Fly management: how to comply with your environmental permit

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We cannot do this alone. We work closely with a wide range of partners including government, business, local authorities, other agencies, civil society groups and the communities we serve.

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Foreword

This guidance provides information for Operators, Environment Agency staff and Local Authority Environmental Health Officers on:

- Regulatory background
- Common types of fly species and the impacts
- Monitoring, management and control techniques
- Investigating fly infestation and resolving fly complaints
- Producing a fly management plan and where to find other useful information.

This Environment Agency guidance has been produced in conjunction with Local Authority Environmental Health Officers and will benefit both regulatory bodies.

Contents

1. Introduction

This document is for operators and Environment Agency (EA) officers to ensure environmental permits are complied with in respect of fly management. This EA guidance was produced in discussions with Local Authority (LA) Environmental Health Officers (EHO), so should also benefit EHOs.

The document is not prescriptive but it identifies ways in which you can gather information and offers solutions which may be applied in the right circumstances. There may be other options which aren't included, for example introduction of new techniques.

This guide will be helpful, but not limited to, where there are sensitive receptors located within 400 metres of the site boundary or where the site has a history of fly-related complaints. Fly problems are better managed by a structured and pro-active approach than by reactive efforts once the problem is established.

The document does refer to other legislation that might also be relevant, such as Health and Safety at Work Act 1974 or the Food Hygiene Regulations 2006, where we aren't the enforcing authority for. Operators need to ensure they comply with all relevant legislation.

1.2 Regulation: working together

Defra guidance on the Environmental Permitting Regulations and the statutory nuisance provisions (Environmental Permitting Guidance – Statutory Nuisance) states that where a site is permitted and the permit conditions address nuisance by flies, it is our responsibility to investigate. Where a fly infestation is discovered at an off-site location (housing, offices) and traced back to a permitted facility which has a condition addressing the issue then we should investigate.

Where the permit does not contain such a provision the LA can exercise their statutory nuisance powers. The LAs are also responsible for investigating non-permitted and Part B permitted sites.

EHOs have wide experience in investigating nuisances and liaising with the local residents. Flies have been included in the list of defined Statutory Nuisances which they enforce. We should always work with the LAs to resolve the issue.

1.3 Permits and pollution

Environmental permit conditions require fly pests to be managed in a number of different ways. Some permits may have a specific 'pest' condition which requires the operator to produce and put in place a 'Pest Management Plan' to ensure they satisfactorily manage the situation to regain compliance with the permit.

In modern permits this would be rule 3.6.1, rule 3.6.2, or typical permit condition:

Typical permit condition or rule 3.6.1:
The activities shall not give rise to the presence of pests which are likely to cause pollution, hazard or annoyance outside the boundary of the site. The operator shall not be taken to have breached this condition if appropriate measures, including, but not limited to, those

specified in any approved pests management plan, have been taken to prevent or where that is not practicable, to minimise the presence of pests on the site.

Typical permit condition or rule 3.6.2
The operator shall:

- *if notified by the Environment Agency, submit to the Environment Agency for approval within the period specified, a pests management plan which identifies and minimises risks of pollution from pests;*
- *implement the pests management plan, from the date of approval, unless otherwise agreed in writing by the Environment Agency.*

This condition requires operators to take appropriate measures to prevent or minimise pests. The measures required need to be reasonable, good practice and balance the costs and benefits to prevent or minimise pests.

Modern permits may not have a 'Pest' condition but will have a General Management condition where it states:

1.1.1 The operator shall manage and operate the activities:

a) in accordance with a written management system that identifies and minimises risks of pollution, including those arising from operations, maintenance, accidents, incidents, non-conformances, closure and those drawn to the attention of the operator as a result of complaints; and so on.....

The general management condition can and should be used to control fly nuisance where a pest condition is not included in the permit, as the definition of pollution includes nuisance. Flies can amount to 'pollution' within the meaning of the Environmental Permitting (England and Wales) Regulations 2010 (EPR):

"Pollution", other than in relation to a water discharge activity or groundwater activity, means any emission as a result of human activity which may;

- *be harmful to human health or the quality of the environment,*
- *cause offence to a human sense,*
- *result in damage to material property, or*
- *impair or interfere with amenities or other legitimate uses of the environment;*

The 'Emissions without limits' condition can also be used as it cover flies as being vectors of transmittable diseases.

Whatever the permit condition the operator should ensure that all appropriate preventative measures are taken to prevent fly dispersal from the site or, if that is not possible, to reduce the impact of flies on the neighbourhood to acceptable levels.

We expect any standards of industry good practice to be met along with any recommendations in our guidance. Having a pest management plan that sets out a number of measures operators will take doesn't necessarily mean they will comply with the condition. An operator is obliged to prevent pests or use all appropriate measures to prevent pests that amount to pollution from their activities. Operators may need to update this plan with further measures to ensure they continue to meet the condition.

If there is a pest problem at a site and the operator has already implemented some measures, there may be a case to justify further measures or restrict the activity, depending on the severity of the problem and the cost.

If the operator has a permit without a specific pest condition and we need the regulatory control this brings, we may vary the permit to add the specific fly condition, particularly if there is fly pollution and the operator hasn't taken measures to control it.

2. Flies and fly problems

Just over 7000 species of true flies (Diptera) are known to occur in the UK. Of these, around ten species have the potential to cause regular and significant problems on and around waste management facilities and livestock sites.

2.1 Main fly species and identification

Correctly identifying the fly species at a site, or reported at complainants' premises, is critical to:

- clarify whether the complainant's flies are the same as those at the alleged source
- establish appropriate monitoring techniques
- establish appropriate prevention and control techniques

With appropriate training the adults of most of the main fly pest species can be identified by eye, with the help of a x10 hand lens. Table 1, below, provides a brief overview of the common fly species which generate complaints and can be associated with livestock or waste management facilities.

Table 1: fly species (illustrations are in Appendix 1)

Fly species	**Typical pest status**	**Notes**
Common housefly (*Musca domestica*)	Can cause widespread and severe problems	Larvae found in poultry, pig, and calf manure, and in refuse. Adult readily disperses and enters buildings.
Lesser housefly (*Fannia canicularis*)	Can cause widespread and severe problems	Larvae found in poultry manure, and in refuse. Adult readily disperses and enters buildings.
Blow flies: Bluebottles / Greenbottles (*Calliphora / Lucilia*)	Localised problems only	Larvae found in carrion and faecal material, commonly associated with putrescible waste. Adults tend not to disperse far.
Stable flies (*Stomoxys calcitrans*)	Localised problems only	Larvae found in manure of large animals, e.g. cattle and pigs. Adult is blood-feeding, and tends not to disperse far.
Fruit flies (*Drosophila spp.*)	Localised problems only	A small (2mm) fly. Larvae found in rotting vegetation or vegetable waste, e.g. green-waste composting. Tends not to disperse far.
Cluster flies (*Pollenia rudis, Eudasyphora cyanella, Musca autumnalis)*	Localised problems only	The larvae of these flies are not found in livestock or waste facilities, but the adults do enter buildings in the autumn, and may be confused with houseflies by complainants.

More detailed information on the predominant fly species, the common housefly and the lesser housefly, is provided at Appendix 2.

2.2 Fly sources

In general, fly larvae occur in damp, decaying organic waste. However, each species will have its preferred niche in terms of temperature, moisture levels, and the nature of the organic material. In the UK, there are two main areas in which fly problems regularly occur:

Waste management industry

Common house flies and bluebottles have always been associated with putrescible waste (this includes food and green waste) particularly during warmer weather. Infestation typically starts at the point of waste generation, when eggs are laid on waste in domestic or trade waste bins.

