Hazardous Substances Advisory Committee (HSAC)

Recommendations for a Prioritisation and Early Warning System (PEWS) on Chemicals in the Environment.

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Contents

Background

The Prioritisation and Early Warning System (PEWS) is a proof of concept approach developed by the Environment Agency to identify emerging substances of concern with a view to inform timely policy actions. It collects nominations, screens and prioritises emerging substances of concern to the environment in different environmental media to inform follow-up action and the national chemical strategy. This work responds to the Government 25 Year Environment Plan goal of managing exposure to chemicals and reducing pollution and a commitment therein to explore development of an Early Warning System for Chemicals. The approach includes governance, a process, tools and temporary resource in the Environment Agency to collect nominations, sift, screen and prioritise emerging substances of concern to the environment for a range of environmental media in a robust, peer reviewed process. As a result, we can define the need for further consideration and priority of concern for each screened substance to water, soil, sediment and biota to inform follow-up action.

PEWS was discussed at the 27th HSAC meeting in November 2020. The Committee welcomed and strongly supported the work conducted so far on this initiative and its future development. It was considered to be an important tool for the Environment Agency, in order that it can help protect the environment from adverse impacts of chemicals. This area is very popular in academia. In theory, the Environment Agency can/could be supported by closer interactions with the considerable number of academics in the UK and elsewhere who work in this field (see below).

The Concepts of Prioritisation and Early Warning

Several HSAC members consider that 'Prioritisation' and 'Early Warning' are quite different issues. Prioritisation refers to the entire chemical portfolio (currently thought to be about 350,000 chemicals) and involves attempting to risk-rank chemicals based on the degree of risk each poses to human and/or environmental health. Put another way, prioritisation attempts to identify which chemicals pose a degree of risk, and hence merit attention from regulators, and which chemicals pose no risk, and hence do not justify scrutiny by regulators. How such a ranking might be produced can be found in the following papers:

Donnachie, R.L., Johnson, A.C., Moeckel, C., Pereira, M.G. and Sumpter, J.P. 2014. Using risk-ranking of metals to identify which poses the greatest threat to freshwater organisms in the UK. Environmental Pollution 194, 17-23.

Johnson, A.C., Donnachie, R.L., Sumpter, J.P., Jurgens, M.D., Moeckel, C. and Pereira, M.G. 2017. An alternative approach to risk rank chemicals on the threat they pose to the aquatic environment. Science of the Total Environment 599-600, 1372-1381.

Ranking small groups of very well-researched chemicals, such as metals, is relatively straightforward, as demonstrated in Donnachie et al., 2014. Risk ranking all 350,000 chemicals with potential to be present in the environment is quite another issue. Far too much data will be missing to be able to conduct a robust risk-ranking exercise on all

substances. Exposure data will not be available for many chemicals, but that will not be the biggest problem: it can be circumvented by the use of models to predict exposure levels, for example. The lack of ecotoxicity data, in particular robust datasets covering both vertebrates and invertebrates, is the biggest problem by far (Gold and Wagner, 2020). Even less is known about the potential impact of chemicals such as fungicides and antimicrobials on microorganisms. A significant proportion of all chemicals thought to be in use, and hence likely to be present in the environment, appear to have no associated (eco)toxicity data at all, or if data are available, they are not transparent, often for commercial, confidentiality reasons. Nevertheless, despite these major problems, HSAC is strongly in support of the Environment Agency conducting, and continuously updating, a prioritisation exercise. Despite risk ranking 'only' 71 chemicals, Johnson and colleagues (Johnson et al., 2017) demonstrated what can be done. They showed, for example, that the risk posed by those 71 chemicals differed by many orders of magnitude, and that some chemicals currently receiving a lot of attention did not appear to pose anything like as great a risk as some of the currently ‘unfashionable’ chemicals, such as the metals.

