

SEWERAGE

## Quantifying urban creep

The increase in impermeable surfaces in urban areas will impact on design of future sewerage systems. To quantify the scale of this issue UKWIR has undertaken *Impact of Urban Creep on Sewerage Systems*, managed by **Brian Wilkinson**.

Urban creep is defined as 'the increase in impermeable area that is not associated with growth' where growth is defined as 'either the addition of a new property where there was no previous property or the addition of paved areas associated with new properties.'

Alternatively urban creep could be considered as 'additional obligations on water companies and highway authorities without any associated increase in income'.

At an UKWIR dissemination project in November, UKWIR Client Manager, Southern Water's **Barry Luck**, said that urban creep's effect on sewerage systems is of a similar order to climate change and population increase with its associated development.

### Front to back

The contractor, **Richard Allitt**, discussed previous studies on the subject from both the UK and overseas. He commented that UK studies had concentrated on changes taking place at the front of houses whilst omitting new paving and development at the side and rear of properties.

The study made full use of the digital analysis of full colour aerial photography. Using photographs of the same area from earlier years, changes in vegetation, paved areas and building development were identified.

Figure 1 shows the changes in paved area (blue) and buildings (orange) over a seven year period in an urban area.

**Figure 1. Change in paved area and building development**



**Andrew Tewkesbury and Kevin Davidson** from the sub-contractors, Infoterra, described their 'land cover classification maps'. 10km by 10km areas were analysed within five towns and cities - Chester, Leicester, Maidstone, Newcastle and Norwich. Aerial photographs were available for 2006 and for years ranging from three to seven years earlier.

'Change maps' were produced from which it was possible to strip out the growth elements leaving just the urban creep area.

### Impact

**Martin Allitt** then described the analysis of the maps to estimate the impact of urban creep and how it will affect sewerage systems in future.

Information was collected for each of the 100km<sup>2</sup> areas on soil type and whether the sewerage system is combined, separate or partially separate.

For smaller sample areas data was collected on property type, property density, building footprint size, depth of front gardens and geodemographic factors.

The analysis showed that property type displayed the best relationship and appeared to be a surrogate for both population density and social classification of the area.

Statistical analysis of the data was carried out by specialists from Scottish Water using a 'regression tree' method. This demonstrated that an urban creep factor to be included in an hydraulic model could be derived from the area of the postcode (or sub-catchment).

Richard Allitt then illustrated the results of applying urban creep to an hydraulic model.

Future effects of urban creep were calculated with respect to flooding locations, flooding volumes, combined sewer overflow spills and pump run times.

The effects were found to be significant. For example the number of CSO spills is estimated to increase by 10%, 22% and 41% by 2020 in three of the areas studied.

## Delivering the Research

UKWIR research outputs have been informing debates with the regulators and hence influencing regulations and legislation.

UKWIR has delivered a series of common methodologies, guidelines and toolkits to meet national requirements imposed by regulators (often in collaboration with them).

This has ensured that companies all report in a consistent manner, which has saved members the expense and effort of devising their own methodologies for:

- capital maintenance planning common framework
- headroom for water resources
- water safety management plans & DOMS
- deployable output
- carbon accounting (direct & embedded)
- pollution inventory
- cost benefit analysis methodologies
- mains and sewer failures.

UKWIR projects are delivered using contractors selected through competitive tendering procedures and costs are minimised through the efforts of UKWIR members who nominate both client managers and project steering groups.

All members receive copies of reports and gain extra value through attending free technology transfer workshops.

During 2008, 510 industry delegates attended 30 project workshops.

Since 2001, the average score by delegates at UKWIR workshops responding to the question 'attending the workshop was a good use of your time' is 4.2 out of 5.0.

Richard Allitt said that urban creep was unlikely to level out in the foreseeable future as the 'saturation point' is a long way off.

He warned of many myths surrounding permeable block paving. The blocks themselves are not permeable, permeability being achieved only by maintaining gaps between the blocks and using permeable material in the underlying layer.

Blocks are available with protrusions that give a guaranteed gap or, alternatively, plastic spacers are available for use with standard blocks. Even then an inspector can find it hard to identify what has been laid.

The project report contains a number of recommendations including factors to be applied in making allowances for urban creep in sewerage scheme designs for flood alleviation or CSO spill assessments.

# Sustaining phosphorus

Global mineral sources of phosphorous (P) are becoming depleted and costs are rising substantially.

