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Odour management and monitoring in Scottish waste water treatment plants

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Executive Summary

Background

Wastewater treatment works in Scotland have evolved substantially in the past 20 years. During the 1990s, major investments were made to comply with the Urban Wastewater Treatment directive. These investments were designed to protect the environment from the adverse effects of urban waste water discharges, and were not specifically focused on odour control. Odours continued to present issues at some sites, and in 2005, a statutory Code of Practice (CoP) for odour control at sewage works in Scotland was published by the Scottish Executive.

Sewage works operators have been working under the CoP since the implementation of the Sewerage Nuisance (Code of Practice) (Scotland) Order in April 2006. At the same time, a number of sites have moved into private sector operation under the Private Finance Initiative (PFI). These changes have delivered ongoing improvements in odour performance. However, odours continue to be reported by local communities living close to some sites. Consequently, CREW has commissioned this project on behalf of Scottish Government, with the aim of reviewing and identifying good practice for odour management and monitoring at wastewater treatment plants in Scotland.

The full report is available from the CREW library at http://www.crew.ac.uk/publications.

Research undertaken

The focus of the project was firstly to draw together and summarise existing statutory and non-statutory guidance on odour control relevant to sewage works in Scotland. Additional research was carried out to investigate the existence of potentially relevant odour monitoring and control methods, so that any new methods could be integrated into the analysis. Based on this, a "site odour potential framework" was developed to enable appropriate odour controls to be identified for an individual sewage works.

Detailed discussions were then held with facility operators and with local authority officers responsible for regulating odours associated with sewage treatment works in Scotland. Five specific sites were evaluated (Shieldhall, Ardoch, Dalmuir, Seafield and Levenmouth). The odour controls in operation at these works were evaluated against the controls that would be expected at these sites based on the odour potential framework. The odour performance of these sites gives an insight into the effectiveness of the controls applied. Based on this discussion and the supporting information, a streamlined guide to management of odours at sewage works in Scotland was development. This was designed to enable effective odour management techniques to be identified, taking into account the odour potential of individual sites.

An odour management and monitoring workshop consisting of representatives from Scottish water, regulators representing a number of local authorities, and operators was held. Feedback from the workshop has contributed to this report.

Recommendations

The analysis highlighted 10 principles for effective management of odours

Principle 1:	Effective site management is fundamental to good control of odours.
Principle 2:	Effective treatment of odour & sludge is likely to result in minimal odours.
Principle 3:	Careful attention to siting can be helpful in minimising odour risks.
Principle 4:	Good housekeeping is an essential & low-cost means of minimising odours.
Principle 5:	It is important to understand the nature and variability of influent.
Principle 6:	Engagement with the regulatory authorities is important for managing odour incidents.
Principle 7:	Engaging with the public, both individually and via elected representatives, is important.
Principle 8:	Any sewage works is likely to benefit from an Odour Management Plan.
Principle 9:	Odours are particularly likely to arise at locations on the works where sewage is agitated or aerated.
Principle 10:	Operators should have a contingency plan in place to deal with fluctuations in influent flows, stormwater surges, failure of key plant, changes in wind direction etc.

A matrix was developed which can be used to assess a site's odour potential. This leads on to identification of appropriate odour management measures depending on the likelihood of odours occurring at the site.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.		
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains		
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing		
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 200 properties within 750 metres	More than 200 properties within 750 metres		
	5	No properties within 100 metres	1 to 20 properties within 100 metres	More than 20 properties within 100 metres		
History of genuine complaints	5	Fewer than 10 genuine complaints per year	10 to 50 genuine complaints per year	More than 50 genuine complaints per year		
Very low potential: Less than 65						Total weighted score
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

Depending on the odour potential of a particular site, an appropriate range of odour management measures can be identified, from a wide range of potentially effective measures under the following headings:

- Odour control through process management
- Odour control through site management
- Odour control through low cost measures
- Odour control through capital investment measures
- Odour control through monitoring
- Odour control through stakeholder and public engagement

Guidance is provided on the specific measures likely to be appropriate for an individual site, depending on its odour potential. More extensive odour control measures are likely to be appropriate at sites with higher odour potential.

This was exemplified through consideration of five case study sites with a range of odour potentials and features of interest.

Key words

Odour, sewage works, sewage treatment, wastewater treatment, abatement, nuisance, guidance

Contents

1.0 Introduction

1.1 Context

Wastewater treatment works in Scotland have evolved substantially in the past 20 years. During the 1990s, major investments were made to comply with the Urban Wastewater Treatment directive. These investments were designed to protect the environment from the adverse effects of urban waste water discharges, and were not specifically focused on odour control. Odours continued to present issues at some sites, and in 2005, a statutory Code of Practice (CoP) for odour control at sewage works in Scotland was published by the Scottish Executive[1].

Sewage works operators have been working under the CoP since the implementation of the Sewerage Nuisance (Code of Practice) (Scotland) Order in April 2006. At the same time, a number of sites have moved into private sector operation under the Private Finance Initiative (PFI). These changes have delivered ongoing improvements in odour performance. However, odours continue to be reported by local communities living close to some sites. Consequently, CREW has commissioned this project on behalf of Scottish Government, with the aim of reviewing and identifying good practice for odour management and monitoring at wastewater treatment plants in Scotland.

The project comprised a literature review and extensive consultation with process operators and regulators at a range of sewage works across Scotland. Based on this analysis, a number of principles for effective odour control have been developed. We have gone on to develop a "site odour potential framework" to enable appropriate odour controls to be identified for an individual sewage works. We have looked in detail at five case study sites, and evaluated the odour controls in operation at these works against the controls that would be expected at these sites based on the odour potential framework. The odour performance of these sites gives an insight into the effectiveness of the controls applied.

1.2 Legislative and policy context

The legal framework for odour control is set out in the Scottish Code of Practice for sewage works,[1] from which the text below is adapted.

The two primary methods of regulatory control of odours are Statutory Nuisance and IPPC. The controls applied by Statutory Nuisance are largely reactive (they only allow action where a nuisance exists, or is likely to exist or recur). The powers under IPPC are proactive (that is they allow the permitting of processes by establishing conditions for all aspects of the design, operation and management of processes). However, they only apply to certain aspects of some WWTWs.

1.2.1 Statutory Nuisance

The starting point for odour control is set out in Part III of the Environmental Protection Act 1990. This requires that operators of WWTW must not cause a Statutory Nuisance due to odours. These provisions are enforced by local authorities. If a local authority is satisfied that a Statutory Nuisance exists, or is likely to occur or recur, the authority must serve an Abatement Notice. The person on whom an Abatement Notice is served has the right of appeal to the sheriff. Grounds for such an appeal include:

- that the Notice is not justified (i.e. no nuisance exists)
- that the authority has refused to accept alternate means of compliance to those specified in the Notice
- that the time limit specified for compliance is insufficient
- that the 'best practicable means' (BPM) have been used to prevent or counteract the effects of the nuisance. If this defence is used, it is for the WWTW operator to establish that BPM was used. It is ultimately a matter for the Courts to determine whether in a particular instance the controls adopted are reasonable or the costs are excessive taking account of local conditions and characteristics of the odour nuisance. BPM is interpreted by reference to the following provisions:

(a) "practicable" means reasonably practicable having regard among other things to local conditions and circumstances, to the current state of technical knowledge and to the financial implications;
(b) the means to be employed include the design, installation, maintenance and manner and periods of operation of plant and machinery, and the design, construction and maintenance of buildings and structures;
(c) the test is to apply only so far as compatible with any duty imposed by law;
(d) the test is to apply only so far as compatible with safety and safe working conditions, and with the exigencies of any emergency or unforeseeable circumstances

If a local authority considers that service of an abatement notice would afford an inadequate remedy, the local authority can taking proceedings in the Sheriff Court or the Court of Session to seek an interdict. Finally, the Environmental Protection Act 1990 allows an individual aggrieved by the existence of a Statutory Nuisance to seek an order from the Sheriff to abate and prohibit the recurrence of the nuisance.

The Statutory Nuisance regime does not provide for the complete avoidance of odours, or even for the complete avoidance of odour nuisance. It requires that odour nuisance should be avoided, and if they occur, that BPM should be used to prevent their occurr2.2ence or recurrence.

1.2.2 Pollution control legislation

A small number of WWTW in Scotland fall under the Integrated Pollution Prevention and Control (IPPC) regime and are regulated by the Scottish Environment Protection Agency (SEPA) under the Pollution Prevention and Control (PPC) Regulations. These Regulations require that operations for the treatment of waste are subject to the IPPC regime, including for example:

(a) The disposal of hazardous waste (other than by incineration or landfill) in a facility with a capacity of more than 10 tonnes per day.
(b) The disposal of waste oils (other than by incineration or landfill) in a facility with a capacity of more than 10 tonnes per day.
(c) Disposal of non-hazardous waste in a facility with a capacity of more than 50 tonnes per day by –
    i. biological treatment or
    ii. physico-chemical treatment.
(d) Making solid fuel from waste using any process involving the use of heat, other than making charcoal

Permits set under the IPPC regime will normally contain a condition stating: "All emissions to air from the permitted installation shall be free from offensive odour, as perceived by an authorised person, outside the site boundary."[2] Again, this does not guarantee an odour free environment, but if fully implemented would avoid offensive odours at offsite locations.

