Paper 9

How much are we mis-connecting?

Authors: Malgorzata Dolata and Nick Orman

Background

A major programme of work was undertaken in AMP3 & AMP4 to deal with the point source pollution from Wastewater Treatment Works and Combined Sewer Overflows. This brought about a significant improvement in water quality to meet the requirement of the Water Framework Directive, Urban Waste Water Treatment Directive and the Bathing Water Directive. Water quality is also likely to be a big driver in the future AMPs.

As a result of this many of the remaining water quality problems are now associated with diffuse sources of pollution. In order to meet the requirements of the Water Framework Directive (WFD), revised Bathing Water Directive (rBWD) and Shellfish Waters Directive (SWD), these diffuse sources of pollution now need to be tackled.

In rural areas the major source of chemical (BOD and ammonia) and nutrient diffuse pollution is likely to be wash-off from of agricultural land. In urban area the so-called Non-Agricultural Diffuse Water Pollution (NADWP) arises from a variety of sources, including:

1) Polluted wash-off from:

    a) Highways which can be contaminated with the products of vehicle wear and tear, vehicle accidents, street furniture wear and tear, pesticides, leaves, general animal and human waste products, sewage debris, chemicals and oil;

    b) Industrial areas which can be contaminated with products from spillages of chemicals, such as paints and solvents;

    c) Construction sites which can contain high levels of suspended solids;

    d) Leisure and amenity areas which can be contaminated with pesticides and fertilisers.

2) Direct discharges to highway and surface water drainage system such as:

    a) Contaminated water from vehicle washing;

    b) Waste oils, solvents and paint;

    c) Spillages of chemicals.

3) Misconnections of foul wastewater to surface water sewers.

4) Misconnections of surface water and groundwater to foul sewers leading to surface flooding that can also discharge to surface water systems or overflows in dual manholes.

UKWIR commissioned WRc to undertake a project to estimate the size of the problem. This paper describes the work undertaken during 2010-2012. The project focused mainly on the problems caused by the connection by third parties of foul sewage discharges to surface water sewers. No new data collection was carried out.

Separate systems

Historically, foul sewage and surface water were collected together in combined sewer systems. More recently separate systems have been constructed, with foul water collected and treated and surface water from rainfall collected and discharged directly to receiving watercourses. This was based on the principle that surface water is

relatively free from polluting material and causes fewer water quality issues for the receiving watercourse. Separate systems were first provided in new developments in Birmingham just before the First World War and were widely used in new developments in outer London during the period between the two World Wars. Their use gradually spread to the rest of the country from the 1950's to the 1970's.

Unfortunately, over time, the separation of the flow between the foul and surface water has become compromised because of misconnections by third parties from domestic, commercial and industrial premises.

Generally, misconnections are unintentional. They commonly occur when sinks, washing machines, dishwashers, baths, showers, outside drains and even toilets are connected to surface water sewers instead of foul or combined sewers or when roof drainage and drainage from paved areas are connected to foul sewers instead of surface water sewers.

For the purposes of the UKWIR project misconnections are defined as:
"any direct discharge by third parties of foul wastewater to a separate surface water sewer, or of surface water or groundwater to a separate foul sewer".

Legislative background

In England and Wales the separation of functions between the water and sewerage companies, local authorities and environmental regulators have split the legislation and all these bodies now have roles in rectifying misconnection problems. Water and sewerage companies have right to only close off misconnections and recover their costs from the offender by the provision of Section 109 of the Water Industry Act 1991, the local authorities have the powers to require homeowners to rectify misconnections by the provisions of Section 59 of the Building Act 1984. However, before they can use these powers, they must identify the location of each misconnection which can be very costly. The environmental regulators' primary role is to identify the cause of pollution and use their powers of Section 161A of the Water Resource Act 1991 requiring homeowners to carry out work to prevent pollution from entering any controlled water. These powers, however, are only usually applied in cases of serious pollution. The Environmental regulator can also liaise with water and sewerage companies or local authorities to rectify the problem. The legislation is similar in Scotland and Northern Ireland.

To address the problem of sewer misconnections, Water UK and the Environment Agency have developed an "Investigation and rectification of drainage misconnections. Good Practice Document" that identifies an operational approach for investigation and resolution of pollution from surface water sewerage systems affected by misconnections (Water UK, 2009).

UKWIR Project

To get an estimate of the size of the problem, WRc carried out a project for UKWIR "Sewer Misconnections – What Is The True Non-Agricultural Diffuse Water Pollution Impact?". The objectives of this project were to use the existing data to identify the true scale of sewer misconnections in the UK; the financial and environmental impacts; and to determine the most cost effective means of control based on best practice.

The project focused mainly on the problems caused by the connection by third parties of wastewater discharges to surface water sewers. No new data collection was carried out.

The recommendations of the project, whilst based on the commissioned work, are *solely* WRc's and do not reflect the views or intentions of UKWIR or its members.

