STORMWATER SHEPHERDS

Investigating pollution from highway runoff across your catchment

This guidance has been written for Citizen Scientists and groups who are working to improve the water quality of local rivers and streams. We have provided this to help these groups to identify and prioritise discharges of highway runoff into rivers, estuaries and groundwater.

Highway runoff causes toxic pollution that harms the river ecosystem and can affect the river for a significant length, as the sediment settles out in pools and estuaries. The range of pollutants in highway runoff is wide. They come from vehicles and the road surface itself and they include toxic metals, hydrocarbons and microplastic tyre-wear particles.

To understand the impact of this pollution on your local river or stream, you can work out where the outfalls from roads might be and then do some monitoring.

Step 1: Look at a map of the catchment and identify where roads cross rivers or streams. There will often be an outfall where there is a crossing. It might be a small pipe sticking out of the river-bank, or it might be a great big outfall with a concrete headwall. It is easier to find them in the rain, because they will be discharging dark grey runoff. Sometimes they will be on the upstream side of the road, and then pass under the road in a pipe or culvert. Some examples are shown below.

Step 2: Decide which outfalls are likely to be having the most harmful impact. This will depend on four things:

a) What is the traffic density on the road? Traffic densities are measured in AADT, Annual Average Daily Traffic. Anything less that 5,000 will be causing less pollution and unless there are site-specific sensitivities, such as limited dilution, it is unlikely that there will be a need for treatment at these locations. Motorways often have traffic densities above 100,000 and these are the most polluted roads. Everything else is somewhere in-between and you should create a 'scale' for your catchment and list your outfalls in accordance with traffic density. You can find some traffic density information here:

https://roadtrafficstats.uk/ and here: https://roadtraffic.dft.gov.uk/#6/55.254/-6.053/basemap-regions-countpoints

b) Is there any existing treatment of the runoff? Can you see a pond or basin that is taking the road runoff? Or is there a series of manhole covers and a concrete pad suggesting that there is a below-ground treatment device? These may be easier to see using Google maps.

c) How much dilution is being provided by the receiving watercourse? Although we must be cautious relying on dilution because some of these pollutants are persistent and bioaccumulative, it does allow us to consider which rivers are at most risk of suffering harm. Look at the flow in the receiving waters and rank your highway outfalls according to the amount of dilution that they receive. Discharges into estuaries are important, but they will often pose a lower risk of harm than discharges into small streams because of the dilution available, but beware of the risks to sensitive environments in estuaries such as mudflats and to protected species such as shellfish.

d) Consider the creatures that are being put at risk of harm by the discharge. If the river has populations of vulnerable species, such as salmonids and those with special protection such as white-clawed crayfish, or water voles, then those outfalls are perhaps more important to 'fix'. So maybe identify any stretches of watercourse that deserve particular attention. Also consider other wildlife that rely on the watercourse such as otters, and recreational activities of humans such as swimming, fishing or abstraction for use.

Note: if your catchment is on permeable geology such as chalk, the highway discharges may simply soak into ground at the roadside. If this is the case in your catchment, you need to seek specialist advice on groundwater protection.

Step 3: Now you have an idea where your outfalls are and which are likely to be posing the highest risk of pollution, you can collect some field data.

a) The easiest and often most powerful things to collect are photos and videos. If you can find some outfalls, go out in the rain and photograph them or video them. This will give you an idea of the 'size' of the discharge and its impact on the receiving watercourse. It also provides evidence that you can use to work with highway authorities in the future. These inspections are often best done in the winter when the vegetation has died back and the outfalls are more visible.

b) If you decide to take samples of the discharge, take samples of the outfall within the first hour of a significant rain event. If you can't safely access the outfall, consider taking a sample of the river upstream and downstream of the outfall. Downstream samples need to be taken at least 20 metres downstream of the outfall to allow for mixing to take place. The most concerning pollution from road runoff contains toxic metals, poly aromatic hydrocarbons and total suspended solids. Analysing samples for metals,

conductivity and solids is relatively cheap (circa £70 per sample), but it is more expensive to analyse for PAHs as well (additional £50 per sample). However, you can measure turbidity and conductivity in the field using a turbidity tube and/or hand-held monitor, which is far cheaper and this will allow you to prioritise your highway outfalls. There are also options to install passive monitors upstream and downstream of the outfall that do the monitoring for you – at least you don't have to go out in the rain!