[1] Scottish Executive, "Code of Practice on Assessment and Control of Odour Nuisance from Waste Water Treatment Works," April 2005, Paper 2005/ 9

[2] SEPA and Natural Scotland, "Odour Guidance," Version 1, 2010

1.2.3 Waste management legislation

Any WWTW importing controlled waste such as sludges, septic tank sludge or screenings from out with the curtilage of the works is required to hold a Waste Management Licence (WML) under Waste Management Licensing (Scotland) Regulations 2012. The standard condition used in WML odour conditions is 'Waste operations shall be carried out so that offensive odours from the site as perceived by an authorised SEPA officer, do not become detectable beyond the boundaries of the site.' There are around 10-20 sites holding a Waste Management Licence in Scotland.

Some sites importing controlled waste can apply annually to SEPA for a Paragraph 10 exemption for the 'reception and treatment of specified waste at a water/sewage treatment works' if they meet the relevant criteria such as ensuring that waste is managed without endangering human health and without using processes or methods which could harm the environment and in particular without:

(a) Risk to water, air, soil, plants or animals; or
(b) Causing nuisance through noise or odours; or
(c) Adversely affecting the countryside or places of special interest;

Registering a Paragraph 10 exemption exempts the sites from the requirement to hold a Waste Management Licence. Around 40 sites in Scotland currently have a Paragraph 10 exemptions registered.

1.2.4 Planning control legislation and guidance

Development of new WWTW, and modifications to existing sites, require planning permission. The Code of Practice refers to National Planning Policy Guideline (NPPG) 10–Planning and Waste Management. However, this has now been withdrawn, and there is no specific reference to WWTW in Scotland's Third National Planning Framework. Advice is set out in Planning Advice Note (PAN) 63-Waste Management Planning, and PAN 51-Planning and Environmental Protection, which sets out the relationship between planning and environmental controls.

In cases where WWTW come under the control of IPPC, the IPPC permitting process should be used to ensure that control measures are implemented to avoid the creation of odour nuisance. Where WWTW are not subject to IPPC control, the careful use of planning conditions to require inclusion of odour control measures and to establish operating conditions may be appropriate.

PAN 51 states that where the possibility that the release of smell might result in nuisance or loss of amenity from a proposed facility subject to planning control, this may be regarded as a material consideration for planning reasons. There is also a need to carefully consider the proximity of proposed new development to existing WWTW, as this can lead to significant problems.

Under the Environmental Assessment (Scotland) Regulations 2011, proposals for WWTW may require an Environmental Impact Assessment (EIA) to be carried out in support of any planning application. Larger WWTW (in excess of 150,000pe) fall under Schedule 1 of the Regulations and therefore require an EIA. Smaller sites (in excess of 1,000 square metres area) are covered by Schedule 2 of the Regulations and would require to be screened to establish whether they were likely to have significant environmental effects. If this proves to be the case then an EIA is required.

If a planning authority decides that a statutory EIA is not required, it is still open to the authority to use its powers under article 13 of the General Development Procedure Order to request additional environmental information.

1.3 Structure of the guidance

This guidance is described to enable a sewage works to be evaluated in order to establish a level of odour control which is likely to be appropriate.

- Chapter 2 provides a matrix to enable a preliminary assessment of odour potentials to be carried out.
- Chapter 3 describes the key sources of odour at sewage works. The report goes on to describe an appropriate level of odour management, control and monitoring which experience shows is likely to be effective in managing odours at sewage works in Scotland. This chapter provides a list of odour control measures, and identifies what measures would be appropriate for consideration at sites with a range of potential for causing odour problems.
- Chapter 4 describes five case studies of sewage works in Scotland. Supporting information for these case studies is provided in Appendix 1.

1.4 Who is the guidance for?

This guidance is for:

Regulators:

- local authorities, who should have regard to the guidance when dealing with odours under the statutory nuisance regime and the Code of Practice;
- the Scottish Environment Protection Agency (SEPA) in relation to odours from sewage sludge processing

Operators who are best advised also to have regard to it when planning future investments and in the operation of their installation;

Members of the public who may be interested to know what the Scottish Government considers, in accordance with the legislation, amounts to appropriate conditions for controlling odours from the generality of installations in this particular industry sector.

2 Site odour prioritisation matrix

This chapter provides a means of evaluating the odour potential associated with a sewage works as a starting point. The matrix below provides a framework for stakeholders, including regulators, operators and neighbouring communities, to discuss and develop appropriate odour management solutions at individual sites. The matrix is designed to assist in benchmarking the level of odour control that can be expected at a sewage works.

There may be site-specific considerations which would justify a greater or lower investment in odour control at an individual site, but the approach set out here enables a preliminary assessment to be carried out. This can then be used as the starting point for justifying a lower level of odour control, or alternatively requesting/requiring a higher level of odour control, in the light of local circumstances.

The matrix set out in Table 1 describes how a site can be evaluated in order to classify it from the perspective of odours as: very low potential; low potential; medium potential; or high odour potential. This matrix differs from the "Odour Risk Assessment Matrix" in Natural Scotland's Guidance on Statutory Code of Practice on Sewerage Nuisance – Assessment and Control of Odour from Waste Water Treatment Works. The Natural Scotland matrix is designed to assist in making objective assessments of likely nuisance by enabling an independent evaluation of reported odours to be carried out.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.	**130,000 p.e.: 1**	**10**
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains	**Neither: 1**	**5**
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing	**Full treatment: 3**	**30**
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 200 properties within 750 metres	More than 200 properties within 750 metres	**40 properties: 1**	**5**
	5	No properties within 100 metres	1 to 20 properties within 100 metres	More than 20 properties within 100 metres	**1 property: 2**	**10**
History of genuine complaints	5	Fewer than 10 genuine complaints per year	10 to 50 genuine complaints per year	More than 50 genuine complaints per year	**No complaints for 3 years: 1**	**5**
Very low potential: Less than 65						**65 Low potential**
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

The steps in the prioritisation process are as follows:

Step 1: Identify the sewage throughput of the site in terms of population equivalent (p.e.).

Step 2: Characterise the risk posed by the sewage arriving at the site, in terms of the length of mains and/or the presence of significant industrial effluent.

Step 3: Characterise the activities carried out at the site in terms of whether screening, primary treatment and/or sludge processing are carried out at the site

Step 4: Calculate or estimate the number of properties within 750 metres and 100 metres of the site. Two separate distances are included because odours can affect a relatively wide area surrounding a sewage works, but the intensity of odours is potentially higher at locations close to the works. Including two evaluations enables both aspects of odour dispersion to be taken into account.

Step 5: Summarise the number of genuine odour complaints received. In this context, a "genuine" complaint means a complaint which has been investigated by the regulatory authority and/or the site operator, and it is likely or plausible that the complaint was due to an odour which resulted from activities at the site. Complaint history is included in this matrix as an indicator of the extent to which the site neighbours are already aware of odours associated with the sewage works.

Step 6: Enter the score for each parameter in the column headed, "Your Score (1, 2 or 3) (B)." Multiply the score for each row (B) by the value in the column headed "Weighting (A)". Enter this number in the column headed "Weighted score (A × B)". Add up the values in this column to give the total score.

Step 7: Determine the preliminary site odour potential based on the total score, as follows:

- Very low potential: Less than 65
- Low potential: 65 to 80
- Medium potential: 81 to 95
- High potential: More than 95

3 Odour control at sewage works

3.1 Sources of Odour

The layout of a particular sewage treatment process depends on the type of influent to the works, the location, the size and quality of receiving water. A conceptual wastewater treatment plant flowsheet is provided in Figure 1.

The main functions of a WWTP are:

- Removal of pollutants, (mainly toxic material) and retention of re-usable material
- Treatment of water to permit safe re-use
- Treatment and disposal of the sludge

The steps of a sewage treatment process are often divided into primary, secondary and tertiary. Primary treatment is largely a mechanical process to separate solids, secondary treatment is a largely biological process whilst tertiary treatment is polishing step for further purification possibly for specific contaminants. The main aim of treatment is to reduce biochemical oxygen demand (BOD) and suspended solids (SS) to acceptable levels. The removal of the solids and reduction of BOD produces sludge that can be recovered for beneficial land use after further treatment or sent for disposal.

Preliminary Treatment

Waste water entering the inlet works is usually screened to remove plastics, paper, cloth and other large debris. During periods of high flow the influent may be diverted to storm water tanks and this may occur before or after screening. Any influent diverted to storm water tanks will be processed as soon as flows return to normal. Effective management of storm water tanks is a key area in the reduction of odour.