Data

Water and sewerage companies currently carry out surveys in response to reported problems of pollution from surface water sewer outfalls. These include surveys of watercourses to identify the location of polluted surface water outfalls and surveys of the drainage of properties in the catchment of those outfalls to identify misconnections. Since the surveys were carried out in response to suspected problems, the data is skewed. A correction factor was therefore applied using an estimate of the proportion of all surface water outfalls that were significantly polluted. Unfortunately the amount of data on the proportion of outfalls polluted was very limited, so the estimate has a high level of uncertainty and therefore the results were skewed towards the areas of known pollution.

The misconnection survey data was provided by five water and sewerage companies and the data sets typically contained high level information on the number of properties surveyed and details of the properties where misconnections were identified. Only one of data sets contained sufficient information to allow the types and ages of all the properties surveyed to be identified. In order to calculate misconnection factors for house age and types, it was necessary to identify the age and type of housing, not only of the properties where misconnections were identified, but also those where no misconnections were found.

To establish whether the data from one data set was representative, the proportions of the total numbers of properties surveyed that were misconnected were calculated and compared for each of the data sets. They were proved to be in line and a more detailed analysis was then carried out.

Sewer length data was provided by water and sewerage companies. These were by local authorities in water and sewerage company areas in England, Wales and Scotland. Data was not available for Northern Ireland and therefore not included in the calculations.

The number of houses of different types and ages for each local authority were obtained from the English House Condition Survey 2001 (EHCS) and the Department of Communities and Local Government (CLG) website (2009/10), the Scottish House Condition Survey (SHCS) and data supplied by Experian for Wales.

The methodology

Sewer length data was used to calculate the percentage of the sewer system that had separate systems for foul and surface water. These were calculated by local authorities in water and sewerage company areas in England, Wales and Scotland.

The proportion of properties served by separate sewer systems was then calculated by assuming that this was proportionate to the length of separate sewer systems in that local authority.

The sewer misconnections at properties in relation to property age and type were estimated from an analysis of data from misconnection surveys from one data set only. The output from this stage was a set of factors for each property type and age giving the proportion of properties that were misconnected and the number of different appliances per misconnection.

A misconnection can involve more than one misconnected appliance and there can be more than one misconnection per property; therefore the number of misconnections is greater than the number of misconnected properties but less than the number of misconnected appliances.

The number of misconnected appliances and the number of misconnected properties was estimated by multiplying the number of properties of a particular type and age by the relevant misconnection factors. The financial costs of dealing with those misconnections were also calculated.

The analysis only considered foul to surface water sewer misconnections as data on surface water to foul sewers was not available.

The results

The analysis of sewer data indicated that approximately 50% of properties are connected to surface water sewers and outfalls.

Based on the available data, the study found that a weighted average of 41% of surface water sewer outfalls were significantly polluted. This may not be representative of all watercourses as surveys were likely to have been concentrated on rivers with reported, pre-existing pollution problems. The proportion has been calculated to estimate the number of misconnections that contribute to the environmental pollution.

It has been estimated that approximately 1% of domestic properties connected to separate systems are likely to be misconnected and be contributing to surface water sewer outfall pollution. Nationally, this would be around 128,000 properties. The total number of misconnections has been estimated to be approximately 282,000.

Although the property misconnection data arises largely from one company, it is possible to conclude that detached and semi-detached houses showed a higher misconnection rate of appliances than terraced houses. The

most common fault occurs when a washing machine or sink was misconnected to a surface water sewer. This was most frequently noted in immediately post-war properties. These were likely to be in the properties where extensions have been built.

No relationship was found between the extent of misconnected appliances and the age or income of the populations living in the high misconnection areas.

A targeted programme to identify misconnected properties in the UK has been estimated at £190 million and rectification of misconnections could cost around £42.5 million once identified.

There was insufficient data available to make any assessment of the impact of misconnections on compliance with the Water Framework Directive, the revised Bathing Water Directive or the Shellfish Waters Directive; however the limited post-project appraisals of misconnection schemes indicate that where sewer misconnections have been tackled in individual catchments, the water quality has improved markedly.

There was also insufficient data available to enable the impact of misconnections to be compared to the impact of other sources of non-agricultural diffuse water pollution.

The project recommended that:

- The Water UK/Environment Agency "Investigation and rectification of drainage misconnections. Good Practice Document" Water UK (2009) should be followed for any future investigation of sewer misconnections.

- A representative sample of surface water outfalls in several regions should be surveyed in accordance with the document to provide more robust estimates of proportion of outfalls that are polluted by misconnections and the extent of the misconnections problem.

- Property surveys should be carried out in several representative areas where there is not necessarily a pre-existing issue to get a better understanding of the scale of the problem. Recently constructed or extended properties should be included in this work.

- Water quality surveys should be carried out by or in conjunction with the Environment Agency to enable the effects of surface water sewer outfall pollution on the water course to be assessed. Water quality surveys should also be carried out before and after remediation programmes to get an understanding of the improvement in water quality.

- The data collected on the effect of misconnections should also cover the extent of other sources of NADWP so that investment programmes may be developed that are based on evidence to provide best value water quality improvements.

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