Trommel Fines: Chemical Analysis and Waste Classification

Waste Classification and Tracking Team

September 2020

Table of Contents

1. Executive summary

A high proportion of the trommel fines sampled as part of this national campaign have potentially been misclassified as non-hazardous. The analysis has identified a number of hazardous substances in the trommel fines that exceeded the thresholds set out in waste classification guidance document WM3.[1] The most significant findings were:

- 57% of the samples contained concentrations of hydrocarbons and benzo(a)pyrene that exceeded the thresholds for hazardous properties HP7 Carcinogenic and HP11 Mutagenic.
- 6% of the samples contained concentrations of heavy metals that exceeded thresholds for hazardous property HP14 Ecotoxic.
- 2.5% of the samples contained asbestos at levels that exceeded thresholds for hazardous property HP7 Carcinogenic.
- Over 60% of the samples exceeded the Loss on Ignition (LOI) limit set by HMRC. Trommel fines must be non-hazardous and not exceed the Loss on Ignition (LOI) limit of 10% (amongst other criteria) in order to qualify for the lower rate of landfill tax.
- None of the producers had carried out WM3 compliant waste assessments (a legal requirement) prior to them classifying the waste as non-hazardous.

[1] WM3 provides technical guidance on the classification and assessment of waste and has applied in England since July 2015.

2. Background

Trommel fines are a significant waste stream in England. Non-hazardous trommel fines are assigned EWC code 191212 *'other wastes (including mixtures of materials) from mechanical treatment of waste other than those mentioned in 191211*'.* In 2019, 16.5 million tonnes of 191212 was removed from permitted waste facilities in England. In contrast, just 210,000 tonnes of waste removed from waste facilities in England was assigned the code for hazardous trommel fines: 191211*.[2] These EWC codes are known as 'mirror entries' and require a waste assessment prior to removal from the place of production. The non-hazardous EWC code 191212 cannot legally be assigned to the waste unless it can be shown that the waste does not display any hazardous properties. The assessment must be carried out in line with guidance document WM3.

Most waste sites that produce trommel fines are primarily authorised to accept and treat non-hazardous waste only, but this often includes mixed loads from the construction (chapter 17) and municipal (chapter 20) sectors. Mixed skips have the potential to contain unauthorised or contaminated wastes. Non-hazardous waste sites therefore have the potential to produce trommel fines that contain hazardous substances, such as hydrocarbons and heavy metals.

In 2018 a landfill in Yorkshire notified their local officer that two separate producers of waste fines had deposited loads which routine sampling later showed to be hazardous. This was due to high concentrations of hydrocarbons and lead. There was a similar instance in KSL Area where another landfill that carried out compliance testing found they had received trommel fines that should have been classified as hazardous, again due to high concentrations of hydrocarbons. On the back of this the HWDI team asked waste officers in Yorkshire area to carry out sampling of trommel fines at sites which classify their waste fines as non-hazardous. Of the five sites sampled three came back as hazardous (elevated TPH and heavy metals), one was just under the threshold, and one was clearly non-hazardous.

As a result of the issues identified, trommel fines were designated as a priority waste stream for the hazardous waste regime and the HWDI team led a national campaign to sample trommel fines at multiple waste sites across England. The aim of the campaign was to better understand the chemical composition of trommel fines and the scale of the issue with the misclassification of this waste stream.

[2] These EWC codes are not used exclusively for trommel fines and can be assigned to other wastes. As such trommel fines will only make up a proportion of these figures. Limitations in data capture mean it is not possible to identify exact volumes of specific wastes, but trommel fines are thought to make up a high proportion of 191212.

3. Methodology

Each of the 14 Areas were asked to take three composite samples of trommel fines from three different waste sites. This would have resulted in 126 samples taken across 42 different sites. However, one Area opted not to take part in the campaign and some Areas did not take the full amount of samples. Furthermore, due to the lockdown as a result of coronavirus, not all of the samples were analysed in time before the laboratories closed. As such, of the 80 samples that were submitted to the laboratory, only 50 were fully completed, although most of them had some analysis done which could be utilised in this report.

Each composite sample taken consisted of 4x increments. Officers were asked, where possible, to take the first sample from the stockpile at the end of the belts, as these were likely to be the most recently produced fines.

The sampling approach taken did not look to replicate appendix D of WM3 and they were not formal samples intended for enforcement purposes. The aim was to build up a national picture of the composition of this waste stream which could then be used to influence the waste sector to improve waste acceptance and waste classification procedures where necessary.

4. Analysis

When carrying out a hazardous waste assessment each substance must be assessed for all the different hazardous properties it may possess, which can be numerous. For example, Nickel Carbonate has ten associated hazard statements that relate to 8 separate hazardous properties. Ordinarily each of the 14 hazardous properties would be assessed in turn against all substances in the waste. However because of the high volumes of samples in the campaign this report will instead focus on the properties with the lowest thresholds. The assessment is therefore not exhaustive but is used to show the substances that are most likely to result in the waste being hazardous. In a real world scenario every hazardous property would need to be assessed, even after the waste has been shown to be hazardous. It is a legal requirement to include a list of all hazardous properties that a waste displays on the consignment note.