The longer the period of time before the waste reaches its final disposal point (landfill, composting, incineration) the greater the opportunity for fly problems to develop. In recent years the move towards fortnightly collection of domestic refuse, the introduction of a variety of waste processing techniques, and the reduction in the number of landfill sites and amounts of waste have increased the potential for fly infestation.

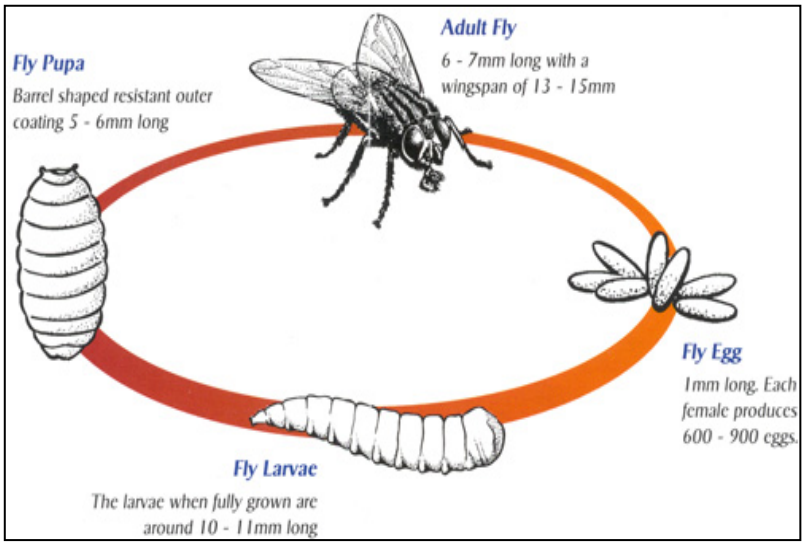
Animal husbandry

Rearing poultry (particularly for egg production), pigs, cattle or other livestock inevitably creates quantities of manure, which is vulnerable to fly infestation. The potential for problems is greatest in husbandry regimes where the manure remains within the animal house for extended periods (such as some free-range poultry laying systems). In recent years, the rapid growth in large-scale free-range egg production has resulted in more frequent problems with lesser houseflies, which prefer the cooler environment in free-range houses.

2.3 Fly breeding and development

The life cycle of most flies has four main stages: egg, larva, pupa and adult, shown in the diagram below (which refers to common housefly).

Fig 1: Common housefly life-cycle



In general, the adult female will lay eggs on a suitable surface for larval development; typically damp, decomposing organic materials. The larvae will hatch out and feed on the substrate, and when fully grown will search out a drier area in which to pupate. The adult fly will emerge from the pupa, mate, and continue the cycle.

The duration of the cycle is very dependent on the temperature of the larval environment, as shown in Table 2.

Table 2: Example of the effect of temperature on the rate of common housefly development.

Species	Approximate duration of life-cycle (egg to adult) in days				
	16°C	18°C	20°C	25°C	30°C
Common housefly	45	27	20	16	10

The higher the temperature, the more quickly flies develop and increase in numbers, and so the greater likelihood of problems. Most other fly species will develop slightly more slowly than the common housefly.

At temperatures below c.12°C, development will cease for most housefly species, while at temperatures above c. 45°C, houseflies and their immature stages will be killed.
As waste decays the microbial action generates heat, which can mean the in-waste temperature is warm enough for flies to breed even in winter months if waste turnaround isn't adequate.

2.4 Fly dispersal

Although most adult flies stay close to their breeding sites (manure or putrescent waste), a proportion will disperse away and may cause problems at receptors. Houseflies are capable of dispersing over distances of several kilometres, although problems seldom occur at distances greater than 2-3 km from the source. Significant problems likely to cause unacceptable nuisance levels tend to occur within 500m of the source. Regulators will look at the extent of fly breeding at the alleged source rather than how far flies have dispersed to ascertain the extent of the problem.

Dispersal factors can vary, but high levels of fly breeding at the source are what normally appears to result in high dispersal levels. Dispersal appears to be greater in calm, warm weather. A specific event, such as opening of poultry houses in preparation for removing manure, allows rapid dispersal which can cause a sudden increase in fly complaints.

Dispersing flies are difficult to find. Even where there are a large number of flies at a source, and concurrent problems with flies in nearby premises, flies are seldom visible in numbers in the intervening areas.

2.5 Problems caused by flies

The persistent presence of flies gives rise to a range of issues:

Annoyance/Nuisance

People find the continued presence of numbers of flies in their home or workplace irritating and unpleasant. Where there are breeding sites nearby, residents or employees may

experience hundreds of flies in their homes or workplace. Where there are no breeding grounds nearby, one or two flies would be normal. The annoyance is often increased because houseflies are difficult to control with insecticides, and are particularly attracted to kitchens and humans.

Disease transmission

Adult flies are often active on putrescent and microbially contaminated substrates. As a result, their external surfaces and gut will become contaminated with a broad range of pathogens. If these contaminated flies subsequently come into contact with people, livestock or foodstuffs, there is the potential for disease transmission.

In the tropics a major source of infections in humans can be traced back to houseflies. Although fly numbers and the opportunities for contamination in the UK are typically much less, a small risk still remains.

Physical contamination

The physical presence of flies may lead to contamination issues. Flies may become incorporated into food products during manufacture, and have been found within the packaging of eggs being delivered for processing.

Fly spotting (fly faeces and vomit) on eggs can lead to their rejection or downgrading. The presence of large numbers of flies in an area might also interfere with the effective operation of other nearby businesses, such as vehicle repainting.

Biting

Of the flies regularly associated with waste or livestock sites, only the stable fly (*Stomoxys calcitrans*) feeds on blood. It normally feeds on large animals such as pigs, cattle or horses, but may also bite people.

Commercial impacts

Egg producers with persistent fly infestation resulting in poor quality eggs may find that their accreditation to various food quality schemes are suspended, or that customers such as supermarkets decide to terminate their commercial agreements.

3. Fly monitoring

The following techniques can be used as part of a one-off inspection to gain an idea of the level of infestation, or regularly as routine monitoring to build up a picture of trends in fly numbers. Operators normally carry out routine assessments as part of their proactive fly control work.

The benefits of fly monitoring include:

- Trends in fly numbers at the alleged source can be compared with trends in numbers in complainants' premises, possibly providing evidence of a link.

- Monitoring data from different parts of the site, e.g. different poultry houses, or different areas on a large landfill, can be used to identify localised areas where fly breeding is occurring. This will allow specific causes to be identified so operators can use more focussed or intensive control efforts.
- Monitoring flies throughout a cycle will allow 'normal' levels to be established. Any rise in numbers will be noticeable, so early additional control measures or treatment can be put in place.
- Where records have been recorded over several seasons, they can predict impending fly peaks, so allowing pre-emptive fly control work.
- Comparing fly numbers before and after particular fly control measures have been used will indicate the effectiveness of the treatment. This is particularly useful if the officer suspects that the treatment is not being used correctly or that resistance to specific chemicals is becoming apparent.

Fly monitoring record forms for use by operators are in Appendix 3.

3.1 Monitoring adult flies at the source

Indoor resting counts for common house fly

This species readily rests in numbers on structural surfaces within buildings, like poultry houses or waste transfer stations, so resting counts are often used to indicate relative population size. Typically 1 x 1m squares are outlined with white paint on internal wall surfaces, with the centre of the square at about head-height.

There may be 4 – 6 squares in a poultry house or waste transfer station. Squares should be located in areas where flies are seen to be resting, away from frequent people or vehicle movements, close to likely fly breeding areas, and where the square will not subsequently be obscured by manure, waste or other materials. The operator counts and records the number of flies resting within each square at regular intervals, for example up to twice-a-week from April to October and once–a-week at other times.

The squares should be brushed occasionally to remove dust and cobwebs, and should not be sprayed with insecticide. Experience shows that a count of less than 5 flies per square can be considered normal, whereas numbers above 20 per square indicate a problem to be investigated.

