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A review of AMG Resource Ltd's Pest Management Plan for Nevill's Dock, Llanelli

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1. Introduction

AMG Resource Ltd is based at Nevill's Dock, Llanelli. The company processes waste metals.

There have been anecdotal accounts of fly issues around Nevill's Dock in previous years, but in May - June 2018, numbers of reports of excessive numbers of flies were made to Carmarthenshire County Council (CCC). Subsequent investigation by CCC and Natural Resources Wales (NRW) indicated that the most likely source of the flies was a consignment of 100 – 250 tonnes of baled post-consumer metal waste, at AMG Resource Ltd's site at Nevill's Dock. It was reported that the flies were the common housefly, *Musca domestica*. Removal of the waste and the use of pest control measures brought the fly problem under control.

Up to that time, AMG had not been required to produce a Pest Management Plan (PMP) for the site, as the process and products had not been considered vulnerable to infestation. However, following the events of 2018, AMG were then required to produce a PMP.

I was contacted by NRW in autumn 2018, and asked to assess to what extent AMG's PMP represented the most appropriate and effective way to prevent future problems with flies.

2. Resources

I have received the following documents from NRW in March 2019:

- Pest Management Plan, AMG Resources, January 2019.
- Emissions Management Plan, AMG Resources, January 2019.
- Non-Technical Summary, AMG Resources, January 2019.
- Compliance Assessment Report 0034078.

I have also consulted:

- Fly Management Guidance, Environment Agency, 2018.
- Waste Treatment Best Available Techniques Document, 2018.
- Other public domain documents relating to fly management (see References section).

I have not visited the Nevill's Dock site, but have viewed the area on-line.

3. Review of AMG's Pest Management Plan

The following table provides a section-by-section commentary on AMG's PMP, from a fly management perspective.

PMP part no.	AMG's PMP content	Comment
1.	Introduction	No comment.
2.	Description of the site and process Some of the waste streams received will be ferrous and aluminium cans extracted from household waste, or from dedicated can collection schemes.	Metal itself is not vulnerable to insect infestation. However, post-consumer cans, or other metal items that have been mixed into household waste, are likely to be contaminated with traces of food, drink and other organic debris. If this contamination is present at only 1% by weight, this nonetheless represents 10kg of debris in a 1-tonne bale. This level of superficial organic contamination is sufficient to result in significant fly populations.
3	Potential sources The PMP states that the source of flies is likely to be: "*fly larvae being present inside metal bales*".	There are actually likely to be several sources of the flies that may become associated with metal waste at the site: 1. Depending on the time of year, the type, and the handling and storage of the waste prior to its arrival at AMG's site, there may be fly eggs, larvae, pupae and adults brought onto the site within the waste itself. 2. In addition, even if organically-contaminated metals are free of immature and adult flies when brought onto the site, the waste may then attract flies from the surrounding area. 3. Finally, if the waste is stored at the site, especially during the warmer months, the flies that have become associated with the waste *via* routes 1 & 2 above, will then breed and go through further generations within the stored waste. If un-checked, this multiplication process is likely to result in greater numbers of flies than processes 1 and 2 above.
4	Potential receptors The PMP lists various potential receptors to the north, east, south and west, within a 1 km radius of AMG's site.	Several of these receptors to the north and east are actually within 50m of AMG's boundary fence. Houseflies have been known to disperse 800m in 3 – 8 hrs, so in terms of fly risk, these receptors are very close. Additionally, the land around AMG's site is relatively open terrain, so there is little to slow the movement of flies away from the waste in their search for other attractive environments. Finally, the metal waste at the site is largely unattractive to flies, so a large proportion of flies that do emerge from the organic contamination, will leave the site in search of a more favourable location. At Nevill's Dock, AMG will need very high standards of fly control to prevent problems for receptors.