5. Total Petroleum Hydrocarbons (TPH)

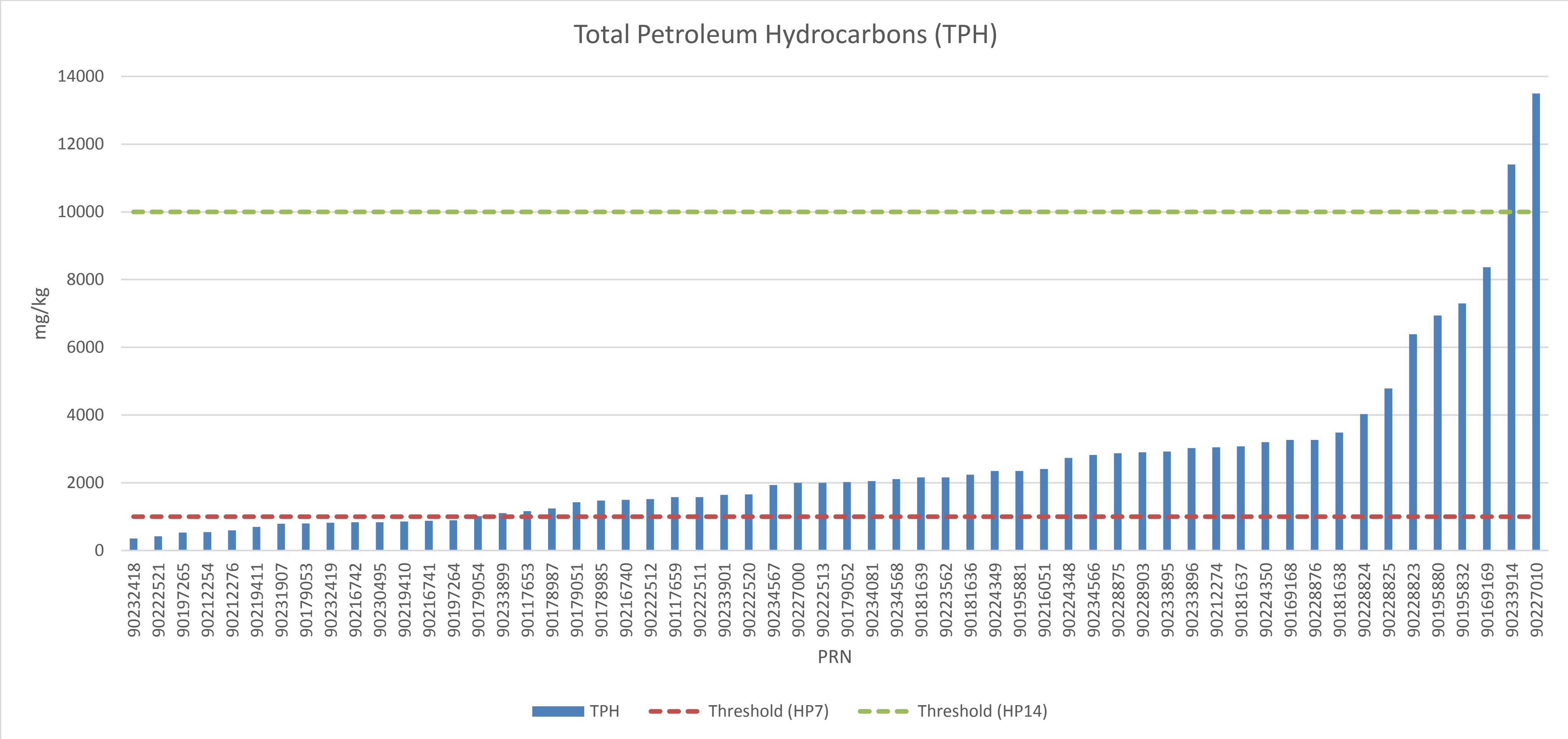

Chart 1

Chart 1 shows the amount of Total Petroleum Hydrocarbons (C_5 to C_{44}) found in each of the samples. The figures have been adjusted for moisture as they are reported by the laboratory as dry weights. Wastes contaminated with oil have a number of associated hazard statements that must be assessed.[3] The two with the lowest thresholds are H350 (HP7 carcinogenic) and H340 (HP11 Mutagenic) at 0.1% (1000mg/kg). Over 75% of the

[3] The assessment used here is in line with WM3 guidance when the specific type of oil is unknown

samples had concentrations of TPH that were at, or exceeded the 0.1% cut off. The marker compound benzo-a-pyrene (BaP) can then be used to determine whether these samples display the hazardous property HP7 Carcinogenic and HP11 Mutagenic. The use of marker compounds is optional; if they are not used as part of the assessment then the waste must be assumed to be carcinogenic and mutagenic.

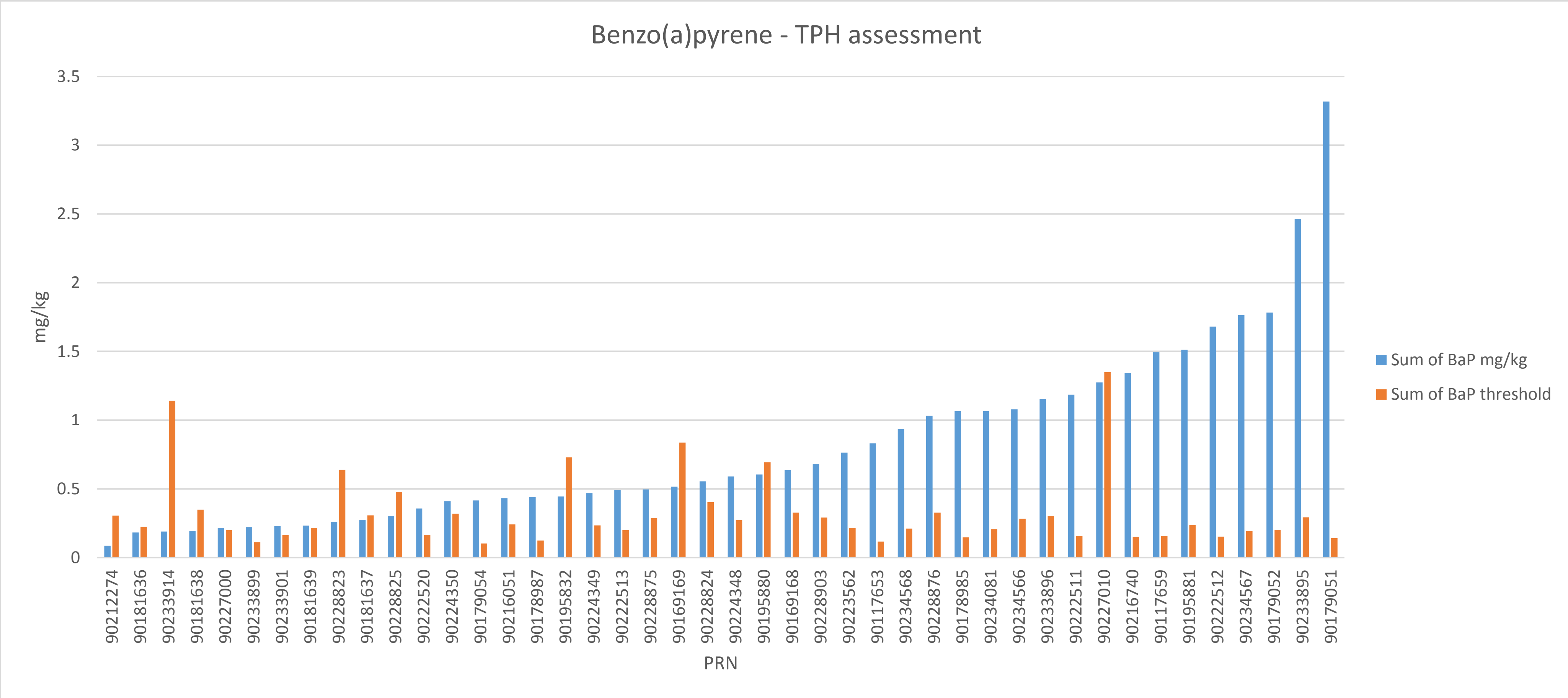

Chart 2

If the concentration of Benzo-a-Pyrene is <0.01% of the concentration of TPH then the waste will not be hazardous by HP7 & HP11 (in relation to hydrocarbons only). Chart 2 shows the BaP concentration for samples which exceeded the 0.1% cut off for TPH. Of these, 70% were also above the marker compound threshold. In total, out of the 58 samples where TPH and BaP testing was completed, 57% breached the threshold and therefore displayed hazardous properties HP7 carcinogenic and HP11 mutagenic.