About 70 per cent of P in biosolids is in inorganic form after water treatment and, with low nitrogen to phosphorus ratios, this leads to soil P build-up and hence low rates of P release in water compared to other manures, as figure 2 illustrates.

Therefore biosolids produced by the water industry can offer a suitable and more sustainable alternative to other manures.

However good management practice is required to protect watercourses from phosphorus run-off and sensible policies are required to efficiently utilise phosphorus stored in soils to meet crop needs.

UKWIR research has been addressing these issues in three phases. Phase 1, from 1995 to 2002, comprised laboratory and field experiments investigating the amounts and forms of P in sludge, the agronomic value of P in biosolids and losses of P in field run-off following biosolid application.

Then, in 2006, UKWIR concluded phase II, a review and laboratory trials of P loss from agricultural land receiving biosolids. As a consequence guidelines for the effective management of biosolids were produced with respect to run-off and phosphorus loss.

A decision tree determines circumstances where P in biosolids might pose a risk when applied to agricultural land and thereby

compromise the objectives of the Water Framework Directive.

At an UKWIR workshop in November delegates heard how, in phase III, these guidelines have been validated in field trials.

## Integrated approach

First of all, Defra's **Dr Daniel McGonigle** set the UKWIR research in the wider context of research into P in the environment and how this is enabling Defra to develop an integrated approach with common approaches to assess agronomic value and environmental risks from organic materials.

ADAS's **Paul Withers** then disseminated the findings of phase III, *Validation of Guidelines for the Effective Management of Biosolids Applications to Agricultural Soils with Respect to Run-off and Phosphorus Loss*.

This project involved visiting six arable farms in each of three regions (Anglian, North West and South West), providing as wide a range in different biosolid inputs as possible on different soil types.

Basic cropping and P input information was collected. Fields on each farm were sampled from October to December 2008 for determination of soil P status and P sorption properties.

The field studies validated the results established in the laboratory. In particular the study confirmed that the degree of soil phosphorus saturation is a more reliable

indicator than soil Olsen-P for guiding sustainable biosolid practice to avoid eutrophication impacts.

The industry's adoption of this additional but simple test will therefore support the beneficial recycling of a valuable resource.

## Lifecycle

**Dr Sean Comber** from the contractor, Atkins, took the opportunity to update delegates on the current UKWIR study on *Lifecycle Phosphorus Management*.

He said that around 40,000 tonnes of P enters wastewater treatment works in the UK each year and is either discharged to watercourses or is left in biosolids, most of which goes to land.

An eight-fold dilution of treated effluent is needed to achieve the most relaxed 'Environmental Quality Standard' (EQS) for 'Good Ecological Status' under the Water Framework Directive.

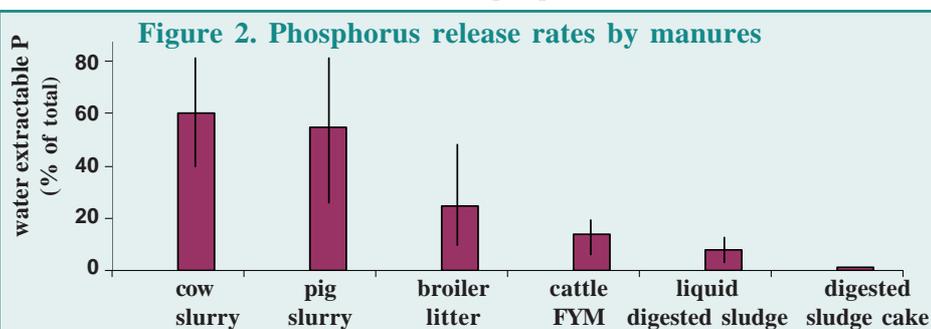
Two thirds of P comes from human sources so source control alone is unlikely to provide sufficient reductions to meet discharge consents. Even with P removal at wastewater treatment works, P levels downstream are often greater than the EQS owing to other point and diffuse sources.

Seventy per cent of biosolids, in dry weight, produced at wastewater treatment works are recycled to land, providing approximately 12,000 tonnes of P a year which is about ten per cent of P requirement for the UK.

A UK-wide map has been produced to show how agricultural use of biosolids is dependent upon the availability of suitable land and its distance from the treatment works.

The project also reviewed the fate and bioavailability of P in different sludges and their loss from land after application.

The study, which has six months to run, is currently drawing together the data, developing scenarios and developing life cycle management tools to assist in future planning.



## SMART METERING

# Reviewing the case for intelligent metering

The Government announced in 2009 that all homes should have a smart meter for both gas and electricity supplies by the year 2020.