Other methodologies for prioritising chemicals for attention (and, possibly, regulation), that do not necessitate the availability of exposure levels and/or ecotoxicity data, are available and already in use. For example, chemicals can be prioritised based on their persistence in the environment. The more persistent they are, the higher up the prioritising scale they would be placed. Persistence, is of course, already taken into account in the regulation of chemicals. Another characteristic that can be used to prioritise chemicals is their ability (or not) to accumulate in organisms; that is, bioaccumulate. The basis of such an approach is that if a chemical does not get internalised by an organism, it is unlikely to harm it, whereas chemicals that are internalised, and bioaccumulate, in organisms, might cause harm, with the greater the degree of bioaccumulation being associated with the greatest potential threat. It is beneficial that PEWS screening reviews both persistency and bioaccumulation.

On a much grander scale of thinking about prioritisation, attempts have been made to prioritise all environmental issues caused by chemicals, and affecting both humans and wildlife, ranging from atmospheric deposition of nitrogen to particulates in urban air (Kim et al., 2020). The aim of such studies is to have the ability to identify issues which are comparatively trivial and those that present more serious challenges to the quality of the environment. Then the limited research and policy resources available can be allocated wisely.

HSAC recommends that the Environment Agency benchmarks their PEWS system by drawing up a list of the different prioritisation approaches in use, then considers the advantages and disadvantages of each, comparing them to the PEWS system developed to ensure that the system developed is of most relevance to the Agency.

The prioritised chemicals shown in Appendices 1 and 2 (Environment Agency peer-reviewed prioritised screening outputs from Tranche 1 and Tranche 2 as a heat map) could also be analysed/displayed in different ways that could provide additional benefit. These could include dividing the compounds into soil or water reception, followed by ranking by tonnage, followed by ranking by predicted water or soil concentration, followed by ranking according to proximity between the environmental concentration vs PNEC.

Early Warning Systems serve a different function. These usually depend on single pieces of information appearing in the literature that suggest that a chemical might be a 'problem'. Those pieces of information can come out of the blue (they usually do, in fact), and from almost anywhere and anyone. The channels listed for flagging up issues appear to be largely from within the regulatory community. The Environment Agency should consider having some system to cast their net wider, via commissioning academics to also make an annual review of the scientific literature. It is very hard to detect 'early warnings'; it is very much easier in retrospect to conclude "we missed that early warning". Despite the difficulty of detecting early warnings, and the associated difficulty of assessing which early warnings are of serious concern and which are not, HSAC is strongly of the opinion that the Environment Agency should do all it can to detect early warnings, in order that it can initiate appropriate responses quickly. Such problematic issues argue strongly for the Environment Agency to strengthen or form new partnerships with committees such as HSAC as sounding boards to help consider emerging chemical challenges. Similarly, partnerships with academia and the UKRI could be used to flag chemicals of concern to stimulate the research they need promptly. The quicker the response, the lesser the environmental damage that will be incurred. Despite the small amount of data usually available in instances of 'early warnings', HSAC is not of the opinion that the best strategy is to wait for more data; that can often take years to become available.

There is plenty of evidence available showing that early warnings and emerging concerns have been ignored in the past (e.g. EEA. 2001). In addition, attempts have been made in the past to discredit the 'early warning' data, and/or discredit those who have raised the issues. Although alternative opinions must always be considered, they should not be allowed to negate plausible early warning concerns.

References:

EEA. 2001. Late lessons from Early Warnings: the Precautionary Principle 1896-2000. Environment Issue Report, no. 22. Harremoes, P, Gee, D. et al. edited. Copenhagen: European Environment Agency)

Gold, S.C. and Wagner, W.E. 2020. Filling gaps in chemical regulation. Science 368, 1066-1068

Kim, N.D. et al. 2020. Development and Deployment of a framework to prioritize environmental contamination issues. Sustainability 12, 9393.

HSAC Recommendations for sourcing credible data to support PEWS

The Environment Agency is seeking sources of credible data to:

1. Inform which substances are emerging or increasing their potential to cause environmental concern or concern to human health via the environment (nominations of concern).

2. Inform our assessment of exposure and impacts for these chemicals– especially where data are traditionally scarce, e.g. impacts, soil, sediments and biota.

The HSAC suggests the following ways of sourcing the information required.