Primary Treatment

The mechanical removal of solids is called 'primary treatment'. Finer solids are then removed in a settling or sedimentation tank, where the waste water spends a number of hours to allow the solids to settle or float and the sludge produced (primary sludge) is scraped along the base of the tank for desludging.

Secondary Treatment

The primary-treated waste water (primary effluent) is passed to an aeration tank, called 'secondary treatment', where oxygen is provided to the active sludges. In the aeration tank, the bacteria in the activated sludge consume the organic substances in the waste water and the secondary sludge is produced.

Sludge Processing

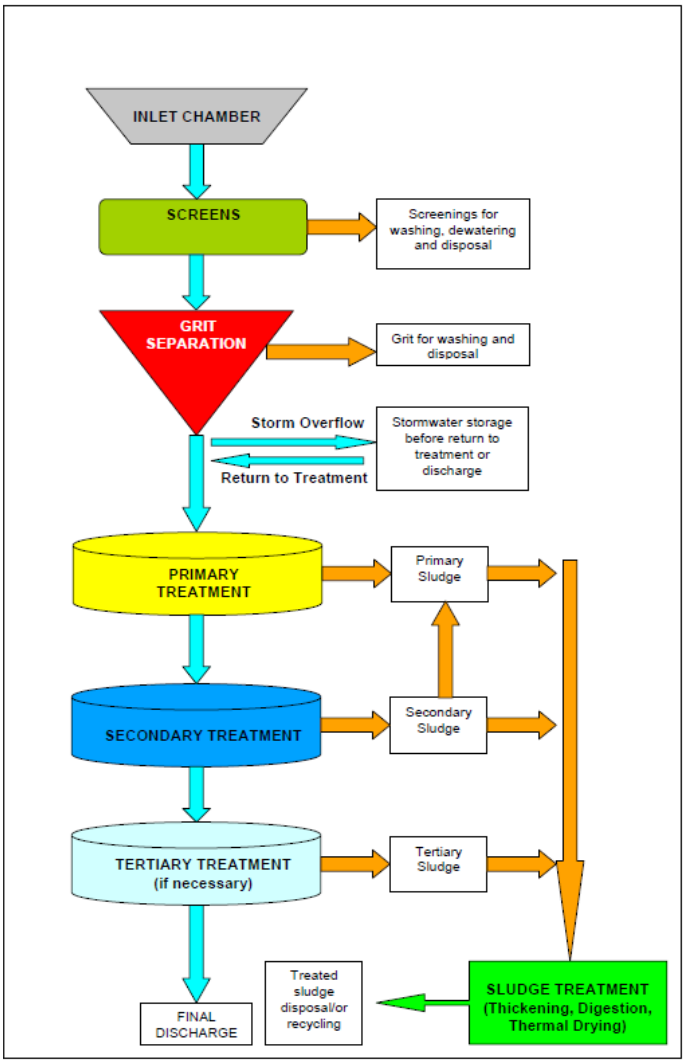
The excess sludges produced in the process are treated to reduce the liquid content of the sludge and volume to minimise downstream costs and stabilise the sludge to allow safe beneficial use for land conditioning or alternate disposal methods. The stabilisation process minimises the potential for odour generation and also destroys the pathogens.

The primary odours from WWTW are the result of biological degradation of organic matter by microorganisms under anaerobic conditions. The development of anaerobic conditions in sewage is often referred to as 'septicity'. Septicity can be enhanced by elevated temperature, high BOD, high sulphate levels and the presence of reducing chemicals.

The potential emission sources for odours are specific to each particular process and operation, however, the following are key sources which should be reviewed at all sewage treatment plants:-

- Inlet works – strong odours in influent may be affected by unfavourable sewer conditions (long retention times, brackish water infiltration, poor maintenance, industrial discharges) and long pressure mains – also the inlet works effectively vent any sewer gases
- Storm water storage – usually due to storage for excessive period leading to septicity or due to infrequent or insufficient flushing of the tanks after emptying
- Primary settlement – highly odorous feeds or excessive sludge accumulation which goes septic – emissions can be caused by excessive turbulence of wastewater
- Secondary treatment – if highly loaded or odorous feed
- Storage and treatment of sludge – especially non-stabilised sludge
- Biogas leaks from anaerobic digesters and first point of sludge discharge.
- Odours can be transported through the system and become airborne at turbulent locations.
- Where the odour abatement equipment comprises a scrubber, emissions of materials which are added to the scrubber for improved performance (such as acids, hypochlorite, sodium hydroxide etc.) may be released with the plume if the scrubber and mist eliminator are not properly managed

Figure 1: Conceptual wastewater treatment plant flowsheet



3.2 Overview of effective odour management

3.2.1 Principles of effective odour control

The general principles set out in this section apply to any sewage works

- **Principle 1:** Effective site management is fundamental to good control of odours. This covers the full range of skills required to operate a sewage works. A good manager will understand how the plant operates, how to get the best performance out of the plant, and what steps to take when things change.

- **Principle 2:** A sewage treatment plant which delivers effective treatment of odour and sludge is likely to result in minimal odours. The odours produced from effective sewage treatment are likely to be relatively low intensity and consistent in nature, and if required, can be treated using established odour abatement techniques.

- **Principle 3:** For new sites and new plant and equipment, careful attention to siting can be helpful in minimising odour risks. New installations should take into account the locations of site neighbours including residential properties, hospitals, leisure facilities etc. They should also take into account factors such as local meteorology and topography.

- **Principle 4:** Good housekeeping is an essential and low-cost means of minimising odours. This involves ensuring that building doors, windows and other openings such as access hatches are kept closed. Keeping the site clean will minimise low-level odours from spilt material. At a psychological level, presenting a clean and tidy site gives a good impression to neighbours and visitors, which may help to reduce potential hostility towards the site and its operations.

- **Principle 5:** It is important to understand the nature and variability of the effluent arriving at a sewage works. Working with the sewerage network managers and effluent producers is important in enabling all parties to understand the constraints that different stakeholders are operating under.

- **Principle 6:** Engagement with the regulatory authorities is important to enable odour incidents to be managed. Ensure that those likely to receive calls and complaints from the public are aware of any potentially odour-generating activities going on at the site – e.g. cleaning storm tanks. This will enable them to make a constructive and professional response to enquiries which may result from an odour being caused.

- **Principle 7:** Engaging with the public, both at an individual level and via elected representatives, is important. This does not have to be a frequent discussion – an annual newsletter, open day or meeting may be sufficient. Opening lines of communication may enable a site operator to understand if there are any issues which could be readily addressed at low cost or no cost. It may also give the opportunity for a site operator to explain something about the site, the work that is carried out, and any planned investments relevant to odour control. Public engagement may give local politicians the opportunity to take a lead in representing their communities in relation to odours

- **Principle 8:** Any sewage works is likely to benefit from an Odour Management Plan (OMP). These can vary in length and level of detail depending on the nature of the site. A good OMP forms an integrated document with the overall site management plan, and is used during the day-to-day management of the site to ensure that odours are minimised and properly managed as a key part of site operations.

- **Principle 9:** Odours are particularly likely to arise at locations on the works where sewage is agitated or aerated. Such locations typically include the inlet works, screens, channels and primary tank weirs. Attention should be focused on these parts of the works to ensure that odour generation potential can be minimised, for example by ensuring a high standard of housekeeping, managing flows, minimising drop heights, and/or chemical dosing. If enclosure, air extraction and odour treatment is required, this should focus on these parts of the works.

- **Principle 10:** Operators should have a contingency plan in place to deal with contingencies such as fluctuations in influent flows, stormwater surges, failure of key plant for odour management, changes in wind direction during odour generating activities. It may be appropriate to have a contingency plan as part of the OMP, or this may take the form of a working plan for a specific activity such as cleaning storm tanks.

3.2.2 Odour management plan

All sites with the potential to generate odours should have an odour management plan. The odour management plan should address the following issues:

- The activities which produce odour and the point of odour release
- Possible process or control failures or abnormal situations which could arise
- Potential outcome of a failure in respect of the likely odour impact on local sensitive receptors
- What actions are to be taken to mitigate odour episodes, identifying timescales for actions and details of the persons responsible for the actions at the site
- Record keeping.

The plan should be reviewed periodically and following the receipt of complaints or after any corrective actions have been undertaken

The Code of Practice identifies a range of example issues for consideration in the odour management plan for a sewage works:

1. Factors with potential to affect the process and the generation of odour

The operator should normally have made arrangements for factors such as:

- Materials input (seasonal variation in weather may affect odour of influent and intermittent discharge of odorous substances to the sewerage system)
- Process parameters (changes in temperature, aerobic conditions)
- Rate of throughput or increased hours of operation
- Development of anaerobic conditions
- Routine maintenance and inspection.

2. Factors with potential to affect the ability to abate/minimise odour

Factors which may be best dealt with by management actions may include:

- Start-up and shut-down of key plant and equipment
- Power failure (although the provision of backup facilities should be considered)

- Poor performance of biofiltration or poisoning (if not the result of poor maintenance or maloperation)
- Flooding of the biofilter due to abnormally high rainfall
- External failure of other utilities, e.g. water supply (This should also be considered
- where the operator has signed up to an interruptible gas supply).