As shown in chart 1, four of the samples had levels of TPH that were also above the cut off for hazard statement H411 (HP14 Ecotoxic). The concentration of TPH alone would not make these samples hazardous by HP14. However, this hazardous property is additive, meaning all substances that are assigned certain ecotoxic hazard statements and are above specified cut offs must be added together. HP14 Ecotoxic is looked at in more detail in the heavy metals section of this report.

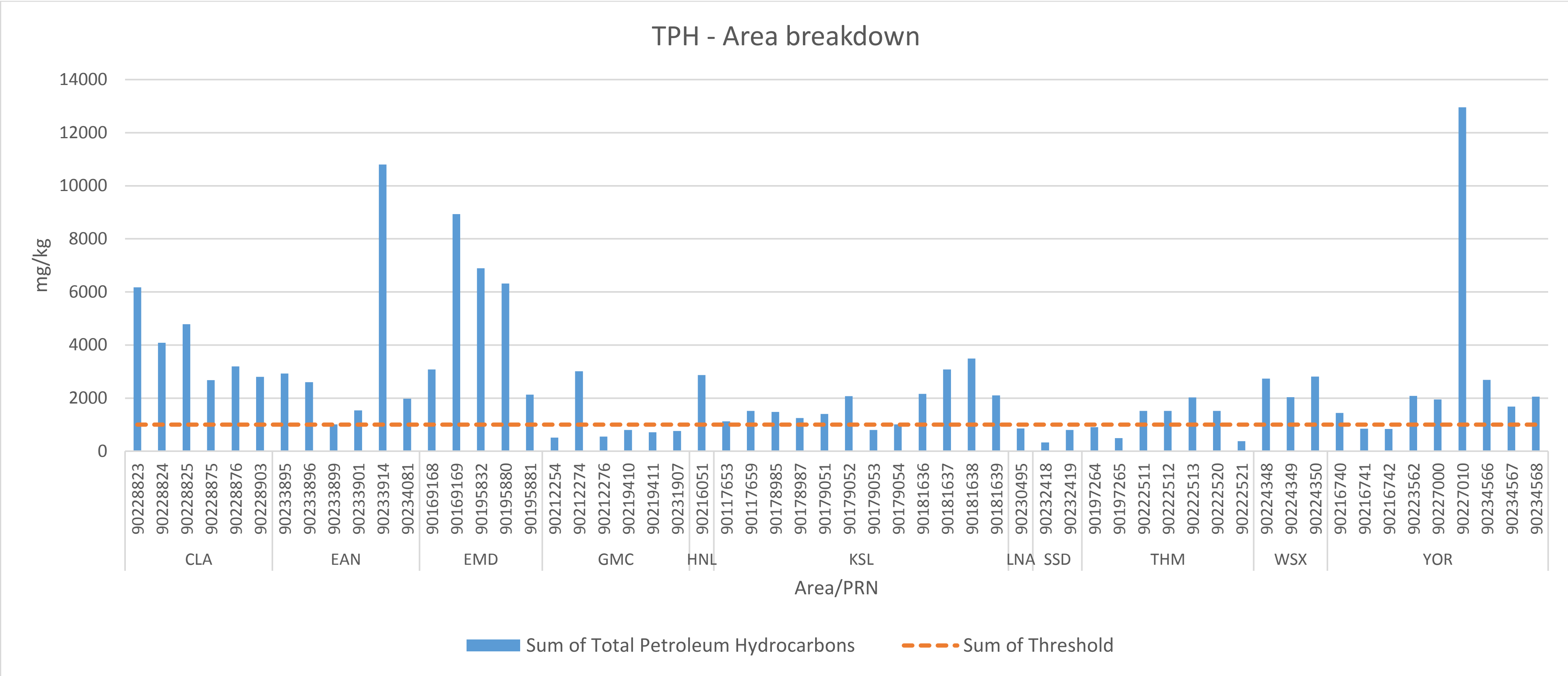

Chart 3

Chart 3 shows how the levels of TPH in the samples varied geographically.