Indoor adhesive paper traps for houseflies

Adhesive fly papers (see Fig.2) are used to monitor lesser housefly numbers. In each building two to four 30cm wide rolls are hung up at about head height in areas where flies have been noted. At weekly intervals, a length of paper (approx 30cm) is pulled down from the roll, and at the end of the week, the flies stuck on the exposed paper are counted and recorded.

The paper should then be torn off the roll, covered with cling-film and retained so flies can be identified and counted. A fresh 30cm length is then pulled down ready for the coming week. Operators should carry out counts from April to October, and at some sites may be required throughout the year. Fly counts increasing to 20 or more of one species of fly on a paper in a week indicates that numbers are rising and may cause off-site annoyance.

Note: fly numbers will vary greatly between sites. Changes in numbers indicate changes in fly activity. Remember, there is no absolute number determined as a nuisance.

Fig 2: Adhesive fly paper used for fly monitoring in a poultry farm (Copyright C. Boase)

Open air Scudder grid counts for houseflies at waste sites

A Scudder grid is a standard 60cm square wooden slatted grid which is dropped onto the surface of the refuse. After a period of 10 seconds, the flies resting on the grid are quickly counted and recorded; these are likely to include common housefly and bluebottles, so an element of identification is necessary.

Fig 3: Scudder Grid in use at a landfill site (Copyright C. Boase)

The count is repeated 10 – 15 times in areas with higher fly numbers, such as on and around the active tipping face. Counts should be carried out at times when flies are active, typically between 10.00 and 16.00 hrs.

Avoid doing counts in cold, windy or wet conditions. Counts should typically be carried out 2-3 times per week from April to October. Regular monitoring can determine 'usual' numbers for that site and therefore any rise will be easily seen.

Open air adhesive paper catches for flies at waste sites

At open air sites, such as landfill sites and waste transfer station boundaries, operators can use adhesive papers to monitor fly numbers. Pieces of adhesive paper (~ 30 x 30 cm) can be attached to a post around the site for a week, then removed, replaced and the catch counted. The limitations are that the papers can't normally be positioned on the active tipping face as they will be damaged by vehicles. The papers also catch large numbers of non-pest species, which have to be separated from the pest species before obtaining a final count. Birds take the captive flies on papers, and adverse weather (wind and rain) will also affect the catch.

3.2 Monitoring larval flies at the source

Scrape-and-count, for common houseflies

Operators can monitor larvae by scraping the top 2 - 5cm layer from the surface of the manure or waste over an area of approximately 30 x 30cm. The number of exposed larvae is quickly estimated, and recorded.

This should be carried out at 4 – 10 locations within each building/vessel, depending on its size and the variability of the material. Larval stages are usually found where undisturbed damp manure or waste is present, rather than on surfaces that experience a lot of movement. Drainage channels/grid drainage channels that have a waste residual within them can become “lucrative” nurseries for flies.

Good monitoring locations are those where this material is present for extended periods, such as the manure pit in a poultry house or the tipping face of a landfill site, allowing a series of counts to be taken and trends to be established. In premises where there is a high turnover and removal of substrate (belt removal systems in poultry houses, or well-run transfer stations), then routine monitoring of larvae may be inappropriate, and monitoring will be based on adult counts.

Counts should be repeated up to twice-a-week from April to October. Consecutive counts should not be carried out on exactly the same area of manure or waste. One or two larvae would be considered ‘normal’, if more than five are found then action is needed.

Sample-and-count for lesser houseflies

The majority of severe problems with lesser houseflies occur almost entirely in free-range poultry layer units. Counting larvae in-situ is not appropriate for lesser houseflies because of limited access to the manure in free-range poultry houses, the difficulty in seeing the young stages within the manure, and the difficulty in separating larvae from pupae. Instead, operators can use a long-handled trowel or similar to scrape a sample of ~300g manure from the top 5-7cm of the pit surface, which is then put into a white bowl or tray. They should then check each sample and count and record the number of larvae and pupae present.

At best, the operator should obtain and check around four manure samples per week per poultry house. Samples should be taken from the manure pit wherever there’s access. If possible, operators should try to get both drier (from edge) and wetter (from under drinkers) samples.

Again, very few larvae or pupae should normally be found. If the number is high, action is needed.

3.3 Monitoring adult flies at complainants’ premises

Monitoring should be carried out in indoor locations where the flies regularly occur in numbers. This may be a porch, outbuilding, conservatory, kitchen etc. We don’t recommend monitoring houseflies outdoors owing to the diversity of the catch, and the risk of catching birds or bats on adhesive papers

Fig 4: Adhesive fly papers in a resident's home (Copyright C. Boase)

Traditionally, long adhesive fly papers are used, available from DIY or farm supply stores. They're cheap, easy to use and catch flies well, although they can be difficult to handle and store after use. Single-sided adhesive fly papers should be transported in cardboard boxes and can then be stuck on white paper to identify (where possible) and count flies.

Officers should take photographs of papers as they may be required for evidence. Fly papers should be replaced weekly throughout the infestation, and continue to be used after numbers have dropped so that 'usual' numbers can be recorded. For enforcement cases it is essential to be able to state what is 'usual' in that area. Experience has shown that fly papers can attract up to 500 flies, and that a number of 50 or more of one species in a week indicates a significant breeding ground nearby.

Alternatively, more specialised adhesive fly catching products devices are available. Although these appear to catch fewer flies, the devices may be conveniently labelled and stored after use, and re-examined later as required. One or more adhesive devices should be hung up in each premise. Adhesive devices should be labelled and changed weekly. The catch should be identified, counted and recorded by the investigating officer.

Liquid-baited fly traps are not suitable for fly monitoring as the traps can't be stored after use and the flies quickly decompose, making them difficult to identify.

3.4 Interpreting fly monitoring data

3.4.1 How many flies at the source constitute a problem?

There is not a fixed relationship between the number of flies at a 'source', and the risk of nuisance in neighbouring properties. The risk of nuisance occurring will depend not only on the number of flies at the 'source', but also on other factors, such as the distance from the 'source' to the neighbours, the attractiveness of the neighbour's premises for the flies and the weather (see 2.4). For example, one poultry site may have very high fly numbers but not cause any problems because the neighbours are too distant, while a similar poultry site situated only 100m from neighbours will have to work very hard to prevent nuisance.

Through fly monitoring and feedback from the regulator, individual sites may develop an understanding of what fly levels on site correspond with complaints from neighbours. This enables a threshold fly count to be set for that site, above which complaints are likely to occur. Fly management measures at the site should then be timed to prevent fly numbers exceeding this threshold.

3.4.2 How many flies in a complainant's property constitute a nuisance?

As with other issues such as noise or odour, there is no rigid definition of how many flies represent a nuisance. Experience shows that some households will complain vigorously

about five flies in their home, while other households will quietly tolerate thirty flies. Defra's guidance on interpreting the Clean Neighbourhood and Environment Act 2005 says that:

'There are no objective levels at which a statutory nuisance exists or may be caused. In general, in domestic premises, it is likely that the threshold will be very low and control actions might be taken in cases of few house flies.

As a guideline, an occupier will normally experience some irritation if there are five or more 'flying' house flies present in any one room at any one time on three successive days. If house flies are monitored with baited traps, sticky ribbons, or spot cards, a collection of more than 25 in any 48-hour period may indicate grounds for distress.'

In practice, there is a significant difference between something being an irritation and a situation constituting a nuisance in law. Therefore, officers should focus monitoring and investigation in properties with an unequivocal problem.

Defra's figure of >25 houseflies caught on fly papers in 48 hours identifies properties with a significant problem. However, for regular monitoring, weekly visits are more practical than 48hr visits, and in practice a catch of more than 50 houseflies per paper per week would indicate a premises with a significant problem as outlined above.