The operator should normally have made arrangements for factors such as:

- Mechanical breakdown of abatement equipment such as pumps, fans etc
- Power failure
- Compaction of the biofilter or surface fissures
- Saturation of a carbon filter bed and subsequent breakthrough of odours
- Below optimum temperature of a thermal oxidiser or boiler etc
- Saturation of scrubber liquor, blocked injection nozzles etc.
- Routine maintenance and inspection.

3. Factors with potential to affect the ability to contain odour (where releases are not normally permitted)

Factors which may be best dealt with by management actions may include:

- Building damage which affects integrity due to for example storms
- Power failure

The operator should normally have made arrangements for factors such as:

- Failure of automatic doors, i.e. in open position
- Failure in procedures to maintain containment (human error)
- Routine maintenance and inspection.

4. Factors with potential to affect dispersion between the source and sensitive receptors

Factors which may be best dealt with by management actions may include:

- Short term weather patterns which fall outside of the normal conditions for that area (ie highly unusual, not just the normal meteorological pattern - for example inversions and other conditions unfavourable to dispersion should have been considered in designing the process).
  The operator should normally have made arrangements for factors such as:
- Weather – wind direction, temperature, inversion conditions if these are normal variants of local weather. When designing and implementing odour management measures, operators should be aware of the prevailing wind direction in the local area, as well as factors which may influence the dispersion of emissions, such as local topography (e.g. for a site in a valley location) or coastal meteorology (e.g. the occurrence of sea mist (also known as "haar") or onshore winds).
- Loss of plume buoyancy/temperature

Odour management plans developed for Dalmuir and Seafield sewage works can be provided by contacting the report authors. The following sections identify specific odour control measures which may be appropriate for sites with an odour potential ranging from very low, through low and medium to high odour potential.

Each section sets out a set of control measures for consideration, and provides a "good practice guideline" as a benchmark for an appropriate level of odour control at high, medium, low and very low odour potential sites. This guidance is designed to assist site operators, regulators and other stakeholders in fulfilling the requirement of the CoP which requires that "a timely, realistic, cost effective and proportionate approach is taken to resolve odour issues."

3.3 Odour control through process management

3.3.1 Overview

The starting point for effective odour management is good process design and management. A site which is appropriately designed for the quantity and composition of sewage treated, and which is run well to deliver effective sewage and sludge treatment, can also be expected to minimise odour formation. Although some odour formation is inevitable, odours from a well-run sewage works will typically be the well-known "earthy" smell characteristic of treated sewage, rather than the more objectionable odours of anaerobically decomposing material. Avoiding anaerobic conditions and sewage septicity is important for all aspects of site operations, but is particularly critical for minimising odour problems. A key part of this is good management of sludge levels in primary settlement tanks to avoid the build-up of solid material with the risk of anaerobic conditions developing.

This requires the site managers and operators to have a good understanding of normal operations at the sewage works, as well as sufficient experience and expertise to be able to take action to deal with abnormal operating conditions. Site managers will understand the importance of odour control alongside other aspects of the site operation, and will take steps to minimise process odours and prevent problems arising. This may require investment in infrastructure to improve the effectiveness, capacity and/or resilience of the sewage treatment process, if this is sub-optimal. Such improvements can be expected to bring wider benefits in consistent operational performance, avoidance of "crisis" operational conditions, and a high standard of final effluent quality and sewage quality.

3.3.2 Good practice guideline

Table 2: Process management measures for odour control

Odour control measure and description		Measure appropriate for:			
		Very low potential	Low potential	Medium potential	High potential
1	Entire site: minimising turbulent discharges	✓	✓	✓	✓
2	Entire site: working with other stakeholders to optimise influent sewage quality		✓	✓	✓
3	Entire site: where possible, preferentially operate plant located further from site neighbours		✓	✓	✓
4	Inlet works: maintaining aeration	✓	✓	✓	✓
5	Screening: cleaning to ensure efficient operation of screens and avoid build-up of odorous material	✓	✓	✓	✓
6	Primary treatment: maintaining aeration	✓	✓	✓	✓
7	Primary treatment: appropriate process for wastewater quantity and characteristics	✓	✓	✓	✓
8	Primary treatment: effective and reliable removal of sludge	✓	✓	✓	✓
9	Secondary treatment: appropriate process for feedstock	✓	✓	✓	✓
10	Sludge treatment: rapid dewatering and treatment of sludge	✓	✓	✓	✓
11	Sludge treatment: avoidance of contact between primary sludge and the atmosphere; effective containment of digestion process	✓	✓	✓	✓

Good practice guideline for odour control: **Process management**

- Very low potential sites: Complete at least 3 measures
- Low potential sites: Complete at least 5 measures
- Medium potential sites: Complete at least 7 measures
- High potential sites: Complete all measures

3.4 Odour control through site management

3.4.1 Overview

Good housekeeping is important for minimising avoidable odour releases from sewage works. The majority of good housekeeping is good working practice, and consequently poses little or no additional cost in relation to odour control.1

Some key aspects of good housekeeping include avoidance of a build-up of scum or foam, prompt cleaning of spillages (and feeding back into the site design and upgrade process in the event of ongoing spillage problems); and good management of wastes such as screenings and grit, as well as digested sludge;

3.4.2 Good practice guideline

Table 3: Site management measures for odour control

Odour control measure and description		Measure appropriate for:			
		Very low potential	Low potential	Medium potential	High potential
1	Working areas: daily check and clearing of any standing water	✓	✓	✓	✓
2	Working area: daily check, reporting and rectification of any obvious leakage	✓	✓	✓	✓
3	All plant: Annual inspection and repair programme	✓	✓	✓	✓
4	All plant: Maintenance of critical spares on site			✓	✓
5	Inlet works: daily check with cleaning as required		✓	✓	✓
6	Screening: daily cleaning to remove odorous material; prompt removal of screenings containers	✓	✓	✓	✓
7	Primary treatment: Checking to ensure no build-up of solids, scum or foam; cleaning where needed			✓	✓
8	Secondary treatment: Checking to ensure no build-up of solids, scum or foam; cleaning where needed				✓
9	Sludge treatment: Checking to ensure no build-up of solids; cleaning where needed		✓	✓	✓
10	Sludge tankering: check vehicles arriving at site and liaison with contractor if necessary			✓	✓
11	Sludge tankering: ensuring vehicles clean on leaving site			✓	✓

Good practice guideline for odour control: **Site management**

- Very low potential sites: Complete at least 4 measures
- Low potential sites: Complete at least 5 measures
- Medium potential sites: Complete at least 6 measures
- High potential sites: Complete at least 8 measures

3.5 Odour control through low cost measures

3.5.1 Overview

In order to prevent or abate odour pollution, different types of control measures should be considered. Appropriate management may provide low cost measures to tackle odour issues. The following measures should be reviewed at all sites:

- Odour sources should be located away from site boundary, where possible
- Chemical or physical methods can be used to partly control many odorous chemicals:

o Flexible covers can be used on screening skips to restrict dispersion of odours (this can also discourage bird scavenging). Covering other sources (e.g. inlet works, screens, sludge treatment) without investing in air extraction and treatment is not recommended, due to the likely formation of a corrosive atmosphere with the risk of adverse effects on plant and equipment. Sludge storage normally takes place in buildings.

o Reduce septicity and the amount of odour by dosing chemical (e.g. oxygen, hydrogen peroxide, potassium permanganate, nitrate or ferric salts) and improve ventilation. This process results in potentially odorous sulphides forming solid iron sulphide precipitates and being removed in the sludge. While beneficial in reducing the odour potential of the treated effluent, this could potentially increase the quantity of sludge, and its potential for releasing sulphides during treatment, storage and disposal.

- In principle, it is possible to collect and treat displaced air from tankers during filling with sludge. However, there is no industry standard tanker vent design, and consequently direct connection from a tanker to an odour control unit is not feasible. At present, tanker filling takes place in an enclosed building at one site (Shieldhall) to enable collection and treatment of displaced odorous air.
- Minimise the potential storage of sludge before treatment and storage for unstabilised sludge on site
- Avoid open storage of sludges or sludge cakes. At one site, sludge cakes are chemically treated prior to loading for transport off-site, to reduce the potential for odours affecting local residents.

