

Summary

Ultimately, the main source of microplastics is macro-plastics, and neither can be tackled without wholesale action on single-use plastics in general. Whilst the ban on microbeads in cosmetics is welcome, as are other efforts to reduce or ban plastic straws and cotton buds, a piecemeal approach is flawed. One piece of plastic cannot be singled out as the ‘worst culprit’ and we cannot start taking action only at the microplastic level; we need a holistic approach, with UK-wide involvement, to truly make a difference. However, Wales can lead the way – as we did on single use carrier bags – and become an early adopter of appropriate measures.

WEL’s briefing on plastics¹ earlier this year called for a suite of measures, to be implemented as soon as possible. This includes:

- A **plastic tax/levy** in England & Wales.
- Wales to introduce a national **Deposit Return Scheme** for plastic bottles, glass bottles and cans.
- **Regulatory targets** – alongside kerbside recycling targets – for plastic reduction and the use of reusable alternatives, and **clarity for on-pack recycling labels**.
- Phased regulatory **targets for businesses** to move to models which phase out single-use plastic through increased support and incentives for R&D in plastic alternatives, such as the Biocomposites Centre in Bangor.
- Explore how local authorities can support **sustainable procurement and bulk purchasing**. This could include business rate relief for zero-waste retailers or areas which are pursuing ‘Plastic Free’ status, including schools and hospitals.

Given the high amount of public support this issue has, we would expect the Welsh Government to be much further along in tackling all single-use plastic. The Welsh Government needs to be leading the way to eradicate single-use plastic and to take advantage of the current wave of public support, before it loses momentum and we miss this opportunity to create a circular, sustainable economy.

Question 1: To what extent are microplastics, including synthetic microfibers, a problem within Wales’ aquatic environment? How does this impact on environmental and human health?

Microplastic sources and marine litter evidence

Microplastics are broken down from many sources, with marine litter being a key source. It is a problem throughout our waterways, from rivers to lakes to the ocean. It’s estimated that 80% of marine debris is from land-based sources, with the remaining 20% from ocean-based ones. The Marine Conservation Society’s

¹ Wales Environment Link, 2018. [WEL Briefing: A single-use plastic tax in Wales.](#)

(MCS) 'Great British Beach Clean' data² shows that, for every 100m stretch of Welsh beach surveyed over one September weekend in 2017, 677 pieces of litter were collected. This is an increase of litter by 11% from the previous survey in 2016. Single-use plastic items found (categorised as takeaway cups, lids, stirrers, straws, plastics bottles and takeaway trays) were also up by 13% from the previous year's survey.

According to MCS data, plastic and polystyrene pieces continue to be the most collected litter item found on UK beaches (255 pieces per 100m stretch). These are plastic pieces broken down so much that they are no longer recognisable. Plastic food wrappers (such as those for crisps, lollies and sandwiches), and plastic caps and lids also make the top five beach litter items found.

Keep Wales Tidy's also collects regular evidence on marine and street litter across Wales. They coordinate the international Blue Flag Awards in Wales, which set high standards for beaches and marinas. Keep Wales Tidy estimates³ that *"1 million birds and 100,000 marine mammals die each year from becoming entangled or ingesting marine litter"*. It's important to highlight their evidence of 80% of marine debris being from land-based sources; this means that the role of rivers and other 'pathways to the sea' are crucial.

Greenpeace⁴ has categorised marine litter into four major groups:

1. Tourism-related litter (left by beach goers, for example, like food packaging and cigarettes).
2. Sewage-related debris from storm drains and sewer overflow.
3. Fishing-related debris.
4. Waste from ships and boats.

Much of this becomes microplastics once they begin degrading, particularly in rivers. **One study analysing rivers in South Wales⁵ found that microplastics were identified in 50% of all macroinvertebrates** (which includes species like crayfish, clams, dragonflies, snails and a variety of insects). Microplastics were found in many other kinds of species, occurring independently of feeding patterns and habitat preference. The study's authors recommend further work be done, particularly around freshwater ecosystems, due to the fragility and species decline found in these habitats.

We would recommend there be more Wales-based research commissioned if we want to find out which areas are the worst affected. However, there is no obvious reason to think it would be any better than rivers in north-west England, as investigated in detail in 2018⁶. The River Tame in Denton was found to have extraordinarily high concentrations of plastic pollution, with up to 517,000 plastic particles per square metre. They also found that flooding reduces plastic levels, concluding that flood events transfer large quantities of plastic from rivers to the oceans.