1. Monitor scientific publications

There are thousands, if not tens of thousands, of research papers covering the presence and effects of chemicals in the environment published every year. As a simple, but probably representative, example, the Web of Science has over 230 papers listed under the search terms 'PFOS and PFAS' for the year 2020. HSAC thus realises that it would be a monumental task to monitor the entire relevant scientific literature. Automated searches using combinations of words such as 'chemicals and environment' are likely to produce extremely long, unmanageable lists. A much more realistic strategy would be to monitor the contents of a selected group of scientific journals that would, hopefully, provide a reasonably informative and balanced picture of which chemicals are being studied, and to what extent, at the time. That list of journals should probably include the following:

- Nature
- Science
- Environmental Science and Technology
- Environmental Toxicology and Chemistry
- Environmental Pollution
- Science of the Total Environment
- Aquatic Toxicology
- Journal of Environmental Monitoring
- Journal of Hazardous Materials
- Chemosphere
- Environmental Monitoring and Assessment
- Journal of Environmental Monitoring
- International Journal of Environmental Monitoring and Analysis

(The first two journals are very general scientific publications with extremely wide remits. Nevertheless, they should be included in any list because occasionally they contain relevant articles that become very influential. See, for example, Washington et al., 2020.

In order for the screening exercise to be practical, the list of journals should be kept relatively short. All journals will provide details of their contents free of charge. HSAC think that one person, spending no more than an hour, or two at the most, each week could scan the contents of 15 to 20 key journals. Doing so would enable 'hot' research topics to be readily and reliably identified.

Reference:

Washington, J.W. et al. 2020. Nontargetted mass spectral detection of chlorofluoropolyether carboxylates in New Jersey soils. Science 368, 1103-1107.

2. Consult key experts in the field

HSAC considers that by maintaining contact with experts in the field, the Environment Agency could obtain a lot of extremely useful information, including early warnings on 'emerging' chemicals of concern. Keeping the list of experts reasonably short and contacting each of them with a personal e-mail no more than once or twice a year, is possibly the most likely strategy to solicit informative replies. The list of experts should include both environmental chemists and ecotoxicologists. Those experts should cover the world: members of HSAC can easily cover the UK (and elsewhere to some degree).

The list of experts could contain the following people:

- Damia Barcelo (Spain)
- Tomas Terners (Germany)
- Shane Snyder (USA and Singapore)
- Derek Muir (Canada)
- Jennifer Field (USA)
- Xiaowei Jin (China)
- Norihide Nakada (Japan)
- Gary Ankley (USA)
- Joanne Parrott (Canada)

The main problems are likely to be (1) keeping the list reasonably short - perhaps 20 people at most - and (2) getting them to reply. Regarding the second potential problem, it is recommended to ask for the minimum for your needs. Perhaps just ask once a year for each expert to name five chemicals that they are currently concerned about, with no more than one sentence covering why each is included. Five essays from each expert would be unnecessary.

One tricky difficulty associated with identifying emerging chemicals of current concern by seeking the opinions of experts is nicely illustrated by the following, recently published, paper:

Tian, Z. et al. 2021. A ubiquitous tire rubber-derived chemical induces acute mortality in coho salmon. Science 371, 185-189.

Although this paper, which identifies a chemical not previously on anyone's radar as of concern, has 27 authors. None of them would, I expect, be on any experts list. I think the most senior author is Edward Kolodziej; someone who already has an impressive CV, but not someone who would (yet) be considered an 'expert'.

However, this very recent and important paper would have been picked up by monitoring key scientific publications (see above) and most probably the proposed expert group.

3. Integrate PEWS with existing horizon scanning tools at the Environment Agency

In the past the Environment Agency conducted horizon scanning by the use of automated scanning of the scientific literature, with the aim of identifying 'up-and-coming' fields. For example, it detected the rapid rise of nanotechnology because it could see the many scientific papers being added to the scientific literature that had the word 'nanotechnology' or 'nanoparticle' in their titles, or as a keyword. Apparently, horizon scanning done in this manner is no longer conducted by the Environment Agency; however, it could be resurrected relatively easily. The software required to conduct the scanning has probably advanced considerably since the Environment Agency ceased conducting automated horizon scanning, which should make the scanning both easier and more efficient (sophisticated). It could also be readily targeted.