Investigating officers should also hang fly papers in premises where no fly problems are reported to get an idea of 'normal' background fly numbers.

In general, claims of fly nuisance relate to indoors. Claims about fly nuisance outdoors are much more challenging because of the numbers and diversity of other non-pest insect species. Complainants about flies in gardens rarely identify the species involved.

4. Investigating and resolving fly complaints

To demonstrate that a particular site is likely to be responsible for the flies at complainant's premises, officers need to show that:

- The alleged source is a breeding site for significant numbers of the same species of flies as those found at the complainants' premises. Simply showing that the adult flies at the alleged source are the same species as the flies at the complainant's premises isn't enough. The flies at the two locations could have come from another unknown site. Breeding has to be established at the source to make a clear link.
- There are no other significant sources of the same species of flies nearby, eliminating the possibility that the complainants' flies come from elsewhere. Not all houseflies come from mass breeding sites; small quantities of waste can generate enough flies to cause a local nuisance.
- Changes in fly numbers at the source (for example due to manure removal from poultry houses, or using an inert cover on landfill sites) are mirrored in the complainants' premises.

The following is an outline procedure to identify, investigate and resolve fly problems reported by complainants. This is neither a prescriptive approach, nor the only approach and the detail and the sequence may vary depending on the site.

Step 1: Fly complaint received

Discuss the issue with the complainant to ascertain the history of the problem, likely species, fly numbers, their habits and impact on the residents. If necessary, ask them to submit samples to the investigating officer for identification. Is the complaint associated with or close to a permitted site?

If there are a number of residents affected or the issue is contentious, you may need to prepare an engagement plan – your local communications team can help with this.

Step 2: Complainant visit

If the problem is persistent and appears to be related to a site we regulate, or involves several residents or businesses and concerns significant numbers of houseflies, consider visiting the complainant's premises to collect samples and take photos as evidence. Offer advice on control measures (section 5.2) they can use within their properties. Consider contacting the local environmental health department to see if they are aware of problems or can offer any advice.

Step 3: Complainant fly monitoring

Ask the complainants to hang adhesive papers in agreed locations in the property (see Section 3) and change them every week until asked to stop. The investigating officer should take a photo of the fly paper in-situ before collecting the papers to identify and count the flies.

The sticky papers are then fixed to white paper and a label attached with details of location, dates, flies and numbers, and the officer takes another photo. Premises that have a significant fly problem are those with 20 or more flies within a room at one time, or more than 50 flies collected on a sticky fly paper over one week. Remember, there is no absolute number.

If the number of flies caught is going to be used in evidence, the complainants will need to give a statement about whether they have moved or done anything to the papers during the monitoring period.

Step 4: Identify potential fly sources

If the complaint concerns significant numbers of houseflies, identify potential fly breeding sites, initially within a 1 km radius of the complainant(s). Contact the LA to discuss any issues they may be investigating in the area.

Step 5: Investigate potential fly sources

Contact the identified sites and ask about any recent fly issues. Visit the sites where the fly breeding may be occurring. Site visits should include:

- Discussion with the operator to understand the systems and processes on their site, such as age of stock on farm, manure storage and removal procedures, ventilation systems, incoming waste streams, waste processing procedures and times, good housekeeping including waste rotation, cleaning and washing down buildings etc. Establish if there have been any recent incidents (e.g. water leaks, or equipment breakdown), or changes in procedures (e.g. new incoming waste streams) that may have increased the risk of fly infestation.

- Checking the site for the presence of adult flies, fly breeding, and conditions conducive to fly breeding. Take dated photographs of key issues seen. On farms this investigation is likely to involve examining manure from various locations within livestock sheds for moisture levels, and for the presence of fly larvae (see 3.2).

  At waste sites this may involve examining waste for fly larvae. Additionally, any adhesive fly papers and electronic fly killers present should be checked for fly numbers and species. Are the fly species present the same as those at the complainants' premises? Is the farmer or operator already monitoring fly numbers? Are fly records available?
- Is the site already using fly control measures? Do they have a fly management plan? What has been identified in their management system? What techniques are used (both non-chemical and chemical), and for how long? Is there a fly control contract? Is the contract or contractor appropriate? Are records of pesticide use available?
- Repeat this process for each potential fly source. Beware of becoming fixated on one potential source at an early stage.
- Discuss with the operator what they need to tell the local community and what part they need to play in any engagement plan.

Step 6 Resolve fly problems

At sites where a clear fly problem has been identified it is likely that the operator has breached their permit.

You need to establish the root causes of the fly problem, such as wet manure, poor ventilation, over-flowing drinkers, insufficient use of cover, allowing unprocessed waste to remain on site for extended periods, inadequate composting process, inappropriate pesticide use etc.

Provide the operator with relevant advice on good practice for fly management, especially on fly prevention. Ask the operator to write or amend and implement a Fly Management Plan (see Section 6), which addresses the root causes to solve the issue and prevents recurrence. Advise the operator clearly of the level of nuisance being experienced in nearby residences.

An example of monitoring sheets which can be used by operators can be found in Appendix 3.

Step 7. Feedback to residents

Discuss the action taken with the affected residents. Advise them that treatment is likely to take several weeks to be fully effective, and they should continue to monitor until otherwise advised or they are confident the problem has been resolved.

Step 8. Follow up visits to site

For sites where action was required, revisit the site within two weeks to assess the implementation of agreed actions and their effectiveness.

If the action taken by the operator is inadequate or ineffective continue to work to address the problems. Ask yourself the following questions:

- Are there issues that were missed at the initial visit?
- Are there fly breeding areas that were overlooked, for example, lesser housefly larvae can be very difficult to locate?

- Does there appear to be resistance to the insecticide products used?
- Are there other significant fly-breeding sites nearby which have not yet been investigated?

Step 9. Conclusion

Once the problem is resolved, advise all parties of the outcome of the investigation, action taken and proposals to avoid a recurrence. Advise complainants to contact us again if problems recur.

5. Fly management techniques

In practice, successful fly management is likely to involve the co-ordinated use of a range of both non-chemical and chemical fly control techniques.

The COSHH Regulations 2002 impose a requirement to consider using non-hazardous pest control techniques in preference to potentially harmful pesticides. Where suitable techniques exist, pro-actively preventing fly problems is a more effective and sustainable approach than trying to deal reactively with an established infestation of flies. Typical permit conditions require prevention of nuisance, where possible.

Sections 5.1.1 to 5.1.8, below, outline the main preventative techniques for reducing the risk of fly problems in a range of sectors.

Sections 5.2.1 to 5.2.3 outline the main control techniques for existing fly problems.

5.1.1 Fly prevention and appropriate measures for in poultry facilities

The key to avoiding fly infestations is managing water and moisture in the manure. Premises which keep manure dry or regularly remove it rarely experience serious infestations, and almost never need to use insecticides. All installations should aim to achieve this situation.

High risk periods for fly infestation in poultry laying units are the first few months after a new flock has been introduced, where that period coincides with warm weather. For example, introducing a new flock into a house in April poses a risk of fly problems within a few weeks that may then persist for most of the summer. This is a result of the combination of rising temperatures, low initial predator numbers, and manure that tends to be wet in the initial period whilst the flock settles.

Operators should ensure they have a sufficient stock of insecticide products, and the resources to use them if required, over this high risk period.

Poultry laying units should adopt the following preventative steps where appropriate: Frequent monitoring of adult and larval flies using appropriate monitoring methods as described in Section 3;

- Where appropriate, manure should be frequently removed from the site
- Manure remaining on site should be managed to keep water content below 50%, i.e. it is dry and friable. This may be achieved by monitoring water drinkers for leakage; preventing water ingress into the building; ensuring good ventilation of manure holding areas, and ensuring the livestock is healthy.