3.5.2 Good practice guideline

Table 4: Low cost measures for odour control

Odour control measure and description		Measure appropriate for:			
		Very low potential	Low potential	Medium potential	High potential
1	Entire works: Where possible, locate potentially odorous activities away from site boundary	✓	✓	✓	✓
2	Entire works: chemical dosing with oxidant (e.g. ferric sulphate) to avoid septicity		✓	✓	✓
3	Screening: flexible cover on screening skips to limit dispersion		✓	✓	✓
4	Sludge treatment: fixed cover on sludge storage	✓	✓	✓	✓
5	Sludge treatment: ensuring treated sludge is rapidly removed from site	✓	✓	✓	✓
6	Sludge tankering: Recirculation of displaced air from sludge tankers, if vent design can be standardised			✓	✓
7	Scheduling potentially odour generating activities to minimise impacts (e.g. by reference to wind direction)	✓	✓	✓	✓

Good practice guideline for odour control: **Low cost measures**

- Very low potential sites with no odour problems: Measure 1
- Low potential sites with no odour problems: Measure 1 and 5
- Medium potential sites with no odour problems: Measure 1, 3 and 5
- High potential sites with no odour problems: Measure 1, 3 and 5

If problems persist, a site-specific evaluation should be carried out to identify and implement appropriate low-cost odour control measures

- Very low potential sites if odour problems persist: Measure 1, 5, 8, 9 as appropriate
- Low potential sites if odour problems persist: Measure 1, 2, 3, 4, 5, 7 as appropriate
- Medium potential sites if odour problems persist All measures as appropriate
- High potential sites if odour problems persist: All measures as appropriate

3.6 Odour control through capital investment measures

3.6.1 Overview

Some odour control measures may involve capital investment to prevent or reduce odour releases. If odour problems persist, the following measures should be reviewed at all sites:

- Relocation of odour source activities away from site boundary, where required
- Lowering discharge points to minimise turbulence and volatilisation of odours
- Using flexible or fixed cover on the inlet works, screening, primary treatment, secondary treatment, sludge treatment and sludge storage to reduce the rate of evaporation of odours
- Reducing the hydraulic retention times in the primary sedimentation
- Recirculation of nitrified final effluent during low flow and avoiding the recirculation of secondary sludge
- Increased aeration in the secondary aerobic treatment by methods which minimise the generation of aerosols and maintain the activated sludge flocs in suspension
- Replacement of lagoons and drying beds in sludge handling, storage and processing with mechanical dewatering plant will help minimise retention and contain odours
- Air extraction and ventilation sent to odour-abatement equipment

All odour control measures must meet the Code of Practice requirement to be technically justifiable and take into account the balance of benefits and costs. This is particularly relevant for capital investment measures, where there are likely to be significant cost and technical issues to be considered.

Particular care should be given to investment in covering, extraction and abatement of potential sources of odour. While some Scottish Water sites are completely or partially covered, this is not necessarily fully effective in dealing with odours (e.g. any odours from the sewerage network would continue). Covering a source results in the creation of a confined space, and careful consideration should be given to issues such as ensuring a safe working environment, the potential for forming an explosive atmosphere, difficulties in monitoring performance, and access to the covered area for tasks such as maintenance and cleaning. Carrying out maintenance during a total site shutdown is an option, but this reduces operational flexibility, and can itself give rise to odours.

3.6.2 Good practice guideline

Table 5: Capital investment measures for odour control

Odour control measure and description		Measure appropriate for:			
		Very low potential	Low potential	Medium potential	High potential
1	Entire works: Where required, relocate potentially odorous activities away from site boundary	✓	✓	✓	✓
2	Inlet works: flexible or fixed cover on inlet works where sewage is first aerated with air extraction and treatment	✓	✓	✓	✓
3	Screening: flexible or fixed cover on screens with air extraction and treatment	✓	✓	✓	✓
4	Primary treatment: cover on primary treatment tank weirs, with air extraction and treatment			✓	✓
5	Primary treatment: flexible or fixed cover on primary treatment tanks, with air extraction and treatment				✓
6	Secondary treatment: flexible or fixed cover on secondary treatment, with air extraction and treatment				✓
7	Sludge treatment: flexible or fixed cover on sludge treatment, with air extraction and treatment	✓	✓	✓	✓
8	Sludge treatment: flexible or fixed cover on sludge storage, with air extraction and treatment	✓	✓	✓	✓
9	Sludge tankering: Collection and treatment of displaced air from sludge tankers by appropriate vent design, or tanker filling within an enclosure		✓	✓	✓

Good practice guideline for odour control: **Capital investment measures**

- Very low potential sites with no odour problems: None
- Low potential sites with no odour problems: None
- Medium potential sites with no odour problems: None
- High potential sites with no odour problems: None

If problems persist, a site-specific evaluation should be carried out to identify and implement appropriate capital investment odour control measures.

- Very low potential sites if odour problems persist: Measure 1, 2, 3, 7, 8 as appropriate
- Low potential sites if odour problems persist: Measure 1, 2, 3, 7, 8, 9 as appropriate
- Medium potential sites if odour problems persist Measure 1, 2, 3, 4, 7, 8, 9 as appropriate
- High potential sites if odour problems persist: All measures as appropriate

3.7 Odour control through monitoring

3.7.1 Monitoring of process emissions

The aim of setting and monitoring emissions limits is to ensure that adequate controls are applied to prevent where practicable, or otherwise reduce emissions and in the case of odour to ensure that they are not offensive to human senses and do not cause a statutory nuisance.

Setting appropriate emission limits in terms of odour levels of chemical constituents can be a key part of achieving and demonstrating compliance with an appropriate standard of odour control at a sewage works. SEPA guidance further indicates the expected odour removal efficiency for installed abatement plant.

- Adsorption e.g. activated carbon systems:
  Depending on chemical species involved,efficiency can be >99%
- Peat and heather type bio filters: Up to 95%
- Soil type bio filters: >99%
- Bio-scrubbers: >99%
- Absorption (wet scrubbers) >90% (2 stage water scrubber)
  >99% (chemical/catalyst type)
- Thermal oxidation/Incineration: >99%

Emissions monitoring can be useful to demonstrate that an appropriate removal efficiency is being achieved. The need for and scope of testing and the frequency and time of sampling depend on local circumstances, operational practice, and the scale of operation. As part of proper supervision the operator will monitor emissions, make tests and inspections of the process and keep records.

Table 6 below summarises the requirements for continuous monitoring for odour control equipment:

Adverse results from any quantitative emission monitoring activity (both continuous and non-continuous) should be investigated by the operator as soon as the monitoring data has been obtained/ received, and appropriate corrective action should be taken. The operator should respond to any odour control equipment malfunction, any incident of odours being detected during the site inspection and to complaints. In cases where odour nuisance and/ or offensive odours are detected beyond the process boundary, the operator should investigate process operations and odour abatement plant performance.

In addition to the continuous indicative monitoring outlined in Table 6, the odour control equipment should be inspected at least once a day to verify correct operation and to identify any malfunctions.

The destruction efficiency of the odour abatement equipment required to meet performance criteria for odour removal should be tested by dynamic olfactometry in accordance with the main procedural requirements of BSEN13725 at least once a year.

Table 6: Continuous monitoring requirements for odour control equipment

Item	Type of odour abatement equipment	Continuous performance monitoring parameter	Conditions indicating a potential performance issue
1	Thermal oxidiser	Carbon monoxide And/or Temperature	Carbon monoxide above 100 mg/m3 Temperature less than 850oC
2	Scrubber	pH or Redox and Liquor circulation	pH or Redox outside normal range Liquor circulation failure
3	Bioscrubber	Pressure drop And Liquor circulation	Pressure drop outside normal range Liquor circulation failure
4	Biofilter	Pressure drop	Pressure drop outside normal range
5	Condenser	Cooling liquid circulation	Cooling liquid flow failure
6	Adsorption (volume > 250 litres)	Pressure drop Hydrogen sulphide	Pressure drop outside normal range Hydrogen sulphide above 1 mg/m^3

3.7.2 Site surveys

Monitoring of odour at the boundary-fence/perimeter line – monitoring can range from straightforward and inexpensive "sniff" tests to complex quantitative measurements (e.g. sampling and analysis of specific odorous compounds, such as H2S). The technique used should be fit for purpose to demonstrate continuing effectiveness of the control measure.

The Arizona Instruments "Jerome" series of reduced sulphur analysers are used in the wastewater treatment industry for providing rapid measurements of hydrogen sulphide and other sulphides with a limit of detection as low as 0.02 parts per billion. The purchase cost for these instruments is several thousand pounds. Studies have also been carried out using an Odalog instrument with a purchase cost of the order of one thousand pounds, but the limit of detection is 100 ppb at best, and this would not be useful for site boundary monitoring. The Odowatch system includes an electronic nose sensor and/or hydrogen sulphide analyser with a limit of detection of 2 ppb to detect environmental odours. These units can be integrated with the site process management systems. Analyses have also been carried out to identify other potentially odorous volatile organic compounds, but no substances likely to contribute significantly to offsite odours have been identified.

The "sniff" test is probably the most common technique for assessing the (continuing) effectiveness of odour control measures. It should, however, be regarded as only semi-quantitative even when the subjective factors have been minimised by the use of a trained assessor with a sense of smell calibrated as lying within the normal range, following a documented protocol. Sniff tests can be useful around specific areas of the site to identify any specific odour issues, and/or as a site boundary measure to check the overall impact of the site on odours. Such surveys would have a cost in terms of the staff time to carry out the survey, but may well provide an operational benefit – for example, in giving early warning of developing problems.