This approach to identifying both individual emerging chemicals of concern and more general trends (e.g. nanotechnology) can, of course, readily be linked to the monitoring of specific scientific publications (see above).

4. Seek input from multiple stakeholders

In the past, many early concerns are raised by health and environmental NGO's (e.g. Warhurst, M.A. 1995 An Environmental Assessment of Alkylphenol Ethoxylates and Alkylphenols. Published by Friends of the Earth). There should also be a mechanism by which they can nominate substances within PEWS rather than just featuring under the sifting function in the future as they have a valuable contribution to offer. Universities and research institutions should also be contacted to encourage the input findings from their research projects, including PhD and post-doctoral research. In this way, PEWS may also present a useful pathway to impact and transfer of scientific research to regulation and policymaking. Informing Research Councils of the PEWS initiative may also provide further data as they will hear about developments from their funded projects. The Environmental Data Information Centre at UK CEH could be engaged as this manages nationally important datasets concerned with the terrestrial and freshwater sciences and includes data on chemicals contaminants, such as the Predatory Bird Monitoring Scheme. It will also provide links to other useful databases. Engagement with other government departments and agencies, such as the Food Standards Agency and Public Health England, will also be useful in promoting data and experience exchange on emerging concerns. Sharing such information across government will help inform better, more harmonised regulatory

protection of the environment and human health. This will also benefit from input from other expert committees, such as the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT).

It would be very advantageous to have industry engagement here. Industry often becomes aware of 'problems' with specific chemicals before many other stakeholders do (but can be slow to publicise them). Many industries also monitor, very thoroughly, all literature, including the so-called grey literature, on any chemical that it relies on or sells. For example, large pharmaceutical companies employ people whose only job is to monitor the literature on all the drugs it has a stake in. As it would not be feasible to engage with all individual industries that use chemicals (thousands do), a practical approach would be to engage with trade associations, such as CEFIC.

5. Utilise the Delphi Method

HSAC recommended the use of the Delphi Method to conduct horizon scanning for future chemicals issues. This is a structured forecasting process that relies on the collective judgement of a panel of subject experts to reach consensus. As part of the process, panellists identify future issues and a list is created of the issues identified from all panel members. Over two or more rounds the issues are scored based on pre-defined criteria, resulting in a prioritised list of issues. Delphi has the potential to identify and prioritise a large number of novel issues and HSAC highlighted its success in the Global Conservation Horizon Scan which has been conducted by Prof Bill Sutherland (University of Cambridge) and his team since 2009. This identified microplastics and nanomaterials as future issues in their 2009 paper.

Sutherland et al. (2019) Ten Years On: A Review of the First Global Conservation Horizon Scan. Trends in Ecology and Evolution 34 (2) pp 139-153.

For chemicals, identifying future “issues” rather than specific “future chemicals of concern” or “emerging contaminants” could help Defra consider how new policies, processes and innovations could lead to new threats and opportunities in the chemicals space. For example, Bioplastics and biodegradable plastics currently constitute 2 million tonnes of the 370 million tonnes of plastics used annually across the globe. If we follow government policy, including the 25 Year Environment Plan, one of the ways to reduce global carbon emissions is to increase bioplastics and biodegradable plastics to 65% of the market. If that occurred, there will be a sudden increase in these products on the market, and they contain unintentionally added substances and form hydrosols in water. This can change the pH of water. They will likely pollute the environment with substances that we are not used to handling or studying.

Defra is currently conducting a ‘Horizon Scanning Exercise for identifying future chemical pollution issues’ utilizing the Delphi Method. A lot will be learnt from that ongoing exercise. Preliminary evidence suggests that conducting such an exercise is not especially time consuming. If, as seems likely, the output (a ranking of the likely novel future chemical

pollution issues) proves to be very useful, then such a Delphi Method exercise could be conducted every couple of years.

6. Work with Environment Agencies from Europe and other nations

Data and knowledge exchange with other agencies and initiatives will help to inform PEWS. This could be done bilaterally or through multilateral organisations (such as the OECD).