More information about sampling and analysis is provided in Appendix 1.

c) Another good way to measure the impact of the pollution from highway outfalls is to count and identify the insects (aquatic invertebrates) that live in the river upstream and downstream of the outfall. You can be trained to do this yourselves via the Riverfly programme and if you do these 3 or 4 times a year, it creates a long-term measure of river health and allows you to really understand any impact of the pollution. It's also fun and all the family can get involved. It should be done in dry conditions and, if you're lucky, it might even be sunny! Have a look at the Riverfly programme and see if you can be trained. Sometimes your local Rivers Trust will pay for Riverfly sessions for local citizen scientists. https://www.riverflies.org/ .

Images: (from left to right) a mayfly nymph found during a Riverfly survey; samples of highway runoff and a photo of an outfall discharging.



Step 4: Part of the reason that pollution from highway outfalls is overlooked is because it doesn't feature on the Environment Agency incident recording system. No-one ever reports this pollution and I think that is because they only ever discharge when it is raining!! So when you find an outfall that is discharging a significant polluting flow, report it to the Environment Agency incident hotline on 0800 80 70 60 (In Wales, the number for Natural Resources Wales is 03000 65 3000). Send them a photo and location and be sure to emphasise that it is causing pollution. If you have a conductivity meter in your pocket, tell them what the conductivity reading is. They are unlikely to attend the event, but if we all get these incidents of pollution recorded, they will start to feature in the Environment Agency's priorities and we might get more attention.

Health and Safety: Working in and around water can always be dangerous, especially when it is raining. Highway outfalls are often in remote locations where people don't often go, and they can be amongst dense vegetation. The runoff is toxic and carcinogenic. So, ALWAYS wear gloves, ALWAYS work in pairs and ALWAYS put your safety first. If you are working near a large watercourse, you should wear a lifejacket and have lifejacket training. NEVER go on National Highways property; this is trespassing and you may be prosecuted, and it is also VERY dangerous. Don't venture across farmland without the owner's permission. Don't take your dog with you; the river will contain toxic pollutants so unless you can be sure that your dog won't go in the river, leave them at home.

But all that said, this work is important and if you can do it safely, then go ahead. The more information we can collect about pollution from highway runoff, the more impact we can have on the regulators and the more chance we have of seeing improvements and treatment schemes.

Next Steps

Once you have prioritised your highway outfalls and gathered some evidence that they are causing pollution, you can speak to the relevant highway authority to see if the outfalls are in line to have treatment devices installed. If they are National Highways outfalls (from motorways and some A roads) , they will be able to tell you whether or not they are going to be remediated in the next Roads Investment period.

If they are local authority outfalls (from other A and B roads), they may not have a programme in place to remediate outfalls, but by drawing their attention to the problem, you may be able to persuade them to consider some remediation.

The installation of remediation schemes is always easier if there is space to create a pond or basin, so you can help by identifying any appropriate land, that is adjacent to the road, and finding out who owns it.

You should also keep an eye out for plans to improve local roads or junctions or to build new roads. These can be excellent opportunities to influence the design of pollution treatment schemes associated with the building work, and you can encourage planners and designers to include effective treatment.

Once you know of treatment schemes and devices that have been installed to reduce pollution, keep the pressure on the highway authority to maintain them in accordance with the maintenance schedule. This schedule should have been created when the scheme was designed, and you might be able to ask the highway authority for a copy.

Finally, remember that some highway outfalls are owned and operated by the local water company, especially in towns and cities where the roadside gully pots connect to a surface water sewer. If your correspondence with National Highways and the local highway authority doesn't identify the outfall owner, it may be one of these that belong to the water company. If it is, you can use your evidence and data to bring it their attention so that they can consider the installation of a treatment scheme.

If you are getting nowhere by speaking with the owner/operator of the outfall, you may want to speak to your local MP or Councillor to see if they can help to persuade the outfall owner to install a treatment scheme.