This opens up an opportunity for the water industry to learn from the energy sector's experience and make possible use of their fixed networks in extending smart water metering.

The timely UKWIR project *Reviewing the Case for More Intelligent Water Metering: Costs, Benefits and Feasible Pathways* provides information for water companies to help them make strategic decisions about the extent and timing of their smart metering.

At a project dissemination workshop in February, UKWIR Client Manager,

Bournemouth & West Hants' **Richard Stanbrook**, said 'the priority is to deliver efficient meter reading and an enhanced customer service'.

**Martin Hall** from the contractor, Mouchel, added that the project had been 'benefit led' more than 'innovation led'. They had also consulted all the main players in the water and energy sectors.

He described how smart metering technology can deliver reduced operational costs, improve customer service and reduce customer demand, particularly at peak times.

There are, though, notable challenges. Should the meters be internal or external? External meters help in identifying supply pipe

leakage but the worst place to have an intelligent meter is in a wet environment under the ground. However there is better news, in that manufacturers are now giving guarantees of battery life of 10 years or more.

Decisions have to be made on whether to install just the basic automatic meter reading or include enhanced facilities to provide water use information or high-flow alarms.

Will the data be collected manually, by walk-by or drive-by systems or through a fixed network?

There are many options for customer communication. Customers can be billed by an e-bill, through the internet or even via TV

# Targeting water efficiency

From next April water companies will be subject to water efficient targets set by Ofwat.

The UKWIR project *Cost Benefit of Baseline Water Efficient Activities*, managed by **Nick Humphrey**, has been undertaken so that a common robust method can be used when completing water saving figures in the June Return to Ofwat. The project was timed to give users the opportunity to fully test out the accompanying spreadsheet tool.

UKWIR's suite of water efficiency projects has built up a substantial knowledge base with information provided on a consistent basis in a database ([www.water-saving.org](http://www.water-saving.org)).

**Dene Marshallsay** from the contractor, Artesia, explained at a project dissemination workshop, how the database was central to the study.

## UK at forefront

The database only contains data on 'hard' measures, those resulting from installing water saving devices. For this study additional evidence on 'soft' measures, those relating to behaviour change, was collected.

On the international front, Zaragoza's *Water Saving City* project is seen as an example of using 'soft' measures in combination with 'hard' measures to reinforce the water savings.

However, Dene Marshallsay noted that a trawl through overseas references confirmed that the UK was in the forefront of research on quantifying the effects of water efficiency initiatives on water use.

A detailed questionnaire had been sent out and twenty companies responded about their water efficiency activities.

Using information from the questionnaire, figure 3 shows the most common 'soft' measures applied.

Figure 4 shows how the water efficiency targets are set to include water savings above 'minimum water efficiency activity', illustrating how both 'hard' and 'soft' measures can contribute.

Artesia devised a scoring system with the level of engagement with customers set as 'minimum', 'low', 'medium' or 'high'.

This, when combined with the potential

water savings of the water efficiency measure, gives an estimate of the water savings.

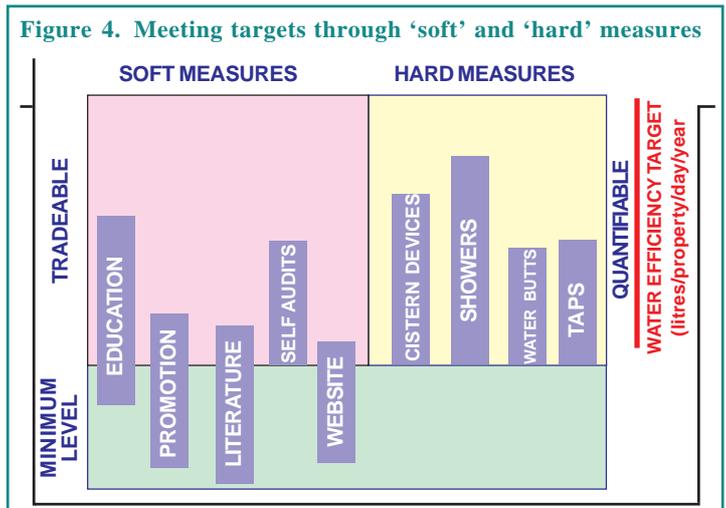
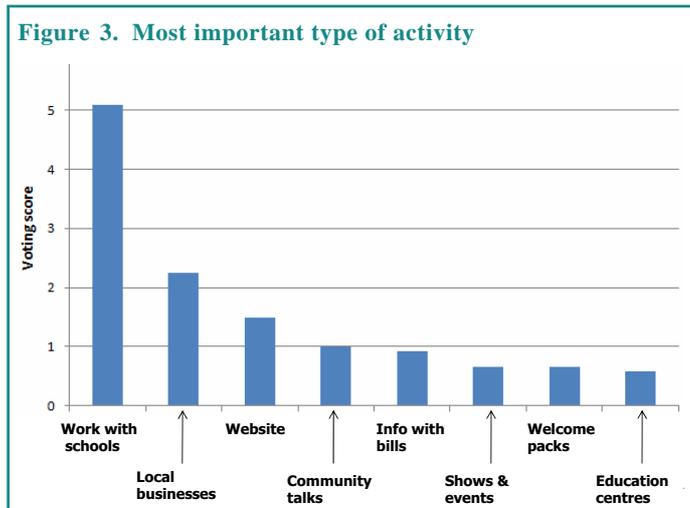
These calculations are all set out in an Excel spreadsheet tool that is being made available to water companies. Delegates were able to test out the spreadsheet in the afternoon session.