HSAC does not know what contacts the Environment Agency already has with other similar organisations across the world. However, HSAC considers it vital that the UK's Environment Agency maintains close contact with appropriate organisations of other countries, or blocks of countries: it would be ridiculous, and inexplicable, if there were no contacts between environment agencies across the world. The first step should probably be to contact the other agencies (e.g. The European Union's ECHA in Finland, the European Environment Agency in Copenhagen, the USA's Environment Agency, and Environment Canada) to find out if they conduct horizon scanning exercises: some co-ordination on this issue would be extremely beneficial to all, which would also enhance co-operation.

Other examples of international work on emerging substances that we may or may not be able to link to now include:

- NORMAN network data exchange platform on emerging substances
- RIVM/ECHA's work to create an EU New and Emerging Risk Chemical (NERC) framework to capture early signals of chemical concern
- EFSAs Emerging Risk Exchange Network (EREN)
- The Norwegian, Swedish, Finnish and Danish SPIN database on chemicals in products
- Human biomonitoring data, e.g. https://www.hbm4eu.eu/about-hbm4eu/
- European Partnership for the Assessment of Risk from Chemicals (PARC) under Horizon Europe
- Information Platform on Chemicals Monitoring (IPCHEM)
- Nordic Screening of Emerging Contaminants https://nordicscreening.org/

HSAC cannot emphasize enough how important it considers maintaining close contact with other like-minded organisations, in order to share knowledge, to be.

7. Use of Current Environmental Chemical Analysis Information

The Environment Agency currently collects a lot of information on the presence of chemicals in the environment through its in-house monitoring programmes. Presently those programmes are targeted at specific chemicals, in order to obtain information on the concentrations of existing chemicals of concern. Much of this work is associated with

regulatory compliance. However, soon the Environment Agency expects to have the capability to conduct non-target screening analysis of water and biota samples. That will enable the Environment Agency to identify chemicals not previously monitored, and/or not known to be present. Those invaluable data can then be fed into the NORMAN network. HSAC is strongly supportive of the Agency acquiring the ability to apply non-target screening to environmental samples.

HSAC recommendations for the committee's future role in PEWS

It seems unlikely that HSAC, or its individual members, can add much more to the Environment Agency's horizon scanning if the EA puts in place a comprehensive system based on the strategies described in this document. However, it would probably be sensible if there was a routine item on the agenda of every HSAC meeting covering horizon scanning: this issue could probably be covered in no more than one or two minutes at the end of each HSAC meeting. Members can also be encouraged to submit nominations directly to the Environment Agency via the PEWS@environment-agency.gov.uk email address. They may also help raise awareness in the academic community about the system and how to submit nominations to it.

Appendix

Appendix 1a: Environment Agency peer reviewed screening/prioritisation results for PEWS Tranche 1 substances

N.B. The colours used below indicate the priority of concern for surface and ground water in which Red = Priority 1, Orange = Priority 2, Yellow = Priority 3 and Green = Priority 4; For soil, biota and sediment the colours indicate need for further consideration (red), no further consideration (green) or insufficient information (white) (-)

Chemical name	Use type	Overall	Surface water	Ground water	Soil	Biota	Sediment
Azoxystrobin	Fungicide	4	4	4	Yes	No	No
Bentazone	Herbicide	1	1	1	No	No	No
Bisphenol A (4,4'-Isopropylidenediphenol)	Plasticiser	1	1	1	Yes	Yes	Yes
Boscalid (Nicobifen)	Herbicide	2	2	2	No	No	Yes
Carbamazepine	Pharmaceutical	2	2	2	Yes	No	Yes
Chloridazon-desphenyl-methyl	Pesticide Degradation Product	2	4	2	No	No	No
Clopidol	Vet med	2	2	2	No	No	No
Clothianidin	Insecticide	2	2	2	No	No	No
Desthio-Prothioconazole	Pesticide Degradation Product	4	4	4	No	No	No
Diclofenac	Pharmaceutical	1	1	4	No	No	Yes
Fipronil	Biocide	1	1	1	Yes	Yes	No
Flufenacet (Fluthiamide)	Herbicide	1	1	1	No	No	No
Gabapentin	Pharmaceutical	2	2	4	No	No	No
Imidacloprid	Insecticide / Vet Med	1	1	2	No	No	No
Lamotrigine	Pharmaceutical	4	4	4	No	No	No
Lidocaine (Diocaine)	Pharmaceutical	4	4	4	Yes	-	-
MCPP / Mecoprop -p	Herbicide	1	1	1	No	No	No
Metazachlor	Herbicide	1	1	2	No	No	No
Propiconazole	Fungicide	1	1	1	No	No	Yes
Propyzamide (Pronamide)	Herbicide	1	1	1	No	No	No
Sucralose	Lifestyle	4	4	4	No	No	No
Tebuconazole (Terbuconazole)	Fungicide	1	1	1	No	No	No
Tramadol	Pharmaceutical	4	4	4	Yes	No	No
Trichloroethylene	Solvent	1	1	1	Yes	No	No