A highway treatment pond in Broughton, Lancashire

If you would like to learn more about pollution from highway runoff, you can read the publication 'Highway Runoff and the Water Environment' which is available here: https://www.stormwatershepherds.org.uk/2024/05/08/bold-new-report-on-pollution-from-highway-runoff-to-raise-awareness-of-the-problem-and-possible-solutions/

There is also a Planet Possible podcast that you can listen to, where National Highways and the Environment Agency talk about their part in preventing pollution: https://planetpossible.eco/2024/02/29/ep1-highway-runoff/#:~:text=EPISODE%20SUMMARY&text=We're%20joined%20from%20the,the%20environmental%20regulator%20in%20England.

Appendix 1:

Sampling and analysis of highway runoff

Sample during significant rainfall and try to sample within the first hour of rainfall. Sample using a clean plastic food-standard container such as a jug. Rinse the container at least 3 times with the runoff before taking the sample to rinse away any contamination from previous sampling. Do not wash the sample container after use with tap water; clean rainwater is better.

Good Health & Safety controls are essential. Wear gloves and do not touch your face when you are sampling. Stay safe at the sample point, making sure that the risk of falling is controlled, and always sample in pairs. The sample needs to go to the lab within 24 hours of being taken, and to be refrigerated when possible. Most labs have a depot with a fridge where the sample can be dropped off.

Record the time, date and weather conditions at the time of the sample.

You will need to find a laboratory to carry out the analysis for you. Use the list below to advise the laboratory of the analysis that you want them to complete.

When you are commissioning the services of a laboratory, please note that the reporting limits are particularly important for PAHs – if they are not low enough, they will not allow assessment against the Environmental Quality Standards.

Also note that the PAH analysis is for the water sample, not for sediment.

Determinand	Reporting Limit	Units
Unionised ammonia as N (calc)	0.04	mg/l
Total Suspended Solids	1.0	mg/l
Nitrite as N	0.08	mg/l
Nitrogen, Total Oxidised as N	0.7	mg/l
Phosphate, Ortho as P	0.6	mg/l
Conductivity- Electrical 20C	30	uS/cm
pH	1	pH units
COD (Total)	11	mg/l
Aluminium, filter as Al (ug/l)	3.5	ug/l
Aluminium, total as Al (ug/l)	7.5	ug/l
Cadmium, filter as Cd (ug/l)	0.02	ug/l
Cadmium, total as Cd (ug/l)	0.07	ug/l
Chromium, filter as Cr (ug/l)	0.2	ug/l
Chromium, total as Cr (ug/l)	0.51	ug/l
Copper, filter as Cu (ug/l)	4	ug/l
Copper, total as Cu (ug/l)	1.8	ug/l
Lead, filter as Pb (ug/l)	0.3	ug/l
Lead, total as Pb (ug/l)	0.3	ug/l
Nickel, filter as Ni (ug/l)	1	ug/l
Nickel, total as Ni (ug/l)	1	ug/l
Phosphorus, filter as P (ug/l)	16	ug/l

Phosphorus, total as P (ug/l)	13	ug/l
Zinc, filter as Zn (ug/l)	5	ug/l
Zinc, total as Zn (ug/l)	6	ug/l
Ammoniacal Nitrogen as N	0.41	mg/l
PAHs TM178 (Waters)		
Acenaphthene	0.005	ug/l
Acenaphthylene	0.005	ug/l
Anthracene	0.005	ug/l
Benzo(a)anthracene	0.005	ug/l
Benzo(a)pyrene	0.002	ug/l
Benzo(b)fluoranthene	0.005	ug/l
Benzo(g,h,i)perylene	0.005	ug/l
Benzo(k)fluoranthene	0.005	ug/l
Chrysene	0.005	ug/l
Dibenzo(a,h)anthracene	0.005	ug/l
Fluoranthene	0.005	ug/l
Fluorene	0.005	ug/l
Indeno(1,2,3-cd)pyrene	0.005	ug/l
Naphthalene	0.01	ug/l
PAH, Total Detected USEPA 16	0.082	ug/l
Phenanthrene	0.005	ug/l
Pyrene	0.005	ug/l

Jo Bradley. Stormwater Shepherds UK. May 2024