- Certain feeds result in wetter litter, and the producer should take action to deal with constantly wet faeces.
- Removal of manure/litter from the building and transport off site should comply with current Codes of Practice.
- Broken eggs and fallen stock should be removed daily.
- Cleaning up feed spillages daily, where possible. If this isn't possible, the operator should monitor the spillage area more closely for flies.
- Incorporating fly screening into buildings if possible and where it won't affect ventilation.
- Training staff in monitoring and treating fly infestations.

5.1.2 Fly prevention and appropriate measures for pig facilities

High risk times for fly infestation are prolonged periods of warm weather. Pig facilities should follow the steps below to help prevent fly problems:

- Twice-weekly monitoring of adult and larval flies during April to October using appropriate monitoring methods as described in Section 4.
- Manure should be removed frequently, ideally daily (or as frequently as possible) from high risk areas such as finisher units.
- Transport of manure/litter off site should comply with current local authority and Defra Codes of Practice.
- Fallen stock should be removed daily.
- Incorporating fly screening into buildings where possible and where it won't affect ventilation.
- Training staff in monitoring and treating fly infestations.
- Clean feed spillages daily, where possible. If this isn't possible, operators should monitor the spillage area more closely for flies.

5.1.3 Manure removal and transportation

To minimise the impact of fly dispersal during manure transportation off-site, operators should comply with relevant local authority and Defra Codes of Practice, especially:

- Ensure adult fly numbers are minimised before houses are opened up for manure removal.
- Avoid overloading trailers to prevent manure spillages onto the highway.
- Cover trailers, if practical, when moving through residential areas.
- Ensure that the recipient of manure has selected an appropriate location for the heap (see below), and where possible can cover the manure heap at the end of each day.
- Wherever possible deliver infested manure to arable land where it can be immediately incorporated as it's spread.
- Infested manure is unlikely to be suitable for reprocessing (for example as poultry manure fertiliser).

5.1.4 Storage and spreading of manure and other biosolids

It may be necessary to store manure or other biosolids before land becomes available for spreading. Manure has the highest risk of infestation, but other biosolids such as anaerobic digestor sludge can also become infested. Such storage should comply with relevant local authority and Defra Codes of Practice to minimise any potential fly nuisance during storage and spreading, as well as to prevent damage to land and watercourses.
Key points are:

- Only non-infested manure should be applied to grassland or growing crops. Infested manure spread to bare soils should be incorporated by deep inversion ploughing at the time it is applied, or in any case within 24 hours.
- Ideally, manure heaps should be located at least 500m distant from sensitive receptors where there is a known fly problem. Greater distances may be prudent where large quantities are being stored.
- If there is a risk of fly infestation, field-stored manure heaps should be tightly covered with polythene sheeting or similar impervious material. There should be no gaps between overlapping sheets, and the edges of the sheeting should be buried in a 30cm deep trench around the entire heap and back-filled with soil.
- Sheeting should remain in place for at least 10 days to ensure the death of any flies within the manure, and ideally longer to prevent re-infestation.
- The integrity of the sheeting should be checked at least weekly, and repairs carried out as necessary.
- Spreading should not be carried out on Bank Holidays or Sundays.
- Manure should not be spread to land within three weeks of the last application of cyromazine larvicide. After spreading, the land should not be grazed or cropped for another 4 weeks.

Local authority Codes of Practice for manure removal, transport, storage and spreading emphasise that manure management is the joint responsibility of the producer, the transporter and the end user. There are steps that each can take to reduce and/or prevent fly infestations. These steps form an integrated approach involving good manure management, together with biological and/or chemical control methods.

5.1.5 Fly prevention and appropriate measures for waste transfer stations

High risk times for fly infestation at transfer stations are periods of warm weather. It is critical that proper fly control is used at the transfer sites with the flexibility to carry out additional treatments at peak times. This should prevent, or at least minimise, the potential for infestations of maggots/flies getting to landfill where it’s often too late to implement adequate control measures. Operators can do this by:

- Monitoring adult fly numbers twice-a-week during April-Oct using an appropriate technique, such as resting counts in squares marked out on internal walls.
- Carrying out waste acceptance checks (monitoring at weighbridge where possible, monitoring fly numbers in each load, recording heavily infested loads in fly contaminated load log sheet, treating loads and priority removal off site, not accepting fly infested loads from other waste sites). Where it's not always possible to monitor loads at the weighbridge, operators should monitor upon discharge.
- Rejecting infested/problematic waste (what procedure is in place to ensure repeat problematic loads/known problematic waste streams are not accepted).

- Proper waste handling and rotation (A/B system of waste in one day and out the next, waste not stored for longer than 48 hours, waste treated). This is especially important during the warmer months.
- Ensuring that waste doesn't accumulate in inaccessible areas such as behind push walls, under plant or in corners. Any such waste should be removed daily, especially during the summer. Operators should also maintain good housekeeping, including cleaning down and disinfecting, regularly removing leachate and maintaining drainage systems.
- Aiming to ensure contingencies are in place if the main nominated disposal point is unavailable e.g. technical problem at waste to energy site or high winds closing landfill. Contingencies should include identifying alternative outlets.
- Minimising the time external doors are left open during the warmer months, and where possible installing automatic doors. Screen other openings where possible to reduce fly dispersal.
- Training staff in using fly spray, identifying flies, toolbox talks and understanding the importance of monitoring/recording fly infested loads.

5.1.6 Fly prevention and appropriate measures for landfill sites

High risk times for fly infestation at landfill sites are generally periods of warm and damp weather. Landfill operators should make sure they have sufficient stocks of appropriate daily cover, and the resources to apply it, over the summer period. Waste arriving on site should be thoroughly compacted immediately. In addition, the operator should ensure that an appropriate fly control contract is in place, and that it is sufficiently flexible to allow changes in treatment frequency if required.

Key fly prevention activities at landfill sites include:

- Monitoring adult fly numbers twice-a-week during April-Oct, using an appropriate technique such as a Scudder grid (see 3.1).
- When adult fly numbers are high, investigate potential fly breeding areas (see 3.2).
- Applying a daily cover thick enough to prevent fly infestation at the tipping area, and to associated flanks of lifts. This is especially important at the end of the working week. NOTE: Cover is applied for many reasons and these other requirements should also be considered.
- Sites should be operated with a small tipping face. This results in refuse acting as its own cover, so smaller quantities of appropriate daily cover are needed, and restricts the extent and need for insecticide treatment.
- When refuse is being brought in from areas operating a two-weekly domestic waste collection, ensure that waste is covered progressively over the course of the working day to reduce fly emergence.
- Immediately covering waste streams that are highly attractive to flies or which commonly experience infestations (e.g. food waste).
- Checking that any waste transfer stations used for intermediate storage have good fly management procedures in place, i.e. fast waste turnaround, and appropriate insecticide use. Doing this could prevent the landfill site becoming infested and being the subject of possible complaints.
- If necessary, investigate the use of alternative and more effective cover materials.
- Where space allows, relocate the active tipping area further away from residential areas, at least during warmer months.

- Ensure that site staff are adequately trained in fly monitoring, and aware of the importance of fly prevention.
- Putting in place methods to manage flies in storm / windy bay storage areas when tipping on working face not possible.