PMP part no.	AMG's PMP content	Comment
5	<u>Operational and process controls</u> *"Through the strict pre-acceptance and acceptance procedures, the waste materials on site will be inspected to ensure it does not contain food or water."*	Superficial organic contamination is more or less an intrinsic part of metal recyclates extracted from household waste. The actual level of organic contamination is difficult to judge by visual inspection, and even crushed cans that appear clean may still contain enough organic deposits to support infestation. It is therefore challenging to achieve a significant reduction in contamination levels on-site, through the visual examination and rejection of contaminated batches of metals, prior to or on arrival at the site.
	"Following tipping of new waste, a sample will be taken with from the load with bales separated to check for evidence of fly larvae."	Regular inspection of incoming loads for fly larvae (and pupae – these can be easier to spot) is good practice. However, finding fly larvae and pupae in scrap metal is a challenging task, as numbers may be low, and larvae quickly hide themselves in crevices in the waste and away from the light. As a result, despite pre-acceptance checking, it is likely that some loads containing flies will still be accepted for processing.
	"The waste piles will be processed quickly to achieve a short turnaround time".	Fly problems at waste sites are frequently associated with waste that has been stockpiled without processing, for periods of only a few weeks. Indeed, the fly problems at this site in May/June 2018, were associated with waste that had remained unprocessed on-site for 2 – 3 weeks only. Speedy waste processing is therefore an important element of fly prevention, as flies are capable of rapid increases in numbers. The PMP should state the maximum period for which unprocessed waste will be stored. During the cooler months, processing time is not critical for fly management, as temperatures are too low to allow fly development. However, during the warmer months (say end April to end October), waste should not be stockpiled without processing, for periods in excess of 1 week. The site will need to establish a transparent system for recording and demonstrating the date of arrival of individual bale stacks. It is not clear if the process used on site will remove the organic debris from the metal, and so reduce the risk of infestation in the finished product. If debris remains within the metal, then the risk of infestation remains, and there should again be time restrictions on stockpiling the finished product.

PMP part no.	AMG's PMP content	Comment
5. cont.	*"Daily inspections are undertaken to monitor for the presence of pests."*	Frequent inspections for flies are an appropriate measure - they ensure that any infestation is detected at an early stage, allowing timely control measures to be put in place. However, AMG's PMP does not specify the type of fly inspection to be carried out. The EA's Fly Guidance document sets out various types of fly assessments, of which the most relevant are likely to be: a) Use of a Scudder grid. This would be placed at c.10 different locations on and around the waste, and the adult houseflies counted and recorded. The EA Fly Guidance document provides more detail on this technique. b) Counts of adult flies per bale. The number of adult flies visible on the long side of say 10 different bales, can be counted. However, this technique is not as reliable as the use of the Scudder grid, as the flies often need to be disturbed to be visible, and it takes skill to spot and count the flies resting among the waste. When documenting fly counts, actual numbers of flies should be recorded, not 'High', 'Medium' and 'Low' categories. These categories are very subjective, will vary from person to person, and will be affected by recent experience. In terms of frequency, careful numerical counts conducted three times/week, would be better than subjective assessment conducted daily. Ideally, larvae would be counted in preference to adults, as they precede the adults and so would allow control operations to be started before adults appear. However, as explained before, it can be difficult to find larvae amongst the waste, even when bales have been broken open. Finally, to allow comprehensive access for monitoring (and treatment if required), bales should be arranged in numbers of small separate stacks.
	"If fly larvae is found following tipping, the load and any surrounding waste will be quarantined to the undercover quarantine area…. The load will be appropriately disposed of immediately."	The immediate removal of fly infested waste from the site is an appropriate measure. However, quarantining waste 'undercover', may not help prevent fly dispersion. Experience at other sites where fly-infested waste has been stored within a building with the aim of reducing fly movement, has been counter-productive. The elevated temperatures and humidity inside the building accelerated fly development, and fly egress still occurred as the doors were often open to allow movement of bales.

PMP part no.	AMG's PMP content	Comment
5. cont.	*"The specialist pest control company will be contacted for advice and to undertake any treatment on the site."*	There are many pest control companies who may consider themselves to be 'specialist'. However very few will have experience of outdoor fly control on baled wastes. AMG should state who they intend to use for this purpose. The PMP does not provide any indication of the type of treatments that would be used at the site. Although the final choice may depend on the exact circumstances, the PMP should provide enough information about the intended treatments, to enable the merits of the proposal to be assessed. The EA Fly Guidance document provides some information on the different treatment types. The most relevant options are likely to be: Residual spraying This involves the application of a coarse insecticide spray to target surfaces. In indoor protected situations, the insecticide deposit may remain active for several weeks, but outdoors, where surfaces are exposed to wind, sunlight and rainfall, the insecticide deposit may last only a few days. Treatments may therefore need rea-applying regularly. There is little drift of the coarse spray away from target areas. Space-spraying Space-spraying involves the application of non-residual and fast-acting insecticide as a fine mist, which is blown at the target with a motorised sprayer (Killgerm recommended the use of thermal fogging (a type of space treatment) on their June 2018 visit.) The airborne droplets kill adult flies, providing they are susceptible, but there is little effect on the immature stages. The treatments remain effective for an hour or two, as the insecticide plume either sediments out or drifts away in the breeze. The short-lived effect means that such treatments at waste sites are often applied frequently, sometimes daily. This raises questions about drift of outdoor airborne spray, safety for the closest receptors, and potential environmental impact on nearby wetland areas. Insecticide resistance Houseflies are notorious at developing resistance, and it is likely that most houseflies in the UK already have some resistance to commonly-used insecticides (Chapman & Morgan, 1992). This tendency of flies to develop resistance and so reduce the effectiveness of treatments, reinforces the need to adopt waste management procedures that reduce the risk of infestation and so avoid the need for routine insecticide use.