6. Heavy Metals

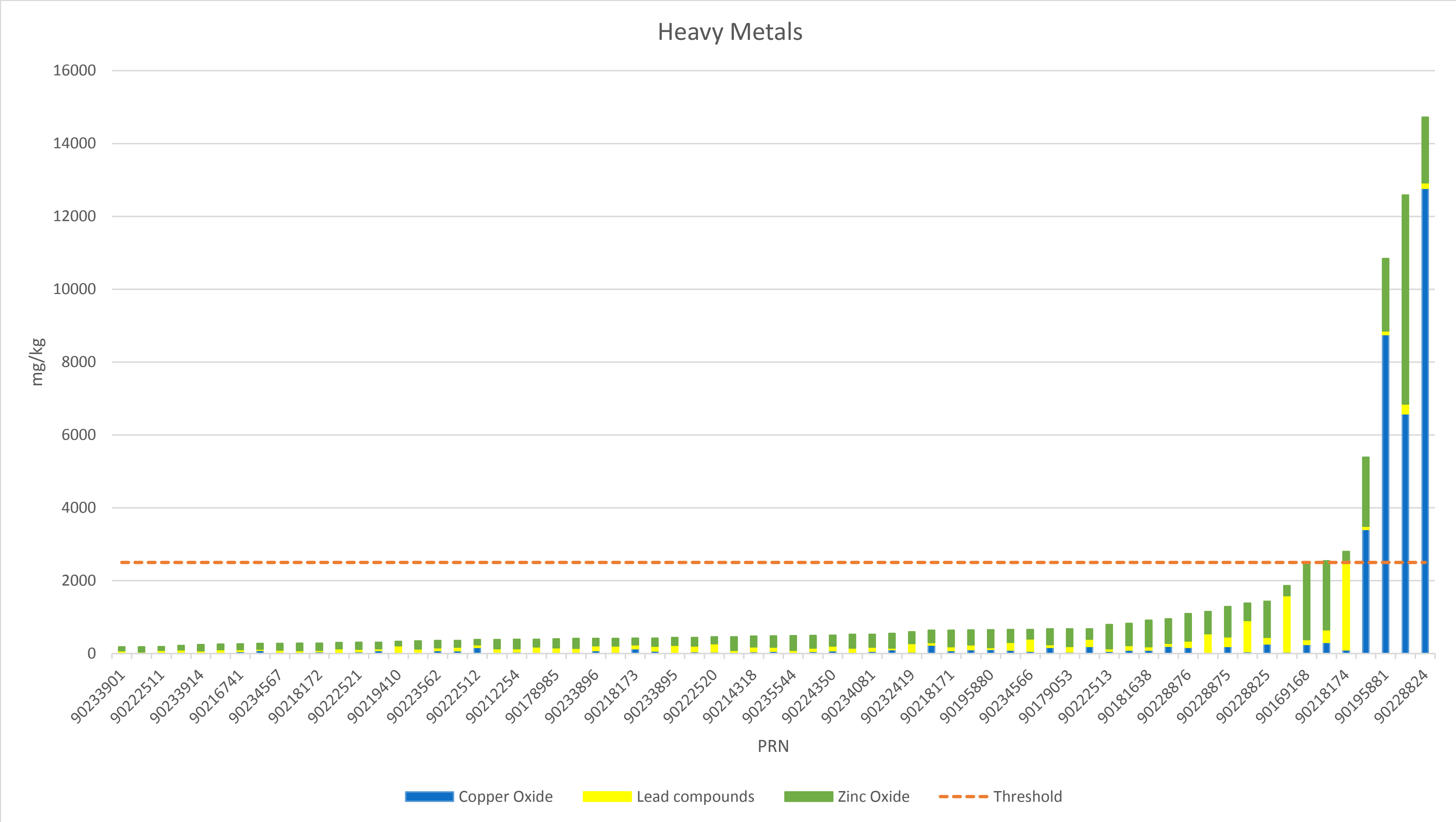

Chart 4

Chemical analyses usually only identify individual cations and anions rather than specific compounds. For the purposes of waste classification it is necessary to identify the specific compounds in the waste. This can sometimes be achieved by carrying out further testing or applying knowledge of the process that gave rise to the waste. Where the precise compound cannot be identified then 'worst case compounds' should be used.

The heavy metals in the samples with highest concentrations, and thus requiring further assessment, were Copper, Zinc and Lead. Copper oxide and Zinc oxide have been used as worst case compounds as both have, among others, hazard statement H410 '*very toxic to aquatic life with long lasting effects*'. This hazard statement has a threshold of just 0.25% (2500mg/kg). Lead is assigned Note 1 by the Classification, Labelling and Packaging (CLP) Regulation, which means the metal cation weight can be used directly, without determining the concentration of the compound. It also has the hazard statement H410. When assessing hazard HP14 Ecotoxic, WM3 provides specific formulas to determine whether a substance is hazardous. HP14 is an additive hazardous property, so each substance that is over the cut off and has the relevant hazard statement is added together. If the combined total exceeds the threshold then the waste is hazardous by HP14 Ecotoxic.

Chart 4 shows the total quantity of Copper oxide, Zinc oxide and lead compounds in each sample.[4] These have been adjusted for moisture as they are reported by the laboratory as dry weights. The majority had relatively low concentrations, well below the hazardous threshold. However, 4 of the samples had concentrations of heavy metals which would make them hazardous by HP14 Ecoxotic. Three further samples were close to the threshold and would require further analysis.

[4] In order to show the range across all of the samples, heavy metal concentrations have been included even if they are below the cut off and would normally be excluded from the assessment.

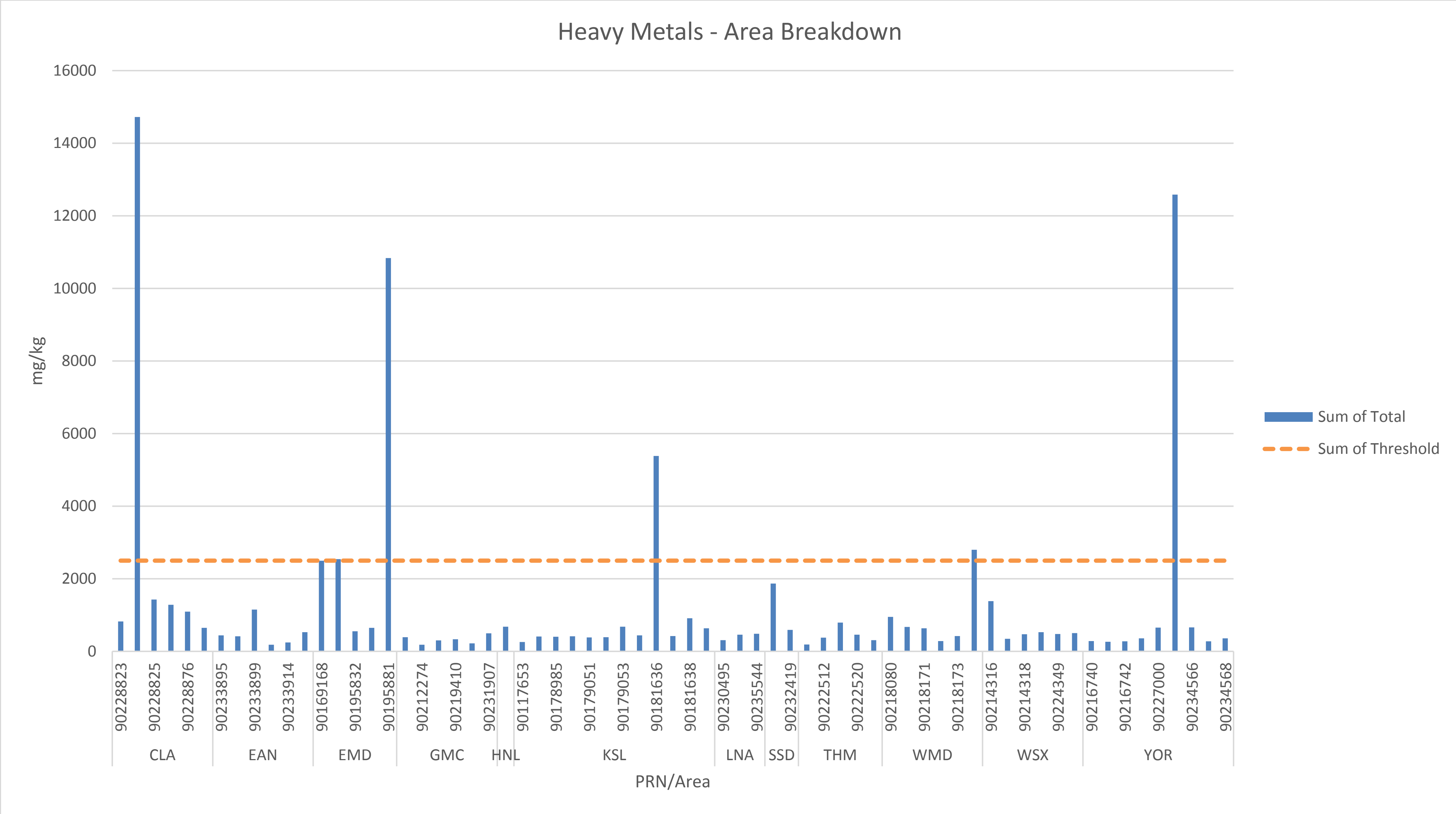

Chart 5

Chart 5 shows how the concentrations of heavy metals in the samples varied geographically.