5.1.7 Fly prevention and appropriate measures for Mechanical and Biological Treatment (MBT) and In-Vessel Composting (IVC) sites

The risk of fly infestation will be high during periods of hot weather, as the incoming waste is likely to be infested and fly development will be rapid. Parts of the site where the process generates elevated temperatures may be at risk of infestation throughout the year. Operators should:

- Monitor adult fly and larval numbers in key areas of site.
- Ensure swift processing of waste and avoid extended storage of unprocessed waste.
- Refuse the waste if it's likely to cause fly infestation - this would be dealt with as a waste acceptance issue under the conditions of the permit.
- Use sheeting or other contaminment when storing waste/waste products that are highly attractive to flies.
- Where applicable, ensure all waste is uniformly heated to above 45^{o}C to kill all fly stages.
- Ensure that waste doesn't accumulate in inaccessible areas such as behind push walls, pipe work or drains under plant or in corners. Any such waste should be removed daily, especially during the summer.
- Where possible, reduce fly movement out of the building e.g. use double or automatic doors for access to treatment halls and using fly-screening material. Maintaining negative air-pressure within waste treatment areas will also reduce fly egress.
- Ensure site staff are trained in fly monitoring, and aware of the importance of fly prevention.

5.1.8 Fly prevention and appropriate measures for green waste composting sites

In general, houseflies do not breed within good quality green waste, although they may be attracted to it. Regular turning of waste windrows, especially the fresher waste, will ensure uniform heating of the waste and limit any fly breeding that does occur.

5.2 Fly control measures

Even if proactive fly prevention measures are in place, it is likely that some flies will still occur and need to be controlled. The following sections outline the various measures available. Under the COSHH Regs operators must consider non-chemical techniques first.

5.2.1 Biological control of houseflies

Naturally occurring predators

Fig 5: *Carcinops pumilio* feeding on housefly eggs (Copyright: World Health Organisation)

Within manure in poultry houses there are often a number of housefly predators present naturally. These include the small mite *Macrocheles muscaedomesticae* which preys on fly eggs, the beetle *Carcinops pumilio* which feeds on housefly eggs and larvae, and *Staphylinid* beetles.

These predators are typically slower developing than houseflies. Predator numbers therefore tend to be low in the early months of the flock, but increase towards the end of the flock. They are more common in drier manure.

Introduced predators or parasites

There are a number of commercial suppliers (often veterinary practices) of other predators and parasites. These insects are delivered to the site, and released into the premises. Several releases may be required over the season. The main kinds available are:

- Parasitic wasps (e.g. *Spalangia* and *Muscidifurax*) locate fly pupae, lay eggs into the case, and the developing wasp larvae eventually kill the fly.
- The predatory larvae of some flies (e.g. *Hydrotaea aenescens*) prey directly on housefly larvae.

	Suitable for:	Controls:	Limitations:
Natural predators:	Poultry layer units, where the manure is not regularly removed, and is relatively dry.	Common housefly, maybe others.	Predator population slow to build up after clean-out, so insufficient predators to control flies under new flocks. Vulnerable to insecticide treatment in poultry house.
Introduced parasites & predators:	Poultry layer units, where the manure is not regularly removed.	Common housefly, maybe others.	Usage pattern not well defined, so effectiveness uncertain. Vulnerable to insecticide treatment in poultry house.

5.2.2 Physical fly control techniques: Electronic fly killers and traps

Fig 6: Electronic fly killer (Copyright C. Boase)

Flies within buildings may be caught by mass trapping with adhesive papers, or with electronic fly control units. These can be effective at reducing the numbers of flies present in small premises but several may be required throughout egg packing rooms or within waste handling buildings. They are unlikely to actually control infestations.

Outdoors, liquid baited fly traps (Fig 7) are widely used in residents' gardens, for example.

Fig 7: Liquid baited fly trap (Copyright C. Boase)

These traps are suitable for:
More effective with smaller fly numbers in smaller enclosed areas, e.g. egg packing room, office, etc.
Controls:
Catch a broad range of species.
Limitations:
Will not provide a useful level of control in large structures such as poultry houses or transfer stations, or in the open air.
Bag traps cannot be used indoors owing to odour.
May actually attract flies to the immediate area.

5.2.3 Insecticides

The approval process is administered by the Health and Safety Executive (HSE.) Approved products carry Statutory Conditions of Use on their label, which must be followed. These conditions cover dosages, application techniques, treatment frequencies, premises, target pests, and other issues. Where insecticides are being used at a site, the officer should check that products are being used in accordance with statutory label conditions.

HSE requires that anyone using pesticides professionally should have adequate instruction, training and guidance in their correct use. Although pest control can be carried out by appropriately trained in-house staff, in general such staff lack broader experience of pest control issues.

Pest control companies that are members of a recognised trade association, such as the British Pest Control Association, will typically have a broader experience, and meet minimum requirements in terms of training, insurance, pesticide handling etc.

Individual pest control technicians should have the RSPH/BPCA Level 2 Pest Control qualification as a minimum. In terms of the company's experience of fly management, there are no specific qualifications on this, and the operator will need to ascertain their experience.

The COSHH Regulations 2002 require that all activities surrounding the use of pesticides (storage, use and disposal) should be documented, and records kept for at least three years.

Insecticides for fly control are available for various types of usage, as outlined below:

Insecticide space treatment ('Knock-down' sprays)

Fig 8: Thermal fogging at a green waste composting site (Copyright C. Boase)

Some insecticides are approved for use as space sprays, where the liquid insecticide is atomised into very fine droplets that drift in the air and contact flying insects directly.

Space treatment is typically achieved by:

- Using a thermal fogging machine, which produces a dense white fog.
- Using an Ultra Low Volume (ULV) sprayer, which uses an air-blast to produce the fine spray. The spray is less visible than that from a fogger. Such machines may be hand-held, or permanently installed, for example within a waste transfer station. ULV treatments are typically more effective than thermal fogging.

Space treatment insecticide products typically contain non-residual pyrethroids, which have a short-lived effect. See product labels for specific usage details, but typically treated premises should remain closed for at least 30 minutes after treatment, and should not be re-entered by unprotected personnel for 2 – 3 hours after treatment. Treatments are normally applied at the end of the working day. These systems are most effective when they are applied direct to insects.

Note: composters in the Association of Organics Recycling (AfOR) Scheme who wish to use fly control products, disinfectants and additives need to first complete an application form for approval.

Suitable for:	Controls:	Limitations:
Waste sector, contained areas i.e. indoors. Empty livestock buildings.	Most species of adult flies, if susceptible.	Very short-lived effect. Less effective outdoors as spray rapidly disperses. Cannot be used in buildings where livestock are present.

Residual insecticide sprays

Fig 9: Applying residual insecticide for fly control (Copyright C. Boase)

Some insecticides are intended for use as a residual spray and are applied to surfaces using a hand-held compression or pneumatic sprayer. They leave a deposit that remains active for some days or weeks. Flies that subsequently alight on the treated surface pick up a lethal dose of the insecticide and are killed. They typically contain residual pyrethroids or a carbamate. If operators turn or agitate the mateiral they'll need to reapply the insecticide.

Suitable for:	Controls:	Limitations:
Waste sector, both indoors and on landfill.	Most species of adult flies if susceptible.	The HSE discourage using pyrethroid products in intensive livestock units as they may rapidly select for resistance. Less effective on lesser houseflies, as they do not rest readily on surfaces.

Insecticide baits

Insecticide baits typically consist of a mixture of insecticide, sugar and pheromone attractants. They are most commonly mixed to a paste and painted onto sheets of cardboard which are nailed up within the premises, or painted directly onto structural surfaces such as supporting posts, where flies commonly rest. Once applied, the bait will normally last some weeks or longer, but may need re-applying where large numbers of flies are present.

Fig 10: Preparing insecticide fly bait cards (Copyright C. Boase)

Although originally developed for fly control in livestock units, some products are also now labelled for use in waste sites.

Suitable for:	Controls:	Limitations:
Pig and poultry and waste sites.	Adult common houseflies, if susceptible.	Less effective on lesser houseflies and stable flies, as they do not feed on baits.

Larvicides

Larvicides are intended to control only the fly larvae, and have no useful effect on the pupal or adult stages. They are applied directly to the larval habitat, i.e. manure, or where the label permits, to refuse. They are normally applied as a spray, but one product may also be applied as dry granules to very wet slurry.