Public perception of protected aquatic environments

Dŵr Cymru details that⁷ there are over 2,000 sewer blockages every month in Wales, but these are from a combination of factors, particularly fats, grease and wet wipes with plastic fibres in them. It's worth noting that they state: *"Our experience of educating customers tells us that making the connection between individual behaviours and consequence for services and the environment does make a difference. If people realise that inappropriate disposal of personal products can harm the environment, they will be less likely to do so."* **Education for behaviour change is vital to create a step-change in how citizens work with**

² Marine Conservation Society, 2017. Report: [Great British Beach Clean](#).

³ Keep Wales Tidy, 2016. Policy Action Paper: ['Land-based sources of Marine Litter'](#).

⁴ Greenpeace, 2006. [Plastic Debris in the World's Oceans](#).

⁵ Windsor et al., 2018. [Microplastic ingestion by riverine macroinvertebrates](#). Science of the Total Environment 646, pp. 68-74.

⁶ Hurley et al., 2018. [Microplastic contamination of river beds significantly reduced by catchment-wide flooding](#). Natural Geoscience 11, pp. 215-257.

⁷ Dŵr Cymru, 2017. [Response to DEFRA consultation on banning plastic microbeads](#).

public bodies to reduce damage together. Wet wipes are a common cause of sewer blockages as they contain plastic and therefore will not breakdown like tissue paper (despite public perception). MCS's 'Great British Beach Clean' data shows that an average of 27.4 wet wipes per 100m stretch was collected by volunteers over their UK survey weekend in September in 2017. People need to learn of the environmental consequences when they misunderstand how and which materials break down.

Environmental health

In terms of environmental health, plastics can be lethal to wildlife; 50-80% of sea turtles found dead have ingested it, as well as 111 out of 312 seabird species⁸. The UNEP estimate⁹ that it costs \$13 billion per year in environmental damage to marine ecosystems. By having marine wildlife and fish digest micro-plastics, this then *“acts as a vector for chemicals such as persistent organic pollutants that may be transferred into the food chain upon ingestion”*.

Public health

There is a clear danger to human health as well. **More than a quarter of all fish now contain plastic**, according to a recent study which analysed the guts of fish sold at markets in Indonesia and California¹⁰. This 2015 study is one of the first findings of plastic debris in fish directly sold for human consumption, raising concerns regarding human health. In a business-as-usual scenario, the ocean is expected to contain one tonne of plastic for every three tonnes of fish by 2025, but **2050 there will be more plastics than fish in the oceans (by weight)**¹¹. Another recent study¹² found that 93% of all bottled water showed some sign of micro-plastic contamination, after testing 259 bottles from 11 different brands.

International Pellet Watch¹³ tracks plastic pellets and found that their concentration of pollutants is a million times higher than in the surrounding seawater; their work shows that pollutants are indeed travelling from pellets to the food chain. They warn that they have the potential to cause adverse effects in people such as cancer, malformation, decreased immune response and impaired reproductive abilities. The UN warns that the presence of microplastic in foodstuffs could potentially increase direct exposure of plastic-associated chemicals to humans and may present an attributable risk to human health¹⁴. But there is also the *“real possibility”* that we are breathing in potentially harmful microplastics from synthetic clothes and cosmetics that have got into the atmosphere after being flushed into the sewage system¹⁵. These could potentially deliver chemicals to lower parts of our lungs, maybe into our circulation, in the same way we worry about vehicle emissions. Plastics contain different types of chemicals, some of which have been shown to interfere with human hormones. They also tend to attract other chemicals.

The first large-scale report¹⁶ of sub-surface micro-plastics in the Northeast Atlantic Ocean found them in 94% of their samples. Micro-plastic pollution is ubiquitous and we are only starting to realise the profound effects this chronic and pervasive problem is having on ecosystems and human health.

⁸ Ibid.

⁹ UNEP, 2014. [Valuing Plastic: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry.](#)

¹⁰ Rochman et al., 2015. [Anthropogenic debris in seafood: Plastic debris and fibres from textiles in fish and bivalves sold for human consumption.](#) Scientific Reports 5. 14340 (2015).