7. Variability

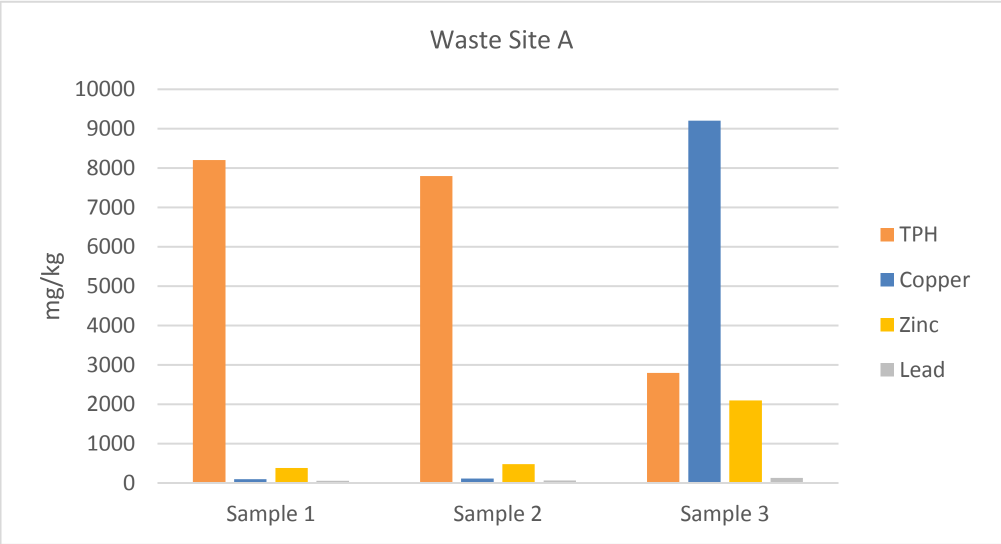

Chart 6

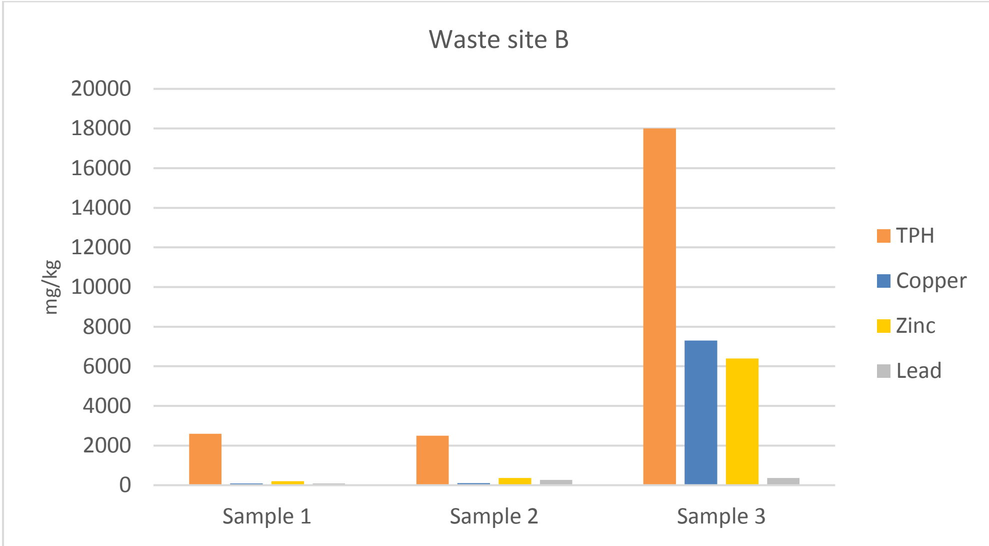

Chart 7

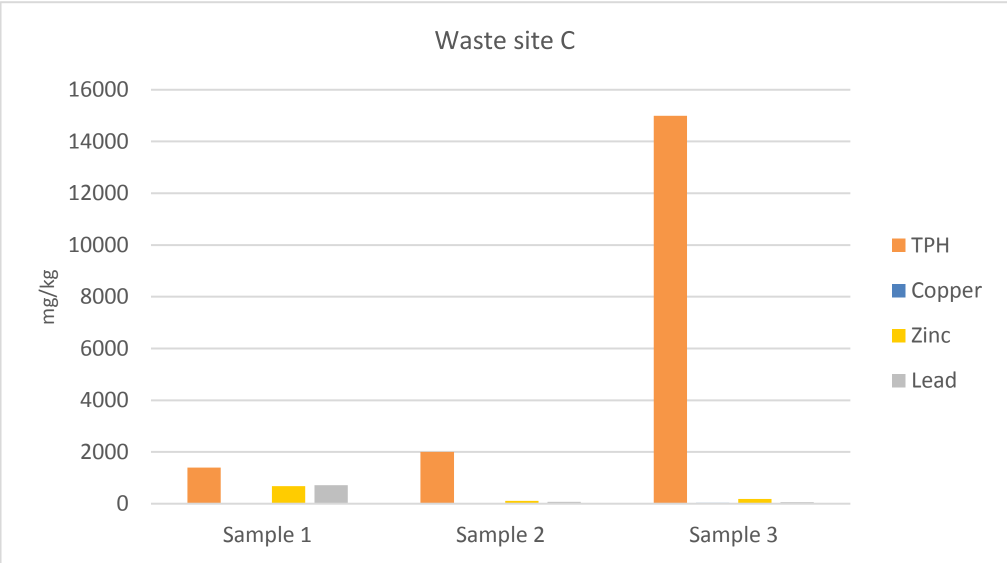

Chart 8

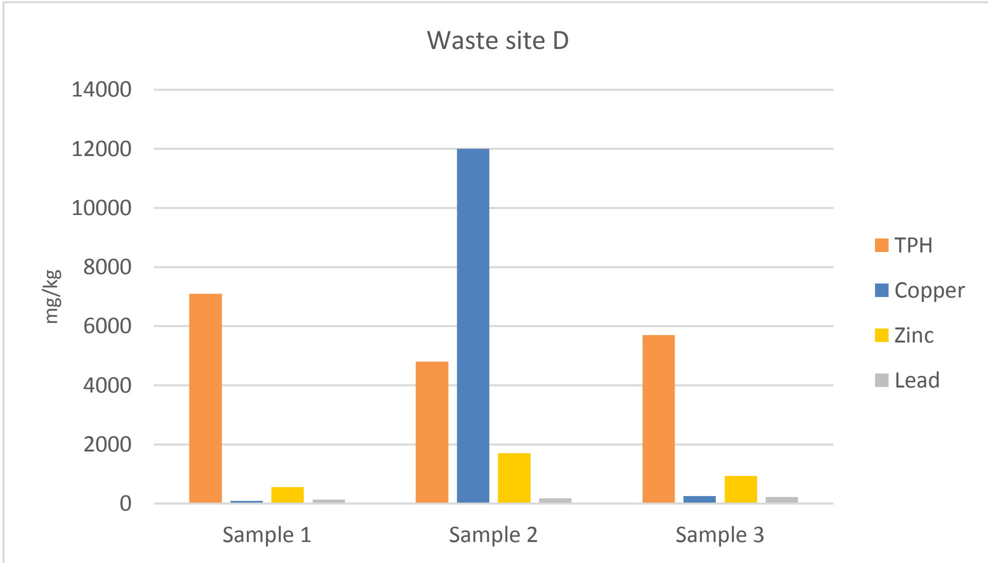

Chart 9

Officers were asked to take three samples from each site they visited. This was to get a more representative view of the chemical composition of the trommel fines and also to see how variable this waste stream is from a given site.

Charts 6 to 9 show how the concentrations in hazardous substances varied between samples that were taken from the same sites. The four example sites illustrated are those that had the highest levels of TPH and/or heavy metals in at least one sample from all of those taken as part of the campaign. All four of them show a significant degree of variability between the three samples. The waste site in chart 6 had a range of between 2800mg/kg and 8200mg/kg in TPH and the amount of copper was significantly higher in one of the samples. However, despite the variation between the three samples taken at this particular site, they all had concentrations of hydrocarbons and/or metals well above hazardous thresholds.

Of the three samples in chart 7, one had considerably higher concentrations of hydrocarbons and metals than the other two taken from the same site. However, the samples with lower concentrations were still above the hazardous threshold for TPH.

Chart 8 shows one sample had a significantly higher concentration of hydrocarbons than the other two taken at this particular site. However, the other two samples still had concentrations of hydrocarbons that exceeded hazardous thresholds and therefore the classification remains unchanged.