They are more effective on the younger larvae than older larvae, so treatment should be carefully timed on the basis of monitoring data. Cyromazine is more active on common houseflies than on lesser houseflies. Larvicides are relatively slow in action, with effects not becoming apparent until a week or two after treatment. Cyromazine is selective in action, controlling the fly larvae while leaving beneficial non-dipteran insects (beetles, mites, wasps) unharmed.

Larvicides are widely and effectively used in livestock units. They are typically applied either as a blanket spray to all the manure within a poultry shed, or as a spot treatment to wet areas or to other localised breeding areas identified through monitoring.

The label for cyromazine is relatively restrictive to delay the onset of resistance. It permits only two full treatments of manure within a poultry house, in the life of each flock of poultry. In addition, for common houseflies (but not for lesser housefly), each of the two treatments may be sub-divided into a series of nine separate more dilute treatments.

Some larvicides are also approved for use on waste. However, as these are slow acting products, their impact at most waste sites is limited. At transfer stations any treated refuse has normally left the premises before the product has had a chance to work, and at landfill sites any treated waste is buried and covered before the product has had a chance to work. It's only at premises where waste remains exposed and unprocessed for extended periods (a situation that should be avoided), that they may have a role.

Suitable for:	Controls:	Limitations:
Pig and poultry sites. Some products approved for use on waste, but see ‘Limitations’.	Common houseflies. Control larval stage only. Cyromazine has no impact on beneficial fly predators.	Relatively slow action against houseflies. Limited number of treatments per year on manure. Restrictions on spreading of treated manure on farmland - see label. Lesser housefly is less susceptible to cyromazine. Less effective against older larvae, so need good monitoring to detect young larvae early. Role on waste is unclear, as treated waste and larvae are typically quickly buried under incoming waste.

5.2.4 Insecticide resistance

Through the gradual process of mutation and then natural selection of advantageous genes, many insect pests have become resistant to insecticides.

Houseflies in particular, because they have a relatively short generation time, and because they are often the target of insecticide treatment, have become resistant to many of the insecticides used against them.

Resistance to a particular insecticide does not necessarily mean the insecticide is completely ineffective. Resistant flies can be managed by:

- Prioritising the use of non-chemical control measures, e.g. manure drying, encouraging predators, swift waste removal, daily use of inert cover, etc.
- Complying with all insecticide product label conditions, particularly those intended to delay the onset of resistance.
- Alternating the use of insecticide products containing active substances with different modes of action.
- Minimising treatment practices (e.g. regular residual treatments) that are known to accentuate resistance problems.

6.0 Pest Management Plan (PMP)

Although flies may not be completely eliminated, their numbers can be minimised by implementing a structured PMP. The PMP should have the following six steps:

1. Ensure that staff are trained in key areas, for example the significance of flies, using control techniques and waste rejection procedures.
2. Monitor fly numbers and the extent of breeding sites.
3. Select and implement the most appropriate long-term fly prevention methods, such as drying or removing manure, confining or covering waste materials, and using predators.
4. Select appropriate insecticidal fly control techniques, bearing in mind the need to minimise the impact of resistance, and the impact on beneficial organisms.
5. Decide the trigger level in fly populations for pesticide treatments, based on the timing of fly complaints from neighbours.
6. Regularly review effectiveness of the fly control methods.

Note: For proposed new intensive farming facilities the best available technique is to install manure removal systems: where manure cannot accumulate, it cannot become a substantial breeding ground and therefore fly breeding grounds will not establish.

The template checklists in Table 3 and 4, below, identify the range of fly management techniques that that may be used on pig and poultry farms and waste sites respectively, and enable practices at any particular site to be identified.

Table 3. On site and Pest Management Plan (PMP) assessment (options not mandatory) – Template check list for Pig and Poultry farms

Source	Method	On-site check	FMP check	Comment
FMP	Manage site activities in accordance to the PMP			
Fly Monitoring	Follow routine monitoring for flies using: resting counts; adhesive paper fly catches fly larval counts other			Specify which monitoring method(s) were used.
	Fly species identified.			
	Trigger levels followed for the relevant monitoring method/s to initiate insecticidal control.			Specify the trigger level for each monitoring method used, if applicable.
Manure management	Daily check of water lines and drinkers for defects and/or spillages.			
	Buildings are watertight with no water ingress from outside.			
	Manure holding areas well ventilated.			
	Manure moisture is kept below 50% in poultry units			
	Ensure liquid feed stores are appropriately sealed and that external sources and surrounding areas are kept as clean as far as practically possible. Try to organise vents so that flies cannot pass through these.			
	Manure and slurry removed frequently, if appropriate.			
	Belts and scrapers are cleaned regularly, if used.			
Infrastructure	Buildings are in good condition and kept well maintained			

	Windows and doors are fitted with fly-screens, if appropriate.			
Carcasses	Fallen stock are removed and/or incinerated frequently			
Housekeeping	Spillages are cleaned up as soon as possible			
	Rubbish bins are emptied regularly			
Biological control options	Use of fly parasites / predators to control flies.			Describe the species used
	Insecticide drift onto manure avoided when using adulticides.			
Insecticide control options	Insecticide labels are complied with, and records kept of all treatments.			
	Fly baits used.			
	Space treatments used.			
	Residual insecticides used.			
	Larvicides used.			
	Larvicide applications are targeted to known infested areas			
	Insecticide products are rotated to reduce risk of insecticide resistance			
Transporting manure	Adult fly numbers minimised before house opened for manure removal.			
	Manure is checked on-site for fly maggots before transporting it off-site			
	If possible treat the infestation and leave on farm for a suitable period of time for the treatment to have been effective.			
	If the manure is infested and flies could be released during transport, cover the trailer before leaving the site.			
Manure storage	Manure field heaps are inspected regularly for flies			
	If manure heap is found infested with flies/maggots, it is covered			
	If sheet covers are used, they are left for at least 10 days			

	If sheet covers are used, they are inspected to check for any damage			
Manure spreading	Manure is spread to land as soon as possible, after it is received.			
	Manure is fully incorporated into the ground immediately after spreading (within 24 hrs)			
	Three weeks must elapse after the last application of cyromazine, before the treated manure can be spread on land. Thereafter, another four weeks must elapse before grazing or cropping.			

Table 4. On site and Pest Management Plan (PMP) assessment – Template check list for Waste Sites

Source	Method	On site check	FMP Check	Comment
FMP	Manage site activities in accordance to the FMP			
Fly Monitoring	Follow routine monitoring for flies using: monitoring squares and resting counts; adhesive paper fly catches grid counts larvae counts			Specify which monitoring method was used, if applicable.
	Fly species identified			
	Trigger levels established and followed for the relevant monitoring method/s to initiate insecticide control.			Specify the trigger level for each monitoring method used, if applicable.
Infrastructure	Buildings are in good condition and kept well maintained			
	Windows and doors are proofed as much as possible to prevent escape of flies. Minimise the time doors and windows are open. Install fly screening where appropriate.			
	Containers used are covered, locked, and leak proof.			
Waste management	Pre Acceptance Check - including checks with previous waste holders that fly management techniques are in place there.			to include waste stream assessment
	Waste rejection (what procedure is in place to ensure repeat problematic loads/known problematic waste streams are not accepted).			
	Check waste types, if of a nature more likely to attract flies (fish waste) ensure it is deposited and covered immediately.			
	Small tipping face. Ensure waste covered down at the end of the working day and waste that can attract flies does not protrude through the cover (landfill sites).			

