of an incubation period of up to 14 days from exposure to virus, suggest the latest date by which new cases could arise from the last IP is 23rd August.

55. In view of the low number of movements of susceptible stock to other holdings either within Surrey or elsewhere (as most movements are direct to slaughter), and the intensive surveillance that has been in place since the first confirmation of disease, it is unlikely that FMD is present elsewhere in Great Britain.
56. This outbreak differs substantially from the 2001 outbreak. The graph below shows a comparison of the number of report cases (holdings on which FMD is suspected that are notified to Defra), and the number of confirmed cases of FMD on each day of the outbreak, up to day 9. The level of notifications rose steadily during this period in 2001, whereas in 2007, numbers started to fall from Day 4.

National Emergency Epidemiology Group
FFG, Defra
14 August 2007
Annex 1: Infection Timeline

Note: the age of lesions used to generate the timeline is based on the expert opinion of staff from the Institute of Animal Health, Pirbright
Annex 2: Environmental load from the IPs (daily viral excretion from each IP)

FMD Outbreak Surrey 2007: Total airborne virus excretion per day from clinically affected animals on IP 1 (FMD/2007/001) and IP 2 (FMD/2007/002)

Annex 3: Distribution of lesions ages on IP 1 and IP 2
57. **Incubation Period**: The incubation period is the length of time from when the virus enters the animal to when the animal shows clinical signs of disease. For FMD the incubation period is variable with the size of the infectious dose and with the strain of virus. The lower the dose, the longer the incubation period. Consequently a wide range is used to allow for this variability. Expert advice from Institute of Animal Health, Pirbright is a range of 1 to 12 days but a more conservative estimate of 2 to 14 days is used in the EC Directive and this has now been adopted in this report. This is also reflected in the timeline in Annex 1.

58. **Dangerous Contacts**: An essential element of disease control is the assessment and control of ‘dangerous contacts’ (DC). These are defined as animals and/or premises at very high risk of being exposed to infection such that they may go on to develop the disease. Such premises need to be identified and controlled before disease does develop in order to prevent further multiplication of the virus and continued spread of the disease. In most cases, we would expect to get negative results from any samples taken and this would confirm that our actions in preventing further spread had been successful.

59. Once identified as a DC by a veterinary risk assessment a variety of actions can be taken by policy makers. These may differ depending on the context of the epidemic and can include additional considerations such as the risk of onward transmission from the DC, for example the proximity of other susceptible stock, and resource availability.

60. Options for control include culling the exposed animals, placing them under restrictions with veterinary inspections until the maximum incubation period has elapsed since the date of exposure and/or serological sampling.