Finally, the waste site in Chart 9 was relatively consistent across the three samples with the exception of the high concentration of copper in sample 90228824. All three samples exceeded the cut off for HP7 due to hydrocarbons but this sample also breached the threshold for HP14 due to the concentration of copper. Further sampling in line with appendix D of WM3 would be required to better understand the variability of this particular substance in the waste.

These samples clearly show that trommel fines have the potential to vary greatly in terms of the concentrations of hazardous substances, even from within the same waste pile. This makes sampling and analysis particularly crucial in order to determine the correct waste classification. Appendix D of WM3 provides detailed guidance on what producers must do to ensure their sampling is representative and a reliable classification is achieved.

8. Asbestos

Out of 76 samples tested, two were found to contain hazardous levels of asbestos. One of the samples contained a cement fragment, containing chrysotile asbestos (0.11%). The other sample contained a vinyl floor tile fragment with a bitumen adhesive. Chrysotile fibres (0.19%) were found in both the vinyl tile and the bitumen adhesive.

There was no asbestos detected in 70 out of the 76 samples tested. Chrysotile and/or amosite fibres were detected in 4 samples but there was insufficient amounts to perform quantitative analysis on these samples, which were therefore below the 0.1% hazardous threshold.

9. HP8 Corrosive

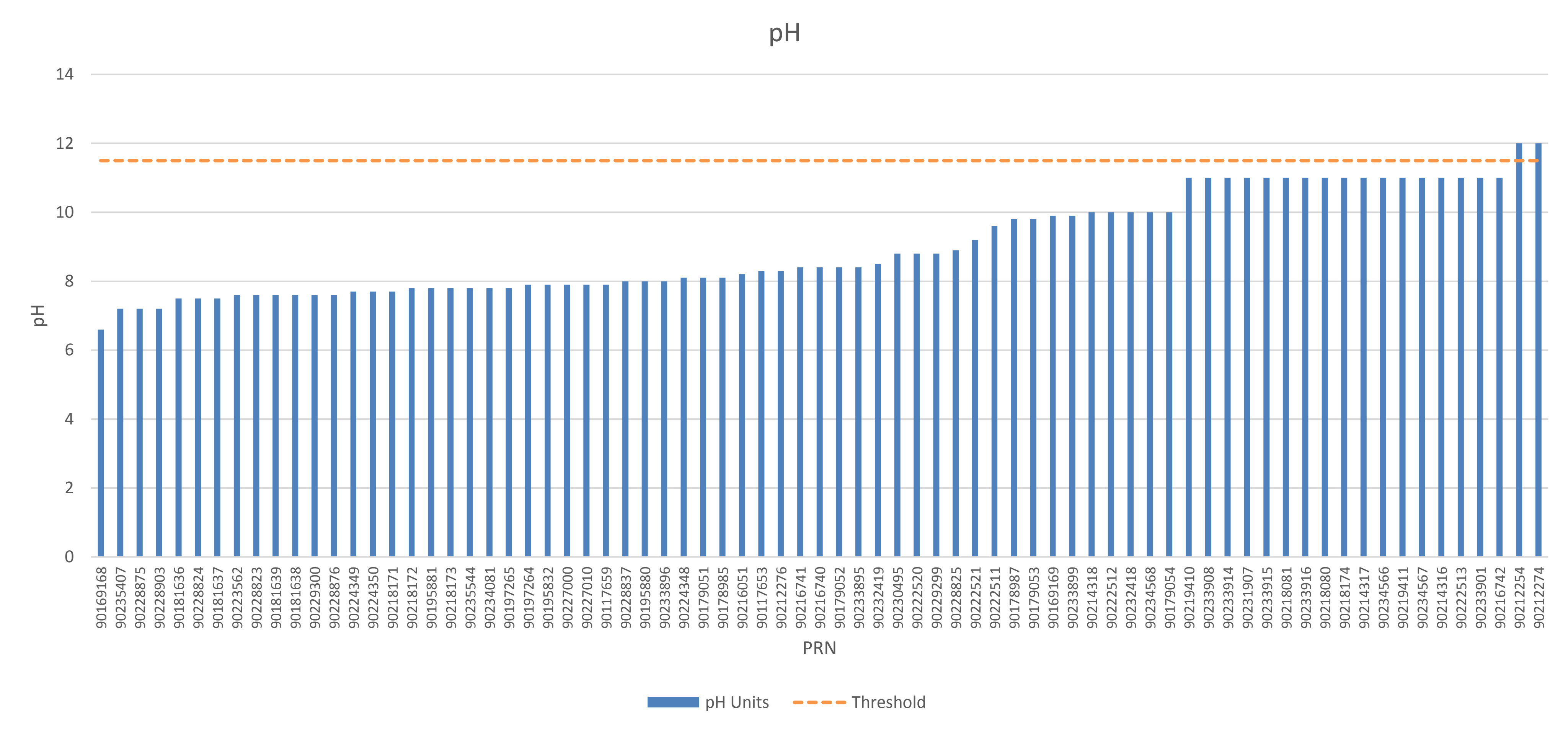

Chart 10

Waste with a pH of ≤2 or ≥11.5 should be considered hazardous by HP 8 Corrosive, unless further testing is carried out which proves otherwise. Only two samples breached this threshold. However, 22% of samples had a pH of 11, just below the threshold and may therefore require further testing.