Appendix 1b (accessible format): Environment Agency peer reviewed screening/prioritisation results for PEWS Tranche 1 substances

N.B. The numbers used below indicate the priority of concern (1-4) for surface and ground water in which; For soil, biota and sediment it is indicated whether there is a need for further consideration (yes/no) or if there is insufficient information (-).

Chemical name	Use type	Overall	Surface water	Ground water	Soil	Biota	Sediment
Azoxystrobin	Fungicide	4	4	4	Yes	No	No
Bentazone	Herbicide	1	1	1	No	No	No
Bisphenol A (4,4'-Isopropylidenediphenol)	Plasticiser	1	1	1	Yes	Yes	Yes
Boscalid (Nicobifen)	Herbicide	2	2	2	No	No	Yes
Carbamazepine	Pharmaceutical	2	2	2	Yes	No	Yes
Chloridazon-desphenyl-methyl	Pesticide Degradation Product	2	4	2	No	No	No
Clopidol	Vet med	2	2	2	No	No	No
Clothianidin	Insecticide	2	2	2	No	No	No
Desthio-Prothioconazole	Pesticide Degradation Product	4	4	4	No	No	No
Diclofenac	Pharmaceutical	1	1	4	No	No	Yes
Fipronil	Biocide	1	1	1	Yes	Yes	No
Flufenacet (Fluthiamide)	Herbicide	1	1	1	No	No	No
Gabapentin	Pharmaceutical	2	2	4	No	No	No
Imidacloprid	Insecticide / Vet Med	1	1	2	No	No	No
Lamotrigine	Pharmaceutical	4	4	4	No	No	No
Lidocaine (Diocaine)	Pharmaceutical	4	4	4	Yes	-	-
MCPP / Mecoprop -p	Herbicide	1	1	1	No	No	No
Metazachlor	Herbicide	1	1	2	No	No	No
Propiconazole	Fungicide	1	1	1	No	No	Yes
Propyzamide (Pronamide)	Herbicide	1	1	1	No	No	No
Sucralose	Lifestyle	4	4	4	No	No	No
Tebuconazole (Terbuconazole)	Fungicide	1	1	1	No	No	No
Tramadol	Pharmaceutical	4	4	4	Yes	No	No
Trichloroethylene	Solvent	1	1	1	Yes	No	No

Appendix 2a: Environment Agency peer reviewed screening/prioritisation results for PEWS Tranche 2 substances

N.B. The colours used below indicate the priority of concern for surface and ground water in which Red = Priority 1, Orange = Priority 2, Yellow = Priority 3 and Green = Priority 4; For soil, biota and sediment the colours indicate need for further consideration (red), no further consideration (green) or insufficient information (white)