¹¹ The Ellen MacArthur Foundation, 2017. [The New Plastics Economy: Rethinking the Future of Plastics and Catalysing Action.](#)

¹² Mason et al., 2017. [Synthetic polymer contamination in bottled water.](#) Orb Media.

¹³ Ocean Health Index, 2013. [Microplastics and the threat to our seafood.](#)

¹⁴ UNEP, 2016. [Frontiers 2016: Emerging Issues of Environmental Concern.](#) United Nations Environment Programme, Nairobi.

¹⁵ House of Commons, 2016. [Oral evidence from Professor Kelly to Environmental Audit Committee: Environmental impact of microplastics.](#) May 2016.

¹⁶ Lusher, A et al., 2014. [Microplastic pollution in the Northeast Atlantic Ocean: Validated and opportunistic sampling.](#) Marine Pollution Bulletin 88 (2), 325-333.

The UNEP report urges for companies to develop closed loop business models and create sustainable, recoverable products, but this can't just be a voluntary approach. It hasn't happened voluntarily yet, despite the evidence, and governments must take a lead in making business conduct themselves sustainably.

Marine debris can only be tackled by preventing the litter at source; this demonstrates the necessity to look at people's behaviour and recycling systems, as well as business planning and a mandated level.

Question 2: What are the main sources of microplastic pollution, including microfibres?

As already stated, ultimately, macro-plastics are the main source of micro-plastics. Which is why action cannot be taken forward on a piecemeal basis if we are to reverse any of the damage already done.

However, micro-plastics can be categorised into primary and secondary sources: the ICUN¹⁷ estimates that between 15-31% of all ocean plastic could originate from primary sources, which are those directly released into the environment in its first form as a small particulate, less than 5mm in size in any one direction. These three primary sources of micro-plastics are identified as:

- Personal care products.
- Plastic pellets.

Secondary sources originate from the degradation of large plastic (more than 5mm in size) into smaller fragments. Key secondary sources are identified as:

- The breakdown of larger macroplastics (such as litter).
- Tyres.
- Synthetic textiles.
- Marine coatings.
- Road markings
- City dust.

It's very difficult to track, let alone filter through the plastic in the ocean as different kinds of material behave differently. For example, those lighter than seawater – such as polypropylene – will float and disperse. Others, like acrylic, is denser so will likely accumulate on the ocean floor.

Clothing fibres are a source that can be tackled with preventative measures. Forensic analysis¹⁸ of micro-plastics showed that 85% of the human-made material found on the shoreline were microfibres, and matched the types of material – such as nylon and acrylic – used in clothing. **A single garment can produce up to 1,900 fibres per wash**, so a lot of fibres are likely derived from sewage water.

Car tyres are estimated¹⁹ to be between 5-10% of the total amount plastics ending up in the ocean. As they erode, particles formed of different kinds of rubber (mixed with other additives) are spread by the wind or washed off the road by rain. Road markings, made up of paint, thermoplastic, polymer tape and epoxy, run off as micro-plastics due to abrasion from vehicles. This also happens with coatings on boats. The way roads are laid need to take this into account as well; tarmac is a plastic and tar-rich resource which can be helpful for recycling waste plastic in an asphalt mix, but it needs to be borne in mind that road erosion

¹⁷ IUCN, 2017. [Primary Microplastics in the Oceans: a Global Evaluation of Sources.](#)

¹⁸ Browne M et al., 2011. [Accumulation of Microplastic on Shorelines Worldwide: Sources and Sinks.](#) Environment, Science and Technology. 45 (21), P 9175–9179.

¹⁹ Kole et al., 2017. [Wear and Tear of Tyres: A Stealthy Source of Microplastics in the Environment.](#) International Journal of Environmental Research and Public Health. 14 (10).

will lead to more of these plastics ending up as micro-plastics in the air and in rivers. High standards for road developers and consideration of which are the most appropriate materials to use is important. Of course, by encouraging more people to take public transport instead of driving cars, Wales would not only be reducing air pollution, but also plastic pollution from the road networks' degradation. Further developing roads does not tend to reduce journey times or congestion, as the Future Generations Commissioner has recently highlighted²⁰. For public health and wellbeing, on multiple levels, building more roads is not beneficial.