10. Gypsum

Whilst not a hazardous substance, waste containing gypsum can cause significant odour issues at landfill. This is caused by hydrogen sulphide gas, which can be released when gypsum is mixed with biodegradable waste. A ban on disposing these two wastes together at landfill has been in effect since 2005. However, unless effective waste acceptance procedures are adhered to, gypsum has the potential to enter waste sites and make its way into the trommel fines, which are usually disposed of at landfill.

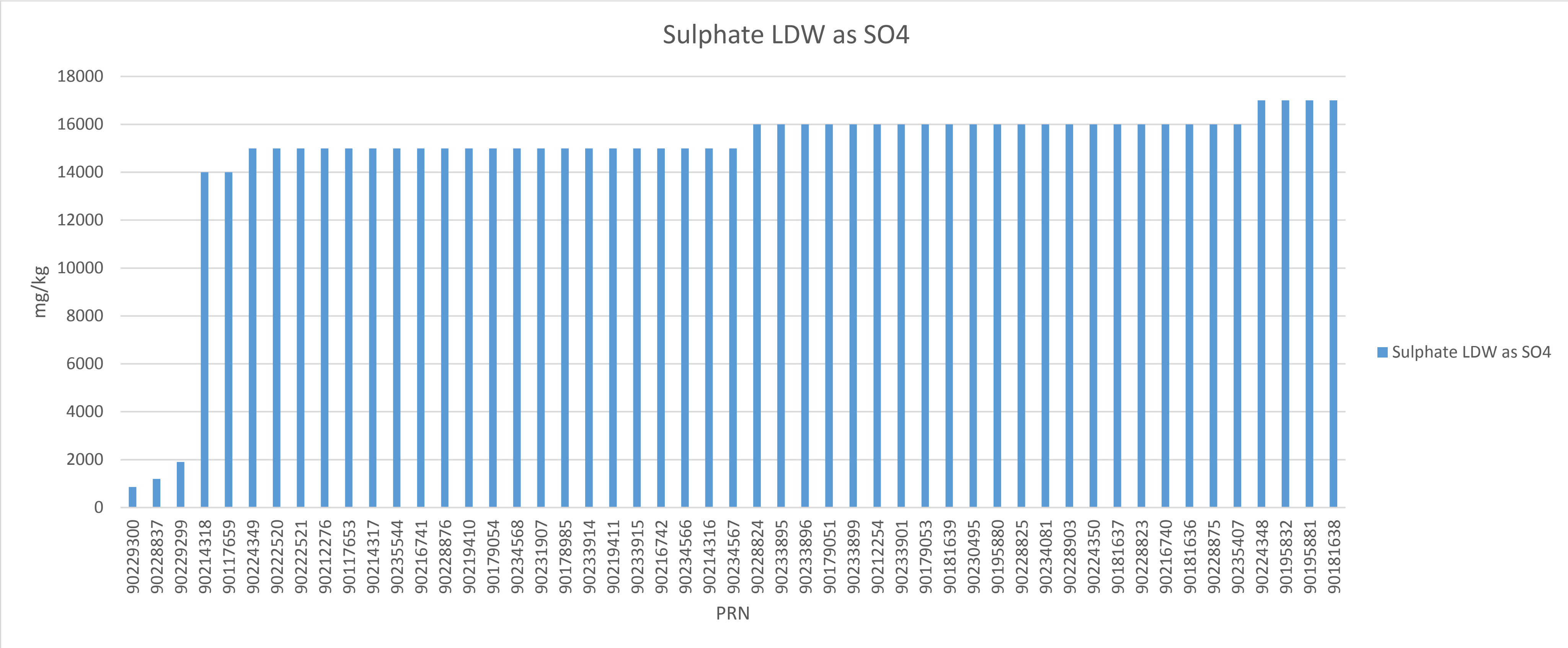

Chart 11

The majority of samples contained between 14000mg/kg and 16000mg/kg of leachable sulphate. Gypsum based and other high sulphate wastes can only be landfilled in cells that contain no biodegradable waste.