Chemical name	Use type	Overall	Surface water	Ground water	Soil	Biota	Sediment
1,4 Dioxane	Solvent	1	1	1	No	No	No
2,4,7,9-Tetramethyl-5-decyne-4,7-diol	Other	2	2	4	No	No	No
Atenolol	Pharmaceutical	4	4	4	No	No	No
Benzenesulfonamide, N-butyl	Plasticiser	2	2	2	No	No	No
Benzenesulfonanilide	Other	3	3	3	-	-	-
Benzophenone	Lifestyle	2	2	2	No	No	No
bis(2-ethylhexyl)phthalate (DEHP)	Plasticiser	1	1	1	Yes	Yes	Yes
Bromoform	Biocide/Pesticide	4	4	2	No	-	-
Caffeine	Lifestyle	4	4	4	No	No	No
Cetirizine	Pharmaceutical	2	2	3	-	-	-
Cholesterol	Other	4	4	4	No	No	No
Clarithromycin	Pharmaceutical	1	1	4	No	No	No
Codeine	Pharmaceutical	2	2	3	No	No	No
Crotamiton	Pharmaceutical	4	4	4	No	No	-
Cyclohexanone	Other	2	4	2	No	No	No
Diphenyl sulfone	Other	4	4	4	No	No	No
Fluoranthene	PAH	1	1	1	No	Yes	Yes
Metaldehyde	Biocide/Pesticide	1	1	2	Yes	No	No
N,N,N',N'-Tetraacetylethylenediamine	Other	4	4	4	No	No	No
N,N-Diethyl-m-toluamide	Other	4	4	4	No	No	No
Pyrene	PAH	1	1	1	No	Yes	Yes
Pyriprole	Biocide/Pesticide	3	3	3	-	-	-
Sotalol	Pharmaceutical	4	4	4	No	No	No
Tri-(2-chloroethyl) phosphate	Flame retardant	1	1	1	Yes	Yes	Yes
Triphenyl phosphate (TPPA)	Flame retardant	2	2	2	No	Yes	Yes
Tris (1,3-dichloroisopropyl) phosphate	Other	2	2	2	Yes	Yes	Yes

Appendix 2b (accessible format): Environment Agency peer reviewed screening/prioritisation results for PEWS Tranche 2 substances

N.B. N.B. The numbers used below indicate the priority of concern (1-4) for surface and ground water in which; For soil, biota and sediment it is indicated whether there is a need for further consideration (yes/no) or if there is insufficient information (-).

Chemical name	Use type	Overall	Surface water	Ground water	Soil	Biota	Sediment
1,4 Dioxane	Solvent	1	1	1	No	No	No
2,4,7,9-Tetramethyl-5-decyne-4,7-diol	Other	2	2	4	No	No	No
Atenolol	Pharmaceutical	4	4	4	No	No	No
Benzenesulfonamide, N-butyl	Plasticiser	2	2	2	No	No	No
Benzenesulfonanilide	Other	3	3	3	-	-	-
Benzophenone	Lifestyle	2	2	2	No	No	No
bis(2-ethylhexyl)phthalate (DEHP)	Plasticiser	1	1	1	Yes	Yes	Yes
Bromoform	Biocide/Pesticide	4	4	2	No	-	-
Caffeine	Lifestyle	4	4	4	No	No	No
Cetirizine	Pharmaceutical	2	2	3	-	-	-
Cholesterol	Other	4	4	4	No	No	No
Clarithromycin	Pharmaceutical	1	1	4	No	No	No
Codeine	Pharmaceutical	2	2	3	No	No	No
Crotamiton	Pharmaceutical	4	4	4	No	No	-
Cyclohexanone	Other	2	4	2	No	No	No
Diphenyl sulfone	Other	4	4	4	No	No	No
Fluoranthene	PAH	1	1	1	No	Yes	Yes
Metaldehyde	Biocide/Pesticide	1	1	2	Yes	No	No
N,N,N',N'-Tetraacetylethylenediamine	Other	4	4	4	No	No	No
N,N-Diethyl-m-toluamide	Other	4	4	4	No	No	No
Pyrene	PAH	1	1	1	No	Yes	Yes
Pyriprole	Biocide/Pesticide	3	3	3	-	-	-
Sotalol	Pharmaceutical	4	4	4	No	No	No
Tri-(2-chloroethyl) phosphate	Flame retardant	1	1	1	Yes	Yes	Yes
Triphenyl phosphate (TPPA)	Flame retardant	2	2	2	No	Yes	Yes
Tris (1,3-dichloroisopropyl) phosphate	Other	2	2	2	Yes	Yes	Yes