Research should be conducted into how markings might be able to be formed differently to not be so polluting. However, as with most sources, they're so embedded into our existing structures that it's a challenging task that needs to be tackled on all fronts. Making joined up decisions, such as promoting sustainable transport options that reduce the number of vehicles on the road, is a start. This includes not promoting road transport via infrastructure decisions e.g. the proposed M4 Relief motorway.

Question 3: How comprehensive is our knowledge about the scale of microplastic pollution and its effects? What should the research priorities be?

Plymouth University is known for its work on marine pollution, but Welsh research institutes are also taking work forward, such as on water quality and marine biodiversity at Cardiff, Aberystwyth and Bangor universities; research into alternatives to plastic at Bangor University's Biocomposite Centre; and Cardiff University is working on citizens' behaviour change with the Severn & Wye Estuary Partnership.

There is clearly a research gap though, with Dŵr Cymru highlighting in their micro-plastics position statement²¹ that they're currently researching their impact through the UK's water industry research body, UKWIR. A new model has recently been developed²² to show how micro-plastics are released on land, stored in soil and sediment, and in run-off from rivers. The researchers recommend that impact assessments should be focused on waters which are calculated as "*likely hotspots for deposition of micro-plastics*". As we're still working out how to even measure the impact, the research needs to be highly prioritised so the worst areas can be tackled sooner rather than later.

With regards to impacts of microplastics on humans, researchers suggest²³ the following areas as needing further study to better understand impacts:

- Transfer of chemicals/pollutants to food; either chemicals inherent in microplastics or chemicals absorbed and transported by microplastics.
- Interactions of fishery/aquaculture species with microplastics and whether these interactions affect the edibility or marketability of fish/aquaculture species.
- Whether application of sewage sludge to terrestrial systems for agricultural reasons may lead to transfer of microplastics and/or chemicals to soil used in growing food.
- Economic considerations, such as whether microplastic presence in aquaculture species could lead to loss in revenues, or the extent of costs associated with clean-up efforts.

Further research is also needed on the impacts of microbeads to environmental health, particularly an understanding of:

- their presence and distribution in the environment;

²⁰ Future Generations Office, 2018. [Report: Transport Fit for Future Generations](#).

²¹ Dŵr Cymru, 2018. [Dŵr Cymru position statement on microplastics](#).

²² Nizzeto et al. 2016. [A theoretical assessment of microplastic transport in river catchments and their retention by soils and river sediments](#). Environmental Science: Processes and Impacts. 18 (8).

²³ Dafne, E., Thompson, R., Aldridge, D., 2015. [Microplastics in freshwater systems: A review of the emerging threats, identification of knowledge gaps and prioritisation of research needs](#). Water Research, Vol 75, pp 63-82.

- their transport pathways and factors that affect distributions;
- methods for their accurate detection and quantification;
- the extent and relevance of their impacts on aquatic life.

Question 4: What is currently being done to minimise the release of microplastics into the environment? What more can be done, and by whom, to address this issue within Wales?

Work the Welsh Government is taking forward

Action on marine litter in general is being taken forward through the Marine Litter Action Plan for Wales, agreed by the Clean Seas Partnership in November 2017. This is welcome, but **we'd like to see more impetus behind the initiative, by having more resources and funding focused on delivering it as a matter of urgency.** The core work of this group must also focus on reduction of litter at source in addition to supporting clean-up initiatives.

There have been announcements²⁴ from Welsh Ministers on refill schemes and potential work on Deposit Return Schemes, but this work is not moving at a fast pace and it doesn't do enough to tackle the overriding issue of plastic pollution, microplastics or marine litter. **The Welsh Government should be pursuing the adoption of comprehensive Extended Producer Responsibility (EPS) in Wales.** Although their report detailing the first steps by selecting six types of food and drink packaging was welcome²⁵, they need to fully embrace the concept of EPS. This is necessary if we are to meet the requirements under the Well-being for Future Generations Act, for 'a globally responsible Wales' as well as 'a resilient Wales'. The Welsh Government should lead by example: **if materials are produced or sold in Wales, there must be the ability, within the in country, to reuse or recycle the material.** There are already EU guidelines on development²⁶ and over 400 schemes within the EU²⁷. A revision of the Packaging Waste Recovery Note needs to be undertaken to redress the financial burden on consumers from packaging. This would also benefit public bodies and enable them to fulfil their well-being objectives and reduce costs.