	Vehicles carrying wastes to and from the site can be carrying fly infestation with them. Clean vehicles inside and out periodically as required.			
	Waste should not be stored for long periods of time. Quick turn-over recommended. Where waste is to be sorted on site it should be done on a first in first out basis. Permit may stipulate the length of time waste is allowed on site.			
	Waste is checked on-site for fly larvae before transporting it off-site			
	If waste is infested ensure it is treated and checked on-site for fly larvae before transporting it off-site			
	Vehicles bringing waste to and from the site are covered.			
Housekeeping	Spillages and accumulations of waste are cleaned up as soon as possible, including in hard-to-reach areas. Records - (action taken, site diary, fly contaminated load log sheet, treatments applied)			
	Rubbish bins are emptied regularly.			
Chemical control options	Insecticide baits are used.			
	Insecticide space treatments are used.			
	Residual insecticide surface treatments are used.			
	Larvicides are applied to waste where appropriate.			
	Larvicide applications are targeted to infested areas.			
	Insecticide products are rotated to reduce risk of resistance.			
Contingencies	Relocation of tipping face further away from receptors if other control measures do not satisfactorily manage problem (landfill sites).			
Incident response	What procedures are in place to deal with complaints from the public, local authorities, or the EA?			Do they notify EA of fly infestation on site? Are they proactive?

Appendix 1 Flies common on waste sites and pig and poultry farms, and pictures of their larvae and pupae

Common Housefly
(*Musca domestica*)

Lesser Housefly
(*Fannia canicularis*)

Stable fly
(*Stomoxys calcitrans*)

Black dump fly
(*Hydrotaea aenescens*)

Cluster fly
(*Pollenia rudis*)

Blowflies:

Blue bottle
(*Calliphora sp.*)

Green bottle
(*Lucilia sp.*)

Larvae of common housefly in wet manure (larvae of blowflies appear similar) (Copyright C. Boase)

Pupae of common housefly in dry manure (pupae of blowflies appear similar) (Copyright C. Boase)

Pupae of lesser housefly (larvae appear similar) (Copyright C. Boase)

Appendix 2 Key differences between common and lesser houseflies

Stage	Feature	Common housefly (*Musca domestica*)	Lesser housefly (*Fannia canicularis*)
Adult	Size:	Typically 6-7mm long, but does vary.	Typically 4-6 mm long, but does vary.
	Pattern on dorsal surface of thorax:	Four distinct longitudinal dark lines.	Three indistinct longitudinal dark lines.
	Abdomen colour:	Yellow-ish at basal end.	Often yellow-ish along sides.
	Wing venation:	Fourth longitudinal vein bends forwards (see below).	Fourth longitudinal vein straight (see below).
	Position of wings when at rest:	Projecting out from the sides of the abdomen, giving a delta-shaped outline.	Folded one over the other, directly over the abdomen, giving a more parallel sided outline.
	Adult resting behaviour	Typically resting in numbers on a range of surfaces within the building, e.g. walls, posts, ceiling etc. Sometimes in large clusters in preferred places.	Even when abundant, tends not to rest in numbers on walls or ceilings. More often resting on the manure, or on surfaces very close to the manure.
	Flight behaviour at source:	Flies very readily and in numbers. Often alighting on or colliding with people within the building.	Even within poultry sheds, the numbers of flies on the wing is low. Males flight is typically jerky circling high up within the building. Very seldom alighting on people.
	Flight behaviour at complainants' premises:	CHF will continually alight on work surfaces, food, walls, cupboards and people.	LHF normally flies in jerky circles within the room, often high up and around hanging objects occasionally alighting on light shades or pelmets etc. It seldom alights on people or food.
Larva	Appearance:	White-ish, smooth, maggot appearance. Active wriggling behaviour, often in clumps, just beneath manure surface. Normally in wetter manure. Easy to see when manure disturbed.	Dull grey-brown, spiky exterior. Inactive, and seldom clumped. Normally in wetter manure. Needs careful and close examination of the manure to find them.
Pupa	Appearance:	Smooth, barrel shaped, from tan, through chestnut-brown to almost black in colour, depending on maturity. Normally in drier manure. Easy to find. (See below)	Dull grey-brown, spiky exterior. Normally in drier manure. Needs careful and close examination of the manure to find them. (See below)

Issue	Common housefly (*Musca domestica*)	Lesser housefly (*Fannia canicularis*)
Overwintering behaviour	This species cannot hibernate. It can only overwinter in warm locations, e.g. in pig farrowing units, or intensive poultry layer sites, where it continues breeding. Flies at cooler sites, e.g. free-range poultry units, will die out each winter, and so have to be re-colonised each spring, hence CHF problems in such sites, if they occur, are often later in the summer.	At the onset of winter, LHF will hibernate at the pupal stage, within the manure. These pupae will hatch the following spring, with the onset of warmer weather. Manure removal in the winter will take out most of the infestation.
Dispersal behaviour	Some adult flies will leave the source, and may cause nuisance in buildings up to two or more km away. Dispersing flies are not obvious in intervening areas.	Some adult flies will leave the source, and may cause nuisance in buildings up to two or more km away. Dispersing flies are not obvious in intervening areas.
Typical breeding sites	- Intensive poultry layer units. - Free-range poultry layer units (less commonly). - Pig units. - Waste bins. - Waste transfer stations. - Landfill sites.	- Free-range poultry layer units. - Waste bins. - Waste transfer stations. - Landfill sites.

Appendix 3 Examples of monitoring sheets

The following are examples of fly monitoring sheets for operators to use at intensive agriculture or waste operations:

Farm Fly Monitoring Record

Site name:
Name of Poultry / Pig House
Date animals in:
Number of animals:
Main fly species assessed:

Date	Adult fly counts (see below)							Larval fly counts (see below)							Notes (eg water leaks, manure removal)
	1	2	3	4	5	6	av	1	2	3	4	5	6	av	

Monitoring details:

Adult flies monitored either by:

- Counting fly numbers resting within 1 x 1m squares marked on internal walls, one to three times per week.
- Fly counts on 30 x 30cm adhesive fly papers, changed weekly.

State chosen monitoring method:

Larval flies monitored by counting the larvae exposed by scraping the surface off a 30 x 30cm area of manure.

Location of monitoring points:

Adults	Larvae
1.....	1.....
2.....	2.....
3.....	3.....
4.....	4.....
5.....	5.....
6.....	6.....

Name of person responsible for fly monitoring:

Waste Transfer Station or MBT Plant Fly Monitoring Record

Site name:
Main fly species assessed:

Date	Adult fly counts (see below)							Larval fly counts (see below)							Notes (eg fresh waste stockpiled, incoming infested waste, etc)
	1	2	3	4	5	6	av	1	2	3	4	5	6	av	

Monitoring details:

Adult flies monitored either by:
Counting fly numbers resting within 1 x 1m squares marked on internal walls, one to three times per week.

- Fly counts on 30 x 30cm adhesive fly papers, changed weekly
- Fly counts using a Scudder Grid on waste, one to three times per week

State chosen monitoring method:

Larval flies monitored by counting the larvae exposed by scraping the surface from an area of 30 x 30cm of waste.

Location of monitoring points:

Adults	Larvae
1.....	1.....
2.....	2.....
3.....	3.....
4.....	4.....
5.....	5.....
6.....	6.....

Name of person responsible for fly monitoring:

Landfill Site Fly Monitoring Record

Site name:

Main fly species assessed:

Date	Adult fly counts (see below)										Larvae counts (see below)			Notes (eg infested incoming waste, issues with cover, any larval counts)
	1	2	3	4	5	6	7	8	9	10	1	2	3	

Monitoring details:

Adult flies monitored either by

- counting flies with a Scudder Grid on and around the active tipping face, one to three times per week
- using adhesive fly papers in fixed locations, changed weekly.

State chosen monitoring method:

Larval flies monitored by counting the larvae exposed by scraping the surface from an area of 30 x 30cm of waste. Typically only done to determine why adult fly numbers are high.

Name of person responsible for fly monitoring:

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