11. Loss on ignition (LOI)

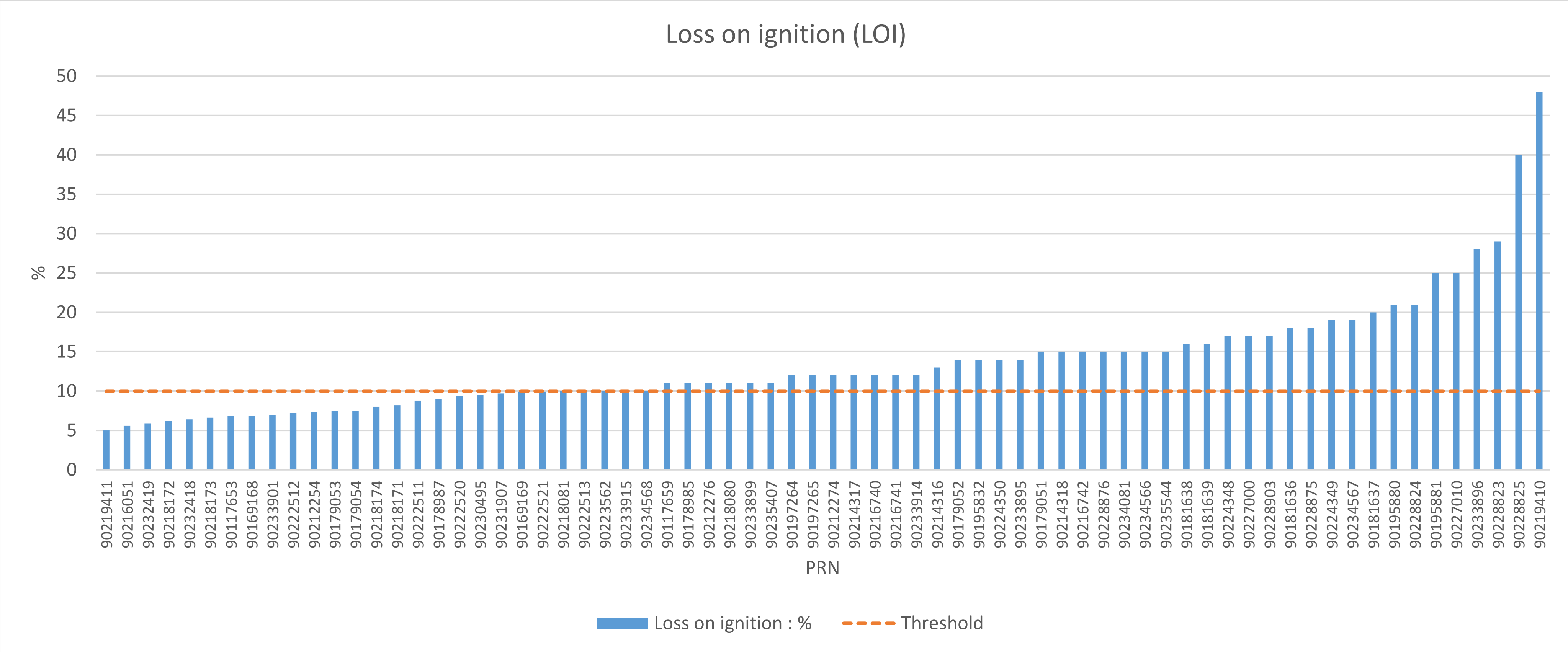

Chart 12

In order to qualify for the lower rate of landfill tax trommel fines must meet the LOI threshold of ≤10%. Of the samples tested, 61% breached this threshold and potentially should have incurred the higher rate of tax if sent to landfill.[5] Information on the destination of the trommel fines has been requested but as yet has not been provided for most of the trommel fines samples. Landfill tax evasion could occur if hazardous trommel fines, or those that breached the LOI limit, are charged the lower rate of landfill tax.

[5] The National Laboratory Service use a different method for testing LOI than the one prescribed by HMRC and therefore these results are only indicative. The difference between the two methods is not huge but generally the HMRC method will produce lower results

12. Conclusion

Trommel fines produced at non-hazardous waste facilities in England are usually classified as non-hazardous and are primarily sent for disposal at non-hazardous landfill. Modern waste management licences & exemptions have conditions which specify which waste codes can be accepted, to ensure that only wastes which are suitable are received at each facility. If the wrong waste code is assigned, either intentionally or in error, the waste could end up at a site that does not have the infrastructure to deal with it, potentially causing damage to the environment and/or human health. Waste classification is therefore vital in ensuring that waste is properly managed across the waste chain. Unless a hazardous property assessment has been carried out, mirror entry wastes, such as trommel fines, cannot legally be classified as non-hazardous. Despite this, producers of this waste stream do not appear to be conducting the necessary waste assessments to ensure that trommel fines have been correctly classified.

The analysis from this campaign shows that the majority of samples have breached hazardous thresholds and these trommel fines have therefore potentially been misclassified. The number of waste sites targeted in this campaign is only a small proportion of the total number of sites producing this waste stream. Further sampling and analysis is therefore required to know the exact scale of the issue across the country as a whole. However, the data clearly shows that trommel fines have the potential to display hazardous properties and that this waste stream cannot be presumed to be non-hazardous.

Producers of trommel fines need to undertake regular sampling and analysis in order to meet legal obligations and prevent misclassification of this waste stream. Doing so will ensure that the right waste is sent to the right place, hazardous waste can be tracked from cradle to grave and the risk that this waste poses to the environment is properly managed.

Appendix 1 – Full list of analysis conducted

Test/test code	DET	DET Code
Metals (Extended) ICPOES DW mg/kg (914)	Aluminium DW	288
	Antimony DW	361
	Arsenic DW	357
	Barium DW	258
	Beryllium DW	234
	Boron DW	284
	Cadmium DW	254
	Calcium DW	242
	Chromium DW	376
	Cobalt DW	426
	Copper DW	216
	Iron DW	422
	Lead DW	329
	Lithium DW	204
	Magnesium DW	238
	Manganese DW	404
	Mercury DW	270
	Molybdenum DW	384
	Nickel DW	430
	Phosphorus DW	349
	Potassium DW	212
	Selenium DW	380
	Silver DW	220
	Sodium DW	208
	Strontium DW	250
	Thallium DW	292

	Tin DW	325
	Titanium DW	317
	Vanadium DW	353
	Zinc DW	246
PAHs ug/kg (1511)	Acenaphthene DW	3794
	Acenaphthylene DW	8382
	Anthanthrene DW	4641
	Anthracene DW	3798
	B(a)anthracene DW	603
	B(a)pyrene DW	3680
	B(b and k)fluoranthene DW	4640
	B(b)fluoranthene DW	766
	B(e)pyrene DW	3806
	B(ghi)perylene DW	715
	B(k)fluoranthene DW	768
	Chrysene DW	3681
	Coronene DW	8453
	DiB(ah)anthracene DW	3804
	Fluoranthene DW	737
	Fluorene DW	7781
	Indeno123cdPyrene DW	6400
	Naphthalene DW	3800
	Perylene DW	9435
	Phenanthrene DW	9987
	Pyrene DW	3682
Dry Solids and Loss on Ignition % (911)	Dry Solids : %	166
	Loss on ignition : %	1012
Total Organic Carbon DW % (535)	Carbon Organic DW	7773

PCBs ug/kg (1508)	PCB 008 DW	8837
	PCB 020 DW	8869
	PCB 028 DW	3143
	PCB 035 DW	8870
	PCB 052 DW	3146
	PCB 077 DW	6677
	PCB 101 DW	3149
	PCB 105 DW	3743
	PCB 118 DW	3152
	PCB 126 DW	6843
	PCB 128 DW	3807
	PCB 138 DW	3155
	PCB 149 DW	8871
	PCB 153 DW	3158
	PCB 156 DW	3745
	PCB 169 DW	6676
	PCB 170 DW	3808
	PCB 180 DW	3161
pH & Conductivity Solids (908)	Conductivity @ 20C	4410
	Conductivity @25C	77
	Conductivity Solid	8238
	pH : Solid sample	9337
Asbestos % via Fibre Counting (1588)	Asbestos Fibre Count	3358
Anions Leach mg/kg (1493)	Sulphate LDW as SO4	7706
Hydrocarbon Screen >C5-C44 (TPH) DW mg/kg	HC Screen DW	4770

Appendix 2 – microscope photos of samples

PRN 90233914

PRN 90227010

PRN 90195881