PMP part no.	AMG's PMP content	Comment
5. cont.		Records The site should keep detailed records of all insecticide treatments, eg date, area treated, operator's name, product used, volume used, and application technique
6.	Complaints *'a specialist pest control company will be appointed'*	Fly problems can be apparent suddenly and develop very rapidly. The appointment of a pest control company should not wait until complaints have been received, but should be agreed before the start of the season.
7.	PMP Review	No comment.

4. Hierarchy of options for preventing fly issues at and around AMG's Nevill Dock site

The following table summarises the various options available to AMG Ltd, and the likely effectiveness of those options in preventing fly problems.

	Option	Effectiveness at preventing flies	Technical issues
1.	• Cease receiving, storing and processing organically-contaminated post-consumer metal waste (CMW).	Very high.	None.
2.	• Cease receiving, storing and processing CMW, from end March to end Oct.	Very high.	None.
3.	• Year-round operation. • Acceptance checks. • Infested stock removed from site. • Ensure that all CMW is processed and despatched within 1 week of arriving on site. • Frequent fly monitoring from end March to end October. • Insecticide treatment as required.	High.	Ensuring compliance with 1-week turnaround time. Some risk of insecticide issues.
4.	• Year-round operation. • Acceptance checks. • Infested stock removed from site. • No time limit on storage of waste. • Frequent fly monitoring from end March to end October. • Insecticide treatment as required.	Moderate.	Risk of fly impacts on receptors. Risk of insecticide issues with receptors. Risk of progressive insecticide failure.

5. Summary and conclusions

It is likely that most of the post-consumer metal cans and other metal containers arriving at AMG's site, will have some organic contamination. This contamination can be difficult to detect on visual inspection. Even low-level contamination may be sufficient to support fly development.

The site is very close (c.50m) to numbers of sensitive receptors, including residential, educational and business premises. At this proximity, it is likely that by the time any adult flies are detected by monitoring at AMG's site, then some flies will already be at receptor sites. This situation shifts the fly management emphasis away from reactive treatments of adult flies, as is commonly done at some waste sites. Instead, the emphasis will need to be on the prevention of adult flies on the site.

Routine preventative use of insecticides is not a preferred option, as this is not good pest control practice, is likely to aggravate insecticide resistance (and so result in a gradual loss of effectiveness - Chapman *et al*, 1993), and has potential human and environmental safety implications.

Instead, the emphasis in the PMP should be to introduce changes to the site process which will result in the sustainable and long-term prevention of fly populations on the site.

AMG Resources Ltd have prepared a Pest Management Plan, following the fly incident at their Nevill's Dock site in May-June 2018. Their PMP does address some of the issues raised above but is lacking in detail in several areas, and in my view does not have sufficient emphasis on process changes.

The PMP should be revised, taking the above issues into consideration, in order to reduce the risk of fly problems.

6. References

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Appendix 1: Common housefly biology, behaviour and impacts

Of the c. 7000 species of true fly (Diptera) found in the UK, only a handful live in close association with human activities, and preferentially enter buildings. The most important of these as a pest, is the common housefly (*Musca domestica*).

Mature female houseflies lay batches of c. 100 eggs at intervals of a few days. The eggs are laid on damp, decaying organic material, with certain animal manures, and fresh mixed household waste, being preferred substrates. Aged manures and wastes are not as attractive. The eggs hatch into larvae which feed on the moist substrate, and develop through three larval stages before leaving the larval habitat in search of a drier environment in which to pupate. The adult fly eventually emerges from the pupa, and will typically survive for up to 10 days. The duration of the common housefly life-cycle is dependent on the temperature, as shown in the table below:

Effect of temperature on duration of common housefly life-cycle (egg to adult)

16°C	18°C	20°C	25°C	30°C
45 days	27 days	20 days	16 days	10 days

In the UK, the housefly can be found breeding in many suitable habitats in the summer months, but in winter is restricted to a few warm indoor environments, such as pig farrowing units or certain types of waste processing sites.

