

October 2006

Wastewater treatment

vol. 2 Wastewater treatment, intermittent discharges, monitoring and nuisance control

The UKWIR research programme is currently divided into the following topic areas: drinking water quality and health; toxicology; water resources; climate change; wastewater treatment; biosolids; water mains and services as well as regulatory and customer issues. This catalogue lists the reports on the subjects of Environmental Impacts, Treatment Processes, Intermittent Discharges, Monitoring and Nuisance Controls, Collection Systems and Intelligence Gathering in the **Wastewater Treatment Programme Area**. Volume 1 included Bathing Waters, Combined Sewer Overflows and Effluent Quality.

Legislation affecting wastewater treatment is changing all the time as *The Impact of Recent Changes in Waste Legislation on Sewerage Networks and Wastewater Treatment Works* (05/WW/23/3) makes clear.

A recent example is landfill legislation which generated *Characterisation and Treatment of Water Industry Waste Streams for Landfill Disposal* (06/WW/23/4).

The adoption of the Water Framework Directive has created a need to identify the sources of pollution and, in particular, diffuse pollution. In 2004 UKWIR carried out a series of reports under the banner of *Priority Hazardous Substances: Trace Organics and Diffuse Pollution* (04/WW/17/2-5).

This followed on from work two years earlier on identifying the source of priority and listed

substances (02/WW/14/1 & 02/WW/25/2), listed in volume 1.

The Water Framework Directive also has *Implications of Potential New Measures and Standards Required under the Water Framework Directive for Natura 2000 Sites* (04/WW/20/1).

Sustainable Urban Drainage Systems (SUDS) is a topical issue and UKWIR have recently collaborated with the Water Environment Research Foundation in the USA (05/WW/03/6) to identify best management practices that can be applied more extensively in both countries.

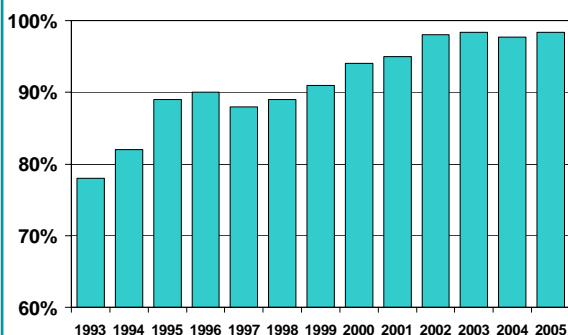
UKWIR research into odour control began in 2001 and has culminated in *A Guidebook for Odour Control at Wastewater treatment Works* (06/WW/13/8).

UKWIR reports can only be purchased via the UKWIR website:

www.ukwir.org

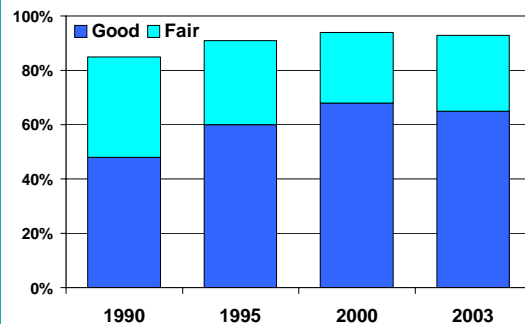
The website also provides information about current and proposed UKWIR research programmes. You can also download the latest version of UKWIR NEWS to get an update on recent projects, publications and technology transfer workshops

UK bathing water compliance



Source: Defra

River quality in England & Wales



Source: Environment Agency

UKWIR was set up by the UK water industry in 1993 to provide a framework for the procurement of a common research programme for UK water operators on 'one voice' issues. UKWIR's subscribers comprise 24 water and sewerage undertakers in England and Wales, Scotland and Northern Ireland to whom these publications are freely available.

Work is often carried out in collaboration with government departments and regulators including the Department for Environment, Food and Rural Affairs; the Drinking Water Inspectorate and the Environment Agency. Work is also done in collaboration with research organisations internationally, including the Global Water Research Coalition.

The work is undertaken by a wide range of companies, academic institutions and other organisations in the UK and overseas. Project management is undertaken by both UKWIR members and individuals employed by UKWIR.

Environmental impacts

SUDS: Increased Liability for the Water Industry - Phase2

Contractor: HR Wallingford

Ref: 06/WW/03/8, ISBN 1 84057 417 8, 40pp, £200

The second of two reports which investigate the liability risks associated with ownership of Sustainable Drainage Systems (SUDS). The first report carried out a broad evaluation of the issues, and the second study then investigated those which were perceived as being the most important. Key topics were assessed as being:

- risk of sediment in ponds and basins being classified as hazardous and the disposal costs associated with their maintenance upkeep
- risk of groundwater pollution from infiltration systems
- risks associated with health & safety and also public nuisance
- development of a SUDS protocol
- current state of existing software in being able to adequately represent SUDS.

Performance and Whole Life Costs of Best Management Practices and Sustainable Urban Drainage Systems

Contractor: Water Environment Research Foundation

Ref: 05/WW/03/6, ISBN 1 94339 743 9, 160pp, £500

Documents the performance and whole life costs of stormwater practices in the U.S. and UK. Includes retention ponds, extended detention basins, vegetated swales, bioretention, porous pavements, and various infiltration practices. Includes literature and database reviews, hydraulic modelling, site investigations and development of a whole-life cost model. Provides guidance on the selection, whole-life costing, design, and maintenance of BMPs/SUDS.

Forecasting the Deposition and Biological Effects of Excess Carbon from Sewage Discharges

- BenOss Version 3 for the Purposes of the Urban Waste Water Treatment Directive

Contractor: Scottish Environment Protection Agency

Ref: 99/WW/03/3, ISBN 1 84057 169 1, CD, £200

BenOss Version 3 is a model that predicts changes in the soft sediment benthic community in response to organic inputs. It produces an assessment of the amount of suspended solids (carbon) from a sewage outfall accumulating in the near vicinity of a domestic sewage outfall in terms of mass carbon unit/area/time. After calculating the amounts of deposition, the model then predicts what effect this will have on the benthic community.

Microbiological Inputs to the Environment from Sewerage and Sewage Treatment Works

Contractor: Public Health Laboratory Services

Ref: 98/WW/07/1, ISBN 1 84057 134 9, 55pp, £200

Reviews pathogenic organisms found in sewage. Those that should be tested include Salmonella, Campylobacter, Escherichia coli 0157, Cryptosporidium, Giardia and enteroviruses. A field survey methodology quantified the microbiological inputs into controlled waters from sewage relative to other inputs. Study area should be waters from sewage relative to other inputs. Study area should be surveyed, and sampling sites should be chosen using evidence of sources of contamination and tracer studies. Following the presence of pathogens over two years will allow for variations in epidemiology and weather.

Treatment processes: general

Disinfection of Storm Sewage Discharges

Contractor: Cascade Consulting

Ref: 05/WW/04/11, ISBN 1 84057 378 3, 84pp, £500

Evaluates the evidence for the satisfactory performance of storm sewage disinfection techniques as an alternative to increased storm sewage storage and subsequent return to full treatment. Reviews the effectiveness of a range of alternative disinfection technologies, including pre-treatment requirements and identifies UV irradiation technologies and chlorination as the technologies with the greatest potential. Interpretation of a storm sewage trial and a microwave UV irradiation trial are included.

Sustainable WWTW for Small Communities

- Vol I: Sustainability and the Water Industry - Identification of Further R&D Requirements

Contractor: MWH

Ref: 03/WW/04/9, ISBN 1 84057 323 6, 146pp, £400

- Vol II: BPSO Methodology Handbook

Ref: 03/WW/04/10, ISBN 1 84057 324 4, 113pp

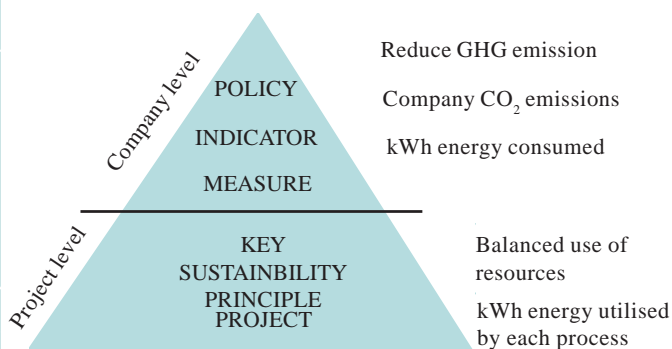
Sustainable development is of particular interest to the water industry which finds itself having to comply with increasingly stringent standards for wastewater effluent quality whilst being pressed to minimise the cost to the consumer. Treatment processes suitable for achieving these high standards of effluent quality are likely to involve increased costs, energy usage and greenhouse gas emissions. These issues are particularly relevant to small wastewater treatment works which are more likely to be located in remote situations where the application of complex high-energy processes are probably inappropriate.

Volume I discusses the background to sustainability considerations within the water industry and presents the framework for the methodology.

Volume II contains structured guidance for practitioners in developing sustainable solutions for small communities.

Sold as a 2 volume set for £400.

Figure 1. Logical continuum for determining attributes



Review of Wastewater Disinfection Treatment Strategies

- Identification of Further R&D Requirements

Contractor: Cascade Consulting

Ref: 03/WW/04/6, ISBN 1 84057 289 2, 8pp, £25

- Final Report

Ref: 03/WW/04/5, ISBN 1 84057 288 4, 110pp, £100

Reviews recent UK and international developments in wastewater disinfection technologies for both continuous and intermittent discharges. Existing technologies include UV irradiation, submerged membrane bioreactors, chlorination, ozonation and constructed subsurface flow reedbeds. Potential new technologies include electro-disinfection, ultrasonics, gamma radiation and microwave irradiation. Each technology has been assessed and its possible advantages and disadvantages identified. A more detailed review has been undertaken for technologies that represent the most viable alternatives for operational application within the next 5 years.

Metals Removal and Treatment

Contractor: W S Atkins

Ref: 03/WW/04/4, ISBN 1 84057 279 5, 225pp, £300

Delivers a comprehensive review of the issues facing the industry resulting from tighter regulations on the discharge or disposal of metals. Provides technical and financial information to avoid ineffective investment and to ensure that appropriate treatment is properly funded. A comprehensive technology review of performance of conventional and other effluent and sludge treatment techniques. Alternatives to treatment are identified and their costs compared.

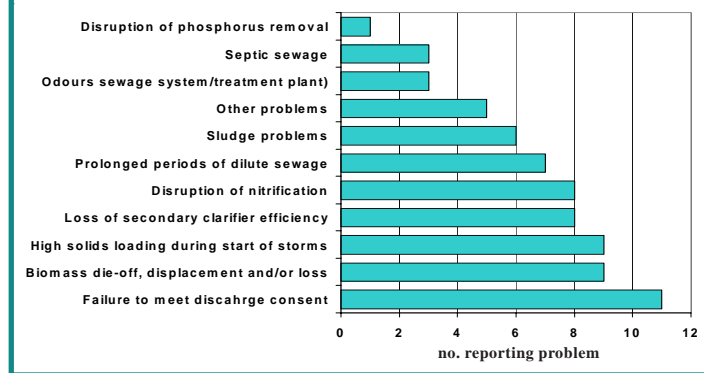
Impact of Extended Storage on Sewage Treatment

Contractor: University of Bradford

Ref: 02/WW/04/3, ISBN 1 84057 266 3, 225pp, £50

Increased extended in-sewer storage may have consequential effects on downstream treatment plants. Problems may occur due to septicity, odours, screen blinding, high hydraulic loads, overloaded bioreactors, and increased sludge volumes. Nonetheless, consent failures are unlikely provided sewer and downstream treatment systems are designed and operated accounting for the potential interactions.

Figure 2. Problems identified in questionnaire



Tightening WWTW Emission Standards; A Review of the Treatment Technologies and their Impact on Climate Change

Contractor: Entec

Ref: 02/WW/04/1, ISBN 1 84057 259 0, 111pp, £150

Examines the feasibility of meeting tighter effluent quality standards at wastewater treatment works. The impact of these tight standards on energy use, greenhouse gas (GHG) emissions and costs has been assessed. Performance of the different treatment technologies has been compared with respect to effluent quality, energy use, GHG emissions, costs, land use and sludge production.

Wastewater Disinfection Processes

Contractor: WRc

Ref: 95/WW/04/1, ISBN, 55pp, £100

Provides a broad technical review of five wastewater disinfection processes: Ultraviolet (UV) irradiation: Microfiltration: Chlorination: Ozonation: Chemically assisted sedimentation (CAS). Gives a brief summary of relevant EU legislation together with an outline of the existing NRA policy for regulating disinfection processes. Gives a number of conclusions relating to the EU directives on quality of wastewater discharges. Reviews NRA policy for the regulation of wastewater disinfection and the disinfection processes.

Nuisance controls

Best Practicable Means (BPM) - A Guidebook for Odour Control at Wastewater Treatment Works

Contractor: WRc plc

Ref: 06/WW/13/8, ISBN 1 84057 415 1, 98pp, £400

Assists operators to select the means to abate nuisance caused by odour from their works. Provides guidelines for an odour management hierarchy, ranging from prevention to treatment and also provides a framework for selecting BPM according to local circumstances. It is one of a series of documents giving guidance on odour control at wastewater treatment works and should be read in conjunction with Defra's Code of Practice (CoP) on Odour Nuisance from Sewage Treatment Works. It describes factors that influence the generation and impact of odours from wastewater treatment works and provides guidance for dealing with complaints and reducing emissions through the adoption of both baseline, and where necessary, more expensive enhanced measures.

Odour Standards for the Wastewater Industry

Contractor: Entec

Ref: 04/WW/13/6, ISBN 1 84057 341 4, 117pp, £300

Reviews scientific literature and documented case studies relating to odour nuisance from wastewater treatment processes with a view to establishing a sound basis upon which a workable odour standard could be promulgated by UK water service providers. Review and assesses current legislative controls over odour in England and the devolved administrations, including examination of recent and ongoing legal actions. Concludes that further work on human exposure-response relationships for wastewater odours would be needed in order to support development of a specific odour standard. At the present time, there is insufficient scientific evidence to allow confident adoption of an odour standard.

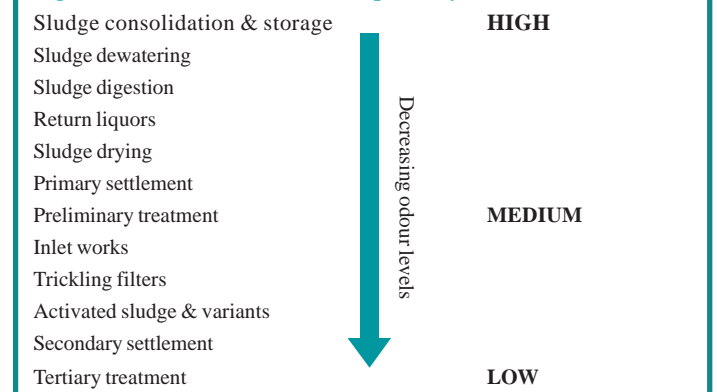
Odour Control in Wastewater Treatment - A Technical Reference Document

Contractor: WRc plc

Ref: 01/WW/13/3, ISBN 1 84057 246 9, 270pp, £400

Provides a comprehensive up-to-date source of information on odour control measures available to wastewater treatment works operators. Part 1 describes the principles of odour formation, measurement and management. Part 2 describes in detail the practical methods available to control odours in wastewater treatment. The two parts together provide practical guidance to those directly involved in management and control of wastewater odours.

Figure 3. Possible relative unacceptability of wastewater odours



Intermittent discharges

Implications of Potential New Measures and Standards Required under the Water Framework Directive for Natura 2000 Sites

Contractor: WRc plc

Ref: 04/WW/20/1, ISBN 1 84057 367 8, 48pp, £250

Identifies and assesses designated habitat sites that were dependent on water and might require more investment and action by the UK water industry. The additional measures identified were extra nutrient removal from discharges, extra BOD/SS/ammonia removal from discharges, and abstractions. The implications for individual companies depend on local circumstances and measures already adopted or planned.

Priority Hazardous Substances, Trace Organics and Diffuse Pollution (Water Framework Directive)

- Treatment Options and Potential Costs

Contractor: WRc plc

Ref: 04/WW/17/5, ISBN 1 84057 333 3, 125pp, £470

Final report of the research programme aimed at improving the understanding of the Water Framework Directive priority substances in sewage. Summarises results of sampling studies from earlier stages of the programme in conjunction with a review of the fate of priority substances in wastewater treatment, to assess potential treatment costs. If end of pipe treatment is required as the main control measure for priority substances then, based on the quality standards being proposed, additional whole life costs for England and Wales could over £6 billion.

- Surface Water Drains and Intermittent Discharges from Sewer Networks

Ref: 04/WW/17/4, ISBN 1 84057 332 5, 45pp, £470

Assesses discharges of priority substances from surface water drains, domestic septic tanks and storm and emergency releases from sewer networks. The dilutions that are required to meet environmental quality standards are generally fairly low. In some cases discharges may occur during storms before river flows have built up. However, it is probable that in many cases additional control measures may not be merited based on considerations relating to priority substances alone.

- Urban Catchment Study and Assessment of Diffuse Inputs

Ref: 04/WW/17/3, ISBN 1 84057 334 1, 67pp, £470

Foul water and runoff samples were taken from locations in housing estates, the town centre and a light industrial estate in an urban catchment. Results confirm that certain groups of priority substances arise from diffuse sources, including housing estates, and are ubiquitous in wastewater. Substances are identified which would cause most concern to the industry if proposed EC sludge limits and water quality standards in the Water Framework Directive are implemented.

- Screening Study and Literature Review of Quantities in Sewage, Sludge and Effluent

Ref: 04/WW/17/2, ISBN 1 84057 322 8, 52pp, £470

Priority substances were analysed in samples taken from thirty wastewater treatment works across England and results have been compared with a comprehensive literature review. Highlights the fact that certain groups of priority substances arising from diffuse sources are ubiquitous in wastewater.

Monitoring

The Efficacy of Natural Wastewater Treatment Systems in Removing Faecal Indicator Bacteria

Contractor: Centre for Research and Environmental Health

Ref: 05/WW/21/7, ISBN 1 84057 385 6, 50pp, £100

Determines the efficacy of natural systems in removing faecal indicators. The most effective systems achieve *Escherichia coli* concentrations in the range 102-103 cfu per 100ml which is comparable to UV treatment. However, there is little data on attenuation during normal changes in flow. The systems studied included a horizontal reedbed, vertical reedbeds (which were relatively immature), a lagoon and integrated constructed wetlands.

A Literature Review of the Efficacy of Natural Systems in Removing Faecal Indicator Bacteria

Contractor: Centre for Research and Environmental Health

Ref: 05/WW/21/5, ISBN 1 84057 375 9, 70pp, £100

Two wetland types were distinguished according to the presence of a free water surface. This feature determines the extent to which key processes, including oxygen diffusion and the balance of removal mechanisms between sedimentation and sieving, will operate. Removal of faecal indicator organisms and pathogens has been represented as a two step process, where initial retention is followed by elimination. The principal data gap is event-based faecal indicator flux assessment to assess impacts on 'protected areas' such as bathing waters.

Detecting and Responding to Sewer Blockages

Contractor: Tynemarch

Ref: 04/WW/21/4, ISBN 1 84057 347 3, 140pp, £250

Considers the occurrence and causes of sewer blockages and reviews current management practice in the context of regulatory developments. A general specification is provided for a blockage detection system, including requirements for installation, maintenance, safety, reliability and cost. Considers potential monitoring parameters are reviewed and available sensors technologies. Reviews communications options, including systems architecture and telemetry integration. A methodology is described for assessing the costs and benefits of alternative approaches to blockage management, and calculations are provided in a spreadsheet. The cost benefit analysis is applied to eight case studies. Assesses the market for sewer blockage detection equipment.

Measurement of Low Flows at Wastewater Treatment Works

Contractor: Yorkshire Water Services Ltd

Ref: 01/WW/21/1, ISBN 1 84057 237 X, 49pp, £500

Evaluates a range of technologies under typical installation and operating conditions on a small works to determine their ability to meet policy requirements and establish limits of detection and accuracy under a range of flow conditions.

Collection systems

Estimation of Population Equivalent

Contractor: WRc plc

Ref: 03/WW/22/1, ISBN 1 84057 300 7, 40pp, £100

Tests the statistical properties of population equivalent (PE) calculations and compare them with PE estimates used for other reporting purposes. In making these comparisons, an understanding of the factors influencing PE estimation was developed together with an insight into the varying interpretations adopted by different companies.

Intelligence gathering

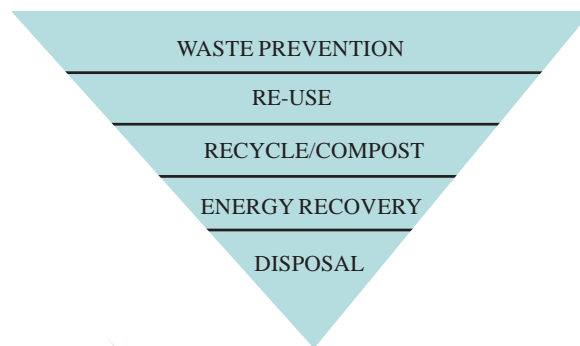
Characterisation and Treatment of Water Industry Waste Streams for Landfill Disposal

Contractor: WRc plc

Ref: 06/WW/23/4, ISBN 1 84057 414 3, 100pp, £250

Provides a characterisation dataset on the priority waste streams of sewer grit and sewage screenings. A UK-wide sampling and testing programme was carried out to encompass the major sources of variability in these waste streams and provide basic characterisation information as required for landfill acceptance. An assessment of existing treatment processes was undertaken to identify those that could meet pre-treatment requirements for landfill.

Figure 4. The waste hierarchy (Defra 2006)



The Impact of Recent Changes in Waste Legislation on Sewerage Networks and Wastewater Treatment Works

Contractor: WRc plc

Ref: 05/WW/23/3, ISBN 1 84057 371 6, 111pp, £200

Changes in legislation controlling the handling and disposal of wastes, both liquid and solid, will have an impact on the operation of sewerage systems and wastewater treatment works in the UK. Identifies and assesses the impacts of these changes and recommends a number of mitigation measures that the industry could adopt to reduce the impact of wastes discharged to the sewerage networks.

Comparison of Member State Implementation and Reporting of Five Waste Water Related European Council Directives

Contractor: WRc

Ref: 01/WW/23/1, ISBN 1 84057 245 0, 101pp, £50

Adoption and implementation of the Urban Waste Water Treatment, Dangerous Substances, Shellfish Waters, Freshwater Fish and Bathing Water Directives are compared between the EU Member States.

Statements contained in this UKWIR catalogue do not necessarily represent the views of UKWIR or the Water Industry