Work businesses and citizens are taking forward

There is encouraging signs of innovation in this area of microfibers; synthetic textiles are, arguably, an easier source to tackle than single-use plastic at large. Washing machine filters are being developed²⁸, as well as laundry balls like 'The Cora Ball'²⁹ and micro-filter bags like 'The Guppyfriend'³⁰. These should be made mandatory though – rather than add-ons bought by aware citizens who can afford it – through consumer legislation. Particularly through the rental market, where there is no choice from tenants as to which white goods they buy and they won't be able to choose one with an extra filter. Like plastic-free supermarket aisles, **by making this a citizen's choice, you're putting all the burden of sustainability, and cost, on them rather than embedding it as the only way of doing business.** Sustainability needs to be requirement on producers, in order to ensure they take responsibility for their products whole journey, not just the initial distribution.

We still need to increase public awareness and options to make ethical choices, but the non-ethical ones needn't be so damaging. The baseline of consumer protection should be no or limited impact on the

²⁴ Welsh Government, 2018. [Press Release: Wales to become first 'Refill Nation' in the World.](#)

²⁵ Eunomia, 2018. [Report for the Welsh Government: Options for Extended Producer Responsibility in Wales.](#)

²⁶ European Commission, 2014. [Report: Development of Guidance on Extended Producer Responsibility.](#)

²⁷ OECD, 2016. [Report: Updated Guidance for Efficient Waste Management.](#)

²⁸ Sky News, 2018. ['Inventor hopes washing machine filter will save oceans from microplastics'.](#)

²⁹ The Cora Ball, 2018. [Getting Started.](#)

³⁰ The Guppyfriend, 2018. [How it Works.](#)

environment, rather than choosing between options that require you, as an 'ethical consumer', to pay more for an environmental add-on.

Work that all partners need to take forward

With an explicitly systemic and collaborative approach, we must overcome the limitations of today's incremental improvements and fragmented initiatives, to create a shared sense of direction; to spark a wave of innovation and to move the plastics value chain into a positive spiral of value capture, stronger economics, and better environmental outcomes. The New Plastics Economy report³¹ outlines a fundamental rethink for plastic packaging and plastics in general; it offers a new approach with the potential to transform global plastic packaging materials flows and thereby usher in the New Plastics Economy.

We need to follow the Three R's: Reduce the amount we use; Reuse; and then Recycle. **Plastics should never become waste; rather, they should re-enter the economy as valuable technical or biological nutrients.** Not only is it crucial to capture more material value and increase resource productivity, it also provides a direct economic incentive to avoid leakage into natural systems. This will enable the transition to renewably sourced feedstock by reducing the scale of the transition. The New Plastics Economy recommends the following:

- **Radically increase the economics, quality and uptake of recycling.**
- **Scale up the adoption of reusable packaging** within business-to-business applications as a priority, but also in targeted business-to consumer applications such as plastic bags.
- **Scale up the adoption of industrially compostable plastic packaging for targeted applications** such as garbage bags for organic waste and food packaging for events, fast food enterprises, canteens and other closed systems, where there is low risk of mixing with the recycling stream and where the pairing of a compostable package with organic contents helps return nutrients in the contents to the soil.
- **Increase the economic attractiveness of keeping materials in the system.** Creating an effective after-use plastics economy as described above contributes to a root-cause solution to leakage. Improved economics make the build-up of after-use collection and reprocessing infrastructure more attractive. Increasing the value of after-use plastic packaging reduces the likelihood that it escapes the collection system, especially in countries with an informal waste sector.
- **Steer innovation investment** towards creating materials and formats that reduce the negative environmental impact of plastic packaging leakage.
- **Establish the global plastics protocol** and coordinate large-scale pilots and demonstration projects. Redesign and converge materials, formats and after-use systems.

³¹ The Ellen MacArthur Foundation, 2017. [The New Plastics Economy: Rethinking the Future of Plastics and Catalysing Action.](#)

Wales Environment Link (WEL) is a network of environmental, countryside and heritage Non-Governmental Organisations in Wales, most of whom have an all-Wales remit. WEL is a respected intermediary body between the government and the environmental NGO sector in Wales. Our vision is a healthy, sustainably managed environment and countryside with safeguarded heritage in which the people of Wales and future generations can prosper.

This paper represents the consensus view of a group of WEL members working in this specialist area. Members may also produce information individually in order to raise more detailed issues that are important to their particular organisation.