At housefly breeding sites, such as accumulations of animal manure or household waste, many of the adult flies will remain on the site, feeding, mating and egg-laying. Nonetheless, a proportion of flies will disperse away from the site (Boase 2008). These dispersing houseflies will quickly pass over unattractive habitats such as green vegetated areas, and accumulate within attractive locations such as warm, sheltered buildings. It is not unusual for there to appear to be more flies at the 'destination' than at the source. Individual flies may disperse for many kilometres, but in practice problems caused by numbers of dispersing flies are usually within 3 kilometres of the source, and the most serious are within 0.5 km (Winpisinger *et al* 2005).

Once inside buildings, the behavior of the different fly species will vary. Some species will tend to accumulate around the windows, or circle within the room. However, the common housefly typically alights persistently on surfaces such as work-tops, tables, kitchen utensils, foodstuffs and people. This increases both the nuisance to those within the building, and the risk of disease transmission.

The presence of numbers of adult houseflies within a building, can cause irritation to people and may be a nuisance (Bonnefoy *et al* 2008). The degree of nuisance will depend on the number of flies, their behaviour, and the duration of the problem. The Environmental Protection Act 1990 (EPA) establishes statutory nuisances, and the Clean Neighbourhoods and Environment Act 2005 clarifies the EPA and creates a specific nuisance of "any insects emanating from relevant industrial, trade or business premises and being prejudicial to health or a nuisance". Defra's guidance to the Clean Neighbourhoods and Environment Act 2005 states 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 adult flies feed and crawl on putrefying organic materials, they become contaminated both internally and externally with a range of bacteria. These bacteria are then carried on the fly, and may be deposited elsewhere by defaecation, regurgitation or tarsal contact, on exposed food or surfaces in homes and kitchens etc (Bonnefoy *et al* 2008, Greenberg 1971). Studies overseas (Sramova *et al* 1992, Emerson *et al* 1999, Levine & Levine 1991) have clearly shown the importance of houseflies in transmitting gastro-intestinal or eye infections. Although fly-borne infection rates in the UK may be lower than some other countries, the risk of fly-borne infection in developed countries is still very much a concern (Macovei *et al*, 2008).

Appendix 2: Author's credentials

I graduated from Reading University with a BSc (Hons) in Applied Zoology. I was elected a Fellow of the Royal Entomological Society in 1978 based on my work in medical entomology. I was elected a member of the Academy of Experts in 1994 as a result of involvement in a number of legal cases on urban pest-control.

I have been involved professionally with the management and control of pests of public health and hygiene importance since 1975. I have worked for a number of multi-national pesticide companies, being involved with the international evaluation and development of novel products for control of pests of public-health importance. This regularly involved investigating infestation problems, in order to identify the cause of the problems and propose solutions. Since 1992 I have been operating as a full-time independent consultant on urban pest management. I continue to work internationally on urban pest problems with organisations in various industry sectors such as housing, waste management, health-care, food, pesticides, animal husbandry etc, being involved in developing pest management programmes and resolving *ad hoc* problems. I lecture regularly on training courses for the British Pest Control Association and other organisations, on technical and managerial aspects of pest-control. I also carry out a number of other activities including technical writing, and acting as expert witness in pest-related litigation. I am an examiner for the British Pest Control Association, and am on the Executive Committee of the International Conference on Urban Pests. I have published over 80 papers, articles and chapters in the scientific and technical press, relating to various aspects of urban pest management.

Regarding fly control on waste disposal sites specifically, I first became involved in this in the 1970s in West Africa, working on evaluating insecticides for control of flies on landfill sites. Since then, I have continued to be regularly involved in advising and investigating fly issues at waste sites, and visit numbers of waste sites each year. I lecture on urban fly control on a Master's degree course at the London School of Hygiene and Tropical Medicine. I have revised the fly control section of the World Health Organisation's publication 'Chemical methods for the control of vectors and pests of public health importance'. In 2013, I co-wrote the Environment Agency's guidance on fly management on animal husbandry and waste sites. Since 2013, I have been working with the Environment Agency on investigating fly management procedures on waste sites, and developing guidance.

I have published the following on articles relevant to flies and waste

Boase, C.J. 2017 Houseflies, Regulations and Unintended Consequences. Proceedings of the 9th International Conference on Urban Pests. Eds: M. Davies, C. Pfeiffer and W. Robinson pp 53-59.

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