Dene Marshallsay added that the tool can also assist companies in calculating the consequential greenhouse gas emissions and impact on energy bills.

## Customer focus

The afternoon session also gave the opportunity for **Kelly Rains** and **Kathy Burdett** to present their experiences on how United Utilities and Wessex Water, respectively, had applied the spreadsheet tool.

In summing up, UKWIR Client Manager, Wessex Water's **Luke de Vial**, said that the targets were important, 'but we should not lose sight of the fact that the customer should be the main focus of water efficiency'.



## SMART METERING (cont)

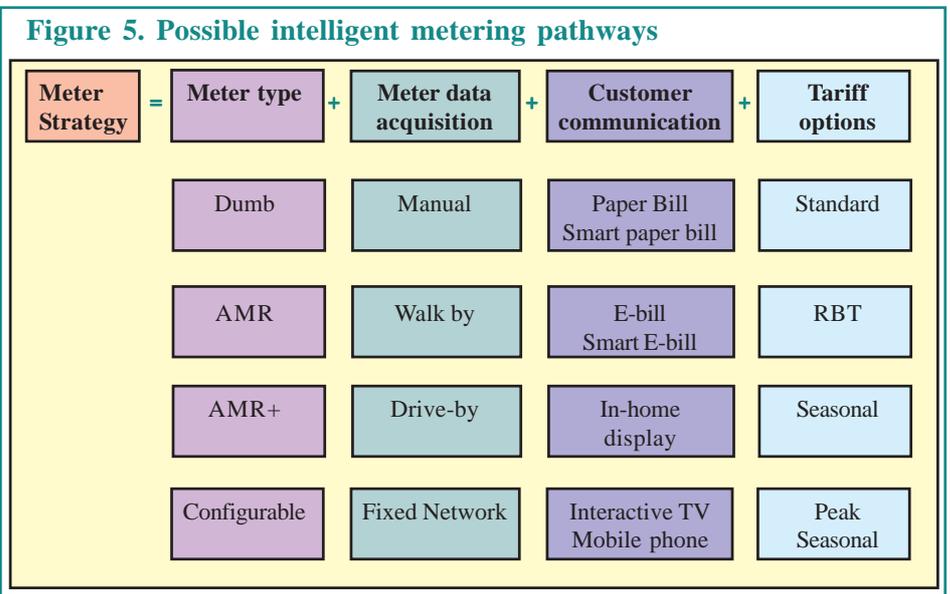
or mobile phone. Home display units can provide both billing information and help customers reduce their water use.

Intelligent metering facilitates the application of 'smart' tariffs, such as rising block or seasonal and peak seasonal tariffs.

Martin Hall warned delegates not to underestimate the logistics and cost of installing fixed network systems.

Mouchel's **Brendan McAndrew** then took the audience through the project's cost benefit framework that provides realistic indicative costs that have been validated by four water companies. All the assumptions are transparent and all the values can be adjusted to suit a company's particular circumstances.

The report also sets out the actions that water companies, regulators and others can make to move intelligent metering forward.



# Cost-benefit review

The 2009 Price Review (PR09) process has introduced cost-benefit analysis (CBA) as an integral component of strategic planning and decision-making.

The use of customer preference studies has provided all parties involved with new perspectives on what constitutes good value to customers.

The industry has collectively set out to capture the learning gained by undertaking a project, *Review of Cost-benefit Analysis and Benefit Valuation*, managed by **Richard Kirby** with Severn Trent Water's **Frank Grimshaw** as Client Manager.

Its principal aims are to review the approach to CBA and its application in PR09 and to understand why customer benefit valuations may differ from company to company.

An outcome of the review will be further guidance on applying CBA and its role in company and regulator decision-making.

The project has been awarded to Cascade Consulting in association with Eftec and ICS Consulting.

## Well attended

A stakeholder engagement workshop at Ofwat's offices in Birmingham on 13 January was well attended despite the snowy conditions. The workshop provided an initial opportunity to gather views from a diverse range of interested parties - asset planners, regulators and PR09 managers on experience to date and priorities for taking benefit valuation and CBA forward.

The issues identified were explored further at a series of regional and individual company meetings during February. The findings of the study are due to be presented to the industry at a workshop in July.

### UKWIR WEB PAGES

Visit [www.ukwir.org](http://www.ukwir.org) to see the newly re-designed UKWIR web pages. The makeover provides more information on UKWIR processes and member services.

Users can read about the projects in the UKWIR programme, order reports and review earlier editions of UKWIR News.

### UKWIR PEOPLE

**Richard Stanbrook**, Bournemouth & West Hants Water's Corporate and Revenue Services Manager, is UKWIR's Client Manager for the intelligent metering project, described on page 2, and for customer debt projects. He is a member of Water UK's *Customer Service Network*.

Richard gained an MSc in Environmental Management and has sixteen years of experience in the water industry. After starting in a network role he moved into corporate services and then customer revenue services.

This edition features a listing of UKWIR publications issued since the last newsletter.

### DRINKING WATER QUALITY

09/DW/02/58 Validating the Cause of Coliforms in Drinking Water (1 84057 548 4) £400

### SLUDGE

09/SL/02/8 Validation of Guidelines for the Sustainable Application of Phosphorus in Biosolids to Agricultural Soils (1 84057 549 2) £50

### WATER MAINS & SEWERS

09/WM/12/26 Smart Sensors for Buried Utility Location and Performance Monitoring (1 84057 546 8) £300

### WATER RESOURCES

09/WR/25/4 Estimating the Water Savings for Baseline Water Efficiency Activities (1 84057 550 6) £200

08/WR/26/4 Water Resources Management in Cooperation with Agriculture: Micro-Macro Economic Analysis (1 84057 541 7) £5

08/WR/26/5 Water Resources Management in Cooperation with Agriculture: Secondary Measures for the Protection of Groundwater - Summary Report (1 84057 542 5) £10

08/WR/26/6 Water Resources Management in Cooperation with Agriculture: Secondary Measures for the Protection of Groundwater - Main Report. (1 84057 543 3) [sold together with 08/WR/26/5] £10

08/WR/26/7 Water Resources Management in Cooperation with Agriculture: Modelling Nitrate Concentrations with Variations in Time (1 84057 544 1) £20

09/WR/26/8 WAgriCo Final Technical Report (1 84057 545 X) £25

UKWIR research reports are available for purchase via the internet on [www.ukwir.org](http://www.ukwir.org)

## WAgriCo reports

WAgriCo was a collaborative catchment management project between UK partners and farmers around Dorchester in the UK and an equivalent arrangement in Lower Saxony in Germany.

It was part of the EU LIFE Programme and in the UK was matched with funding from Defra and UK Partners.

It was managed by **Roger Trengove** on behalf of UKWIR.

The aim of the three year project was to improve groundwater quality by reducing nitrate leaching through adopting the large scale use of a 'Programme of Measures' (PoMs) in eight pilot catchments in the Wessex Water area.

The report describes farmer engagement, subsequent farm audits and their assessments.

It also details the take up and monitoring of the PoMs.

Several Wessex Water sources of water supply have shown increasing concentrations of nitrate over the past few decades threatening their use for drinking water.

Concentrations in drinking water can be reduced by the construction of treatment plants, blending with water from lower nitrate sources or managing the surrounding land to decrease movement of nitrate from soil to water.

## Mitigation

Six actions, or 'mitigation measures', were identified as a focus for farm advice:

- fertiliser recommendations
- manure management plans and farm waste audits
- cover crops
- fertiliser spreader calibration
- moving application of slurries and poultry manure
- the calculation of N efficiency.

Basic farm data on feed, fertiliser inputs, animal numbers and crop yields were used to calculate a nutrient balance for each farm.

The report concludes that the key to the success of the project was good liaison between the different groups within the catchment and, most importantly, the engagement of farmers.



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