3.7.3 Good practice guideline

Table 7: Monitoring measures for odour control

Odour control measure and description		Measure appropriate for:			
		Very low potential	Low potential	Medium potential	High potential
1	Daily walkover/site boundary olfactory survey	✓	✓	✓	✓
2	Daily walkover or targeted survey by staff with calibrated sensitivity to odour	✓	✓	✓	✓
3	Daily walkover using handheld hydrogen sulphide analyser	✓	✓	✓	✓
4	Targeted survey using handheld hydrogen sulphide analyser	✓	✓	✓	✓
5	Sampling and laboratory analysis of ambient air – olfactometry			✓	✓
6	Sampling and laboratory analysis of ambient air – VOCs			✓	✓
7	Sampling and laboratory analysis of emissions from odour abatement plant – olfactometry				✓
8	Sampling and laboratory analysis of emissions from odour abatement plant – H2S, VOCs			✓	✓
9	Electronic nose system for odour management				✓
10	Meteorological measurements			✓	✓

[1] Sara Abdikheibari, Ho-myon Song, Jeong-il Cho, Sung-jin Kim, Su-cheol Gwon, Kyoohong Park, Benildo Maluleque, Nyoman Marleni, Li Shu, Veeriah Jegatheesan (2016) "In-situ evaluation of predictive models for H2S gas emission and the performance of optimal dosage of suppressing chemicals in a laboratory-scale sewer" International Biodeteriation & Biodegradation 106:25-33

[2] Odowatch (2015) "Odowatch continuous monitoring systems" http://www.odotech.com/en/odowatch/; accessed 16/08/2016

[3] Eric C. Sivret, Bei Wang, Gavin Parcsi, Richard M. Stuetz (2015) "Prioritisation of odorants emitted from sewers using odour activity values" Water Research 88:308-321

Good practice guideline for odour control: **Odour monitoring**

• Very low potential sites with no odour problems:	None
• Low potential sites with no odour problems:	Measure 1
• Medium potential sites with no odour problems:	Measure 1, 2
• High potential sites with no odour problems:	Measure 1, 2, 10
• Very low potential sites if odour problems persist:	Measure 1, 2, 3, 4 as appropriate
• Low potential sites if odour problems persist:	Measure 1, 2, 3, 4 as appropriate
• Medium potential sites if odour problems persist	Measure 1, 2, 3, 4, 5, 6, 8, 10 as appropriate
• High potential sites if odour problems persist:	All measures as appropriate

3.8 Odour control through stakeholder and public engagement

3.8.1 Overview

Maintaining effective, regular and frequent communications with regulatory authorities (normally the local authority, and including SEPA for sites regulated under IPPC) is essential for effective operation and management of odours. In addition to fulfilling their regulatory role, these authorities are often contacted by local residents when odours arise, and pro-active engagement to ensure that the public authorities are aware of activities at the site can be very helpful in minimising the impact of odours on members of the public. The sewage treatment works operator should ensure there is liaison with the local authority Environmental Health Practitioner on the continuing effectiveness of the control measures and any problems that have been encountered or expected.

Complaints are a very important indicator of nuisance and other community dissatisfaction. As described in Section 3.2.2, it is important that complaints are properly and systematically dealt with and acted upon. Barriers to complaints should be minimised, wherever possible.

A standard Scottish Water odour complaint logging form is reproduced as table 8.

It would be helpful if this form requested provision of email contact details (subject to data protection requirements) to assist in responding to complainants in the most cost-effective way. Additionally, operators have found that the question "Is there a wastewater treatment works in the area?" encourages complainants and responders to immediately associate a complaint with the site, even when this is not necessarily justified. For example, a sewage-like odour could be associated with the sewerage network or activities such as agricultural slurry spreading. It would be preferable for this to be replaced with a more open question, asking the respondent for their views on the possible source(s) of the odour.

Clear and effective communication and the provision of useful information are essential when working with local communities who may be or are being affected by offensive odours. Engagement can include a wide variety of activities, but establishing appropriate channels of communication between the sewage treatment works operators, local authorities, local residents and community representatives (e.g. Councillors and MSPs) is considered a key aspect. Liaison and communication could involve:

- writing to affected people
- face to face meetings
- attending community group meetings
- providing a reliable source of information to the community and being available to hear what they have to say
- contacting and discussing issues with local and/or national elected representatives
- informing local authorities and the local community, especially if the operator is planning to undertake any non-routine activity which could give rise to odour, for example cleaning of equipment. One approach for doing this could be via social media. A notice placed on a relevant social media group (e.g. account run by the site operator or relevant community group) would trigger notifications for anyone who has registered with the group. This could be a useful back-up to website, email and house-to-house notifications.
- informing the public of the possible sources of odours and the complaints procedures

In the event of significant odour issues, members of the public can be encouraged to maintain odour logs and odour diaries. Such tools can be used to help monitor and maintain the effectiveness of abatement measures introduced to deal with an odour incident.

Table 8: Scottish Water odour complaint logging form

SCOTTISH WATER — Odour Complaints Logging Form

PART A (To be completed by the CSC)			
Service Request Number		SR Creation Timestamp	
PART B (To be completed by the person receiving the complaint)			
Completed by:		Position:	
1. Name and address, including postcode			
2. Telephone number, for contact or additional information requests			
3. When was the odour first detected? Date and specific time if possible.			
4. Where they detected the odour – as much detail as possible regarding the actual location of odour. Note: this may or may not be their home address.			
5. Is the odour still present in the same location?			
6. Description of odour (As much information as possible please. Information to be added to notes field; e.g. sulphur, eggs etc.) An indication of the strength of the odour is also important.			
7. Is there a wastewater treatment works in the area?			
8. If yes, what is the name of the site? What is the name of the locality as a clue to naming site?			
PART C (To be completed by the person investigating the complaint)			
Completed by:		Position:	
1. Is the odour linked to a Scottish Water asset?			
2. If yes, what type of asset?			
	YES/NO	Network	YES/NO
3. Confirm the name of the WWTW.			
4. Have there been any elevated odour levels recorded at the site in the past 24 hours?			

3.8.2 Good practice guideline

Table 9: Monitoring measures for odour control

Odour control measure and description		Measure appropriate for:			
		Very low potential	Low potential	Medium potential	High potential
1	Liaison committee between regulators, contractors, sewerage network operators, and Scottish Water	✓	✓	✓	✓
2	Newsletter to keep residents informed of planned investment and performance against odour management plan		✓	✓	✓
3	Mailshot to inform residents of actions being taken to deal with ongoing issues		✓	✓	✓
4	Dedicated contact number to report odour issues to Scottish Water or authorities				✓
5	Provision of odour diaries		✓	✓	✓
6	Meeting with elected representatives/ community leaders	✓	✓	✓	✓
7	Site open day				✓
8	Provision of information on company website and/or via social media		✓	✓	✓
9	Appointment of independent expert to represent community interests				✓
10	Appointment of Odour Reporting Officer				✓
11	Engagement of public relations company or appointment of PR officer				✓

Good practice guideline for odour control: **Public engagement**

- Very low potential sites with no odour problems: Measure 1
- Low potential sites with no odour problems: Measure 1
- Medium potential sites with no odour problems: Measure 1, 2, 8
- High potential sites with no odour problems: Measure 1, 2, 7, 8

- Very low potential sites if odour problems persist: Measure 1, 2, 8
- Low potential sites if odour problems persist: Measure 1, 2, 6, 8
- Medium potential sites if odour problems persist Measure 1, 2, 3, 4, 5, 6, 8
- High potential sites if odour problems persist: Measure 1, 2, 3, 4, 5, 6, 8; consider 9, 10, 11

4 Case studies

4.1 Case study 1: Shieldhall sewage treatment works (2016)

The Shieldhall site was classified as "Medium potential" using the matrix approach described in Chapter 2.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.	**3 585,000 p.e.**	**30**
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains	**2 Long mains; no major industrial component**	**10**
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing	**2 Sludge handling and occasional treatment**	**20**
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 100 properties within 750 metres	More than 100 properties within 750 metres	**3 >200 properties within 750 m**	**15**
	5	No properties within 100 metres	1 to 10 properties within 200 metres	More than 10 properties within 100 metres	**No sensitive properties within 100 m**	**5**
History of verified complaints	5	Fewer than 10 verified complaints per year	10 to 50 verified-complaints per year	More than 50 verified complaints per year	**1 7-10 complaints per year**	**5**
Very low potential: Less than 65						**85 Medium potential**
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

Shieldhall is a large sewage works located in the centre of Glasgow's south side. The site treats mainly domestic effluent, and also handles sludge from a variety of sources which is then usually pumped to Daldowie. Odour control is provided for the sludge handling processes. The inlet works (screens and grit removal) is covered to reduce the escape of odours, but does not have odour treatment. There has been significant investment in covering and providing odour control for the main potential sources of odour, including inlet works, screens, grit removal, sludge thickening, transfer and disposal. This site also shows good control and optimisation of effluent flow through the system. In the majority of respects, this conforms with the odour controls that would be expected of a "medium" potential site. Evaluation using the tools in the guidance may highlight the further options for reducing odour emissions from the site.

The sewage works is adjacent to the Queen Elizabeth University Hospital. The proximity of the hospital means that odour problems do arise periodically, particularly in the summer months. Odour problems are not strongly influenced by the extent of the sewerage system: the Council officer considers that the problems are to some extent inevitable when treating a large quantity of sewage in close proximity to a hospital and residential properties. There is a potential source of odours from the Glasgow City Council cleansing / recycling plant in close proximity that is thought to contribute to odours in the area.

The matrix assessment in Chapter 2 and description of odour controls in Chapter 3 indicate that a site of this nature should also focus on site management and good housekeeping, and engagement with the site neighbours.

4.2 Case study 2: Ardoch sewage treatment works (2016)

The Ardoch site was classified as "Low potential" using the matrix approach described in Chapter 2.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.	**1 130,000 p.e. (design)**	**10**
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains	**1 Mains up to 6 km; industrial compo-nent 20% of total**	**5**
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing	**3 Full treatment and sludge biological treatment & thickening**	**30**
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 200 properties within 750 metres	More than 200 properties within 750 metres	**3 Well over 200 properties within 750 m**	**15**
	5	No properties within 100 metres	1 to 20 properties within 100 metres	More than 20 properties within 100 metres	**2 Approximately 10 properties within 100 m**	**10**
History of verified complaints	5	Fewer than 10 verified complaints per year	10 to 50 verified complaints per year	More than 50 verified complaints per year	**2 7-43 complaints per year**	**10**
Very low potential: Less than 65						**80 low potential**
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

Ardoch is a medium sized sewage works located at the foot of cliffs on the River Clyde to the west of Dumbarton, and takes sewage from Castlegreen, Cardross and Dalmoak. A distillery contributes approximately 20% of industrial effluent flows. There has been significant investment in covering and providing odour control for the main potential sources of odour, including inlet works, screens, grit removal, sludge thickening, transfer and disposal. This conforms with the odour controls that would be expected of a "medium" potential site, but there would remain further options for reducing odour emissions from the primary settlement tanks if required, in accordance with the measures outlined in Chapter 3.

However, despite the investments in odour control infrastructure, and preliminary assessment of "low" odour potential, odour complaints have continued at reasonably high levels in recent years. Odour incidents typically result from low flow conditions during dry weather. The local authority has issued abatement notices in the past, although there are none current at present. The sewage works is located close to residential areas of Dalreoch, which are located at a higher elevation from the site, and downwind of the prevailing wind direction from the sewage works. This may tend to increase the potential impact of any odours released from the site.

The matrix assessment in Chapter 2 and description of odour controls in Chapter 3 indicate that a site of this nature should also focus on site management and good housekeeping, and engagement with the site neighbours.

4.3 Case study 3: Dalmuir sewage works (2016)

The Dalmuir site was classified as "Medium potential" using the matrix approach described in Chapter 2.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.	**3 650,000 p.e. (design)**	**30**
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains	**2 Long gravity mains; 95% domestic**	**10**
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing	**3 Full treatment and sludge treatment & thickening**	**30**
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 200 properties within 750 metres	More than 200 properties within 750 metres	**3 Well over 200 properties within 750 m**	**15**
	5	No properties within 100 metres	1 to 20 properties within 100 metres	More than 20 properties within 100 metres	**No properties within 100 metres**	**5**
History of verified complaints	5	Fewer than 10 verified complaints per year	10 to 50 verified complaints per year	More than 50 verified complaints per year	**1 5 - 10 complaints per year**	**5**
Very low potential: Less than 65						**95 Medium potential**
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

Dalmuir is a large sewage works located on the River Clyde in Glasgow, and takes sewage from much of central and north-west Glasgow. About 95% of the sewage is domestic. The implementation of the Code of Practice enabled improvements in odour control to be mandated by the regulatory authorities. Considerable improvements have been made in management of the site and specific odour controls. The site management now understands and can manage fluctuations in the effluent arriving at the site. The site is well managed, for example ensuring that critical spares are kept at the site. Investment has been made in covering of key parts of the site, and odour collection, treatment and monitoring. The site operates in accordance with an extensive and detailed odour management plan developed with the local authority. This is used by the site manager as a general operational manual as it covers all aspects of the site.

Sewage arriving at the site is dosed with ferric sulphate solution to facilitate the complexing of sulphates and sulphides into the sludge, ensure oxygen levels remain high, and thereby avoid septicity. Sulphides in the effluent react to form solid ferric sulphide which is removed via the sludge. While not specifically designed as an odour control method, dosing with ferric sulphate has a beneficial effect on odour risk. The injection point is changed during the summer to ensure that potential odours are mitigated.

Odorous air is collected from all areas where strong odours could arise, comprising sludge pumps, wet wells and tanker discharge point, and sludge storage tanks. A scrubber system is used to abate odours, with caustic soda dosing to ensure effective collection of hydrogen sulphide and mercaptans. Activated carbon is used as a final polishing stage. Hydrogen sulphide and total hydrocarbons are monitored in the discharge stacks from odour treatment plant.

Further investment in odour collection and abatement is planned for the distribution chamber between pre-treatment and secondary treatment. The turbulent flows in this chamber can result in odours during the summer. These controls conform with the requirements that would be expected of a "high" potential site.

These measures have been effective in reducing the incidence of odour complaints to low levels for a site in an urban centre setting. In view of the preliminary assessment of "medium" odour potential, achieving fewer than 5 odour complaints per year represents a good performance for this site. Occasionally, complaints are made which are due to a different source of odours (e.g. slurry spreading on fields). There is now little public interest in the site, and hence no requirement for ongoing public or stakeholder meetings.

4.4 Case study 4: Seafield (2016)

The Seafield site was classified as "High potential" using the matrix approach described in Chapter 2.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.	**3 300,000 m3/day ~1,500,000 p.e.**	**30**
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains	**1 Almost all domestic**	**5**
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing	**3 Full treatment and sludge treatment & thickening**	**30**
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 200 properties within 750 metres	More than 200 properties within 750 metres	**3 Well over 200 properties within 750 m**	**15**
	5	No properties within 100 metres	1 to 20 properties within 100 metres	More than 20 properties within 100 metres	**2 Approximately 12 properties within 100 metres**	**10**
History of verified complaints	5	Fewer than 10 verified complaints per year	10 to 50 verified complaints per year	More than 50 verified complaints per year	**2 11 - 15 complaints per year**	**10**
Very low potential: Less than 65						**100 High potential**
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

Odours from the Seafield works have been a long-established problem for many years. Around 2003, there were 400-500 complaints received per year, and improving this situation was viewed as an urgent priority by City of Edinburgh Council (CEC). CEC issued an Abatement Notice, which was subsequently appealed and then quashed. One key problem was that residents expected that the substantial investment to meet EC directive requirements for water treatment at that time would result in the complete elimination of odours, whereas this was never the focus of this investment.

Following the abatement notice, a steering group was set up to discuss and agree the way forward. A range of options were considered which had to be evaluated on a "best value" basis – that is, having regard to cost. An £18m investment programme was agreed, which was designed to deliver a 70% reduction in odour emissions and complaint numbers, based on a modelling analysis. To secure a further 2% reduction would have required a further £10m investment, so the specified solution was clearly indicated as "best value". Delivering the agreed improvements took 3-4 years. This has been effective in reducing odour impacts and complaints as part of ongoing improvements over a 20 year period.

The investment programme has focused on parts of the site where potentially odorous flows are aerated, potentially leading to the release of odours. The inlet works, channels and sludge treatment processes are now fully enclosed. The primary tank weirs are partially enclosed. Air is extracted and treated in chemical scrubbers (bulk flows) and activated carbon scrubbers (lower flows). The main operating cost is the energy requirement for the fans to deliver the required air extraction. Other costs, such as filter media, chemicals and monitoring costs, are lower.

Figure 2: Grit skips with flexible covers to minimise odour release

Figure 3: Brush covering on primary tank weirs

Figure 4: Covering on channel from inlet works to primary tanks

Figure 5: Chemical scrubber for air extracted from inlet works and primary tanks

Figure 6: Activated carbon scrubber for air extracted from thermal hydrolysis sludge plant

Site management continues to be a key focus, with the emphasis on maintaining a low sludge level in the primary tanks. The site preferentially uses primary tanks located further away from the closest residential properties to minimise odour impacts. Despite these improvements, odours have not been completely eliminated, and people continue to be dissatisfied whenever odours occur, and are quick to make complaints. One problem was that meetings in the early days were not well handled. The site management at that time were perceived as not taking complaints seriously. Scottish Water stepped in to improve liaison with residents. The residents have access to an independent expert paid for by Scottish Water. This has been a useful step in giving residents confidence in the investments being carried out, and the expert has been able to meet and discuss with residents individually. However, this has been a mixed experience for CEC. One issue with the Code of Practice is that operators are considered to have complied with the COP if an odour is caused, but then measures are put in place to deal with the circumstances giving rise to the odour. There is little incentive on an operator to put preventive measures in place.

The investments carried out have focused on improvements to inlet works, covering of inlet works and detritors, and partially covering the primary tanks. Odour control is applied to air extracted from these sources. Further abatement could theoretically be applied to primary tanks, but this would have considerable cost and practical implications. It is more important to focus on site management to minimise odour impacts. For example, the key to dealing with odours from primary settlement is to manage them properly and avoid the build-up of sludge. It is important to carry out storm tank cleaning when the wind is blowing offshore, but it may be necessary to step in to process effluent in the storm tanks before it turns septic, even if the wind is onshore. This may cause a short-term problem, but prevents a much greater problem which would arise if the effluent turns septic. One-off activities of this nature are managed using an established protocol. The Council and Scottish Water are made aware of plans, so that they can deal with any calls from the public. Additionally, a daily report is provided on activities at the site (e.g. level of sludge in the primary tanks). The operator takes account of the best available meteorological forecasts, and has a contingency plan in place in the event of a change in wind direction.

Site liaison meetings are currently held on a 6 weekly basis. These include the local authority, SEPA Scottish Water, Veolia and Stirling Water representatives. Meetings are held with public representatives annually: these are important, but tend to be less effective in relation to the operation of the site.

The odour management measures implemented at the site are in accordance with the expected level of odour control for a "high" odour potential site.

4.5 Case study 5: Levenmouth (2016)

The Levenmouth site was classified as "High potential" using the matrix approach described in Chapter 2.

Aspect	Weighting (A)	Low: Score 1	Medium: Score 2	High: Score 3	Your score (1, 2 or 3) (B)	Weighted score (A × B)
Throughput	10	<150,000 p.e.	150,000 to 500,000 p.e.	>500,000 p.e.	**2 402,000 p.e. (design)**	**20**
Sewage odour potential	5	Neither industrial component; nor long rising or gravity mains	Either industrial component; or long rising or gravity mains	Both industrial component; and long rising or gravity mains	**3 Long (12 miles) mains; partly above ground affects influent quality; 85% domestic**	**15**
Activities carried out	10	Screening only	Screening; primary treatment; no sludge processing	Screening; primary treatment; sludge processing	**3 Full treatment and sludge treatment, thickening and drying**	**30**
Proximity of neighbours	5	Fewer than 50 properties within 750 metres	50 – 200 properties within 750 metres	More than 200 properties within 750 metres	**3 Well over 200 properties within 750 m**	**15**
	5	No properties within 100 metres	1 to 20 properties within 100 metres	More than 20 properties within 100 metres	**2 5 properties within 100 m**	**10**
History of verified complaints	5	Fewer than 10 verified complaints per year	10 to 50 verified complaints per year	More than 50 verified complaints per year	**3 29 - 173 com-plaints per year, not verified**	**15**
Very low potential: Less than 65						**105 High potential**
Low potential: 65 to 80						
Medium potential: 81 to 95						
High potential: More than 95						

The Levenmouth site was commissioned in 2004. Odour assessments were carried out at that time, but in retrospect, this was carried out on an optimistic basis. These assessments indicated that there would be no detectable odours, but this was not realistic in practice. Consequently, a large number of complaints were received, which has taken a substantial investment of time and funds from both Scottish Water and the local authority to address.

One of the key issues is that sewage is collected from a wide area with a long flow time (up to 14 hours) with part of one sewage main above ground. Consequently, sewage can arrive at the site having undergone anaerobic decomposition. Consequently, a number of measures have been introduced to improve influent quality. Two stormwater works have been constructed on the sewage main, and chemical dosing is carried out to reduce septicity. Telemetry has been implemented to provide real time data on BOD, COD, suspended particles and sulphide levels in the sewage, enabling additional dosing to be carried out if required. Further improvements might focus on reducing the extent of above ground sewage main, or interim treatment of sewage prior to arrival at the Levenmouth site although this would have considerable cost and practical implications.

The site operates in accordance with an Odour Management Plan. Housekeeping and management at the site are considered to be good. Preliminary and secondary treatment plant is fully covered with odour extraction. Sludge holding tanks and storm channels are also covered, with partial odour extraction. Odour treatment consists of bio-filters and chemical scrubbing as appropriate.

Air is also extracted from the sludge treatment and sludge cake export buildings, and treated using chemical scrubbing, activated carbon filters and thermal oxidation. Hydrogen sulphide levels are monitored continuously in discharges from odour treatment plant, and at the site boundary.

The site is located in a bowl, which may contribute to relatively poor dispersion of odours. Taller stacks have recently been constructed on the drier building and sludge processing building. The site has in the past employed a liaison officer. The liaison officer was effective in enabling residents to bring their concerns to Scottish Water's attention. A liaison group continues with representation from local residents, Councillors, MSPs, council officers and site management. This has been worthwhile. The local authority used to attend in response to every complaint received. The Council is now not able to do this because of resource issues, and the improvements in odour performance at the site.

All sludge and odour treatment processes are regulated under PPC where specific environmental management and environmental limit conditions are to be complied with. The sites' OMP also falls under the licence conditions.

The management and controls on odour conform with the requirements that would be expected of a "high" potential site. These measures have been effective in reducing the incidence of odour complaints, although odour complaints remain at a relatively high level. Further improvements would potentially focus on management of sewage upstream of the site.

Appendices

Appendix 1: Supporting evidence

A1.1 Shieldhall sewage works

Table 10: Shieldhall site characteristics

Item	Description
Throughput (population equivalent or m3/ day)	Treat up to 7500 L per second or 655,000 m3 per day plus same again to for storm tanks. This is maximum capacity. Population equivalent: 585,000
Nature of sewage	South part of Glasgow extending towards Cambuslang.
Description of sewerage mains	Lots of pump stations feeding into site, largest is Kinning park. A lot gravity fed to pumping stations then pumped here. Most pumped from stations. 2 sewers come in from Renfrew and Kinning park… estimate 50/50… Vast majority at some stage is pumped.
What sewage/sludge treatment activities are carried out at the site?	Screening (coarse and fine), grit removal, primary settlement (PST), biological aerated system, final settlement tanks. No tertiary treatment. Desludging and PST pumped to Daldowie. Have centrifuges on site and used occasionally if Daldowie can't take sludge
How many residential properties are within 400 m of the site?	Very large Hospital, located next to the site. Within 400 m housing only to the east of the site along Govan Rd, up as far as the Clyde tunnel. Mostly apartments, ~60-100. Scrap yards and docks on other sides, so not many houses.
How many verified odour complaints have been received each year for the past 5 years? Please provide details of local authority contact	2 in last few days, have sent on Odour complaints logging forms. These complaints came from east of the site in Linthouse Buildings, Glasgow G51 4RG and North of the river Dumbarton Road, Glasgow G14 9TR. There is a cleansing/recycling plant close by run by Glasgow City Council that also has smells so not sure where smell comes from. Most calls go to SW, previously had staff on site here to deal with but gone now. Process is Caller – SW; SW – person on standby on site – they then follow up with customer and form to fill in for investigation.
Describe the sewage and sludge treatment process. Highlight any specific measures you use to ensure that the process is as effective as possible	A lot of imported sludge is brought on site from septic tanks and other smaller works. Pumped from here to Daldowie. Not treated, straight into sludge tank. Septic tanks sludge water sludge and septic tanks etc. goes through process. Sludge tanks underground. Have new odour control systems. Tanker bay discharge. Scrubbers. Centrifuge used on occasion. Pump sludge across road, Centrifuged then liquid pumped back. This may create odours? Not always sealed. Liquid gravity feedback to low level sewer, bottom of screw pump and fed back into treatment process. Increase in use of centrifuge. Add ferric so will mean take sum of Dalmuir sludge here. Will run more in new year. Dalmuir have centrifuge, but can't do it all. If backlog or too much ferric sent to Shieldhall. Sludge, from Dalmuir pumped to shiedhall with sludge from Erskine, but not at same time. Laypark (Paisley) pumped in separate line to Shieldhall. Then all pumped to Dalmarnock who add their sludge and then all goes to Daldowie.. vents along the way, air valves, release pressure… Certainly areas such as storm tanks and PST are the issues where odour coming from… under better control than previously, but no odour control for those
Describe your procedures for normal site management, including regular inspection, cleaning and other housekeeping measures	Do have OMP. Jerome hydrogen sulphide measurements are undertaken on occasion, at various locations on site. Have more robust procedure for emptying scraping storm tanks and dropping the flow to primary settlement tanks. Drop and empty some PST if flow low. More likely in summer. Housekeeping measure: storm scrapers and empty PST tanks to keep flow consistent.

Table 10: Continued

Item	Description
Describe any site management measures (and their frequencies) introduced specifically for odour control, e.g. olfactory surveys, monitoring, control of material residence times	PST and storm tanks procedures and Jerome test on occasion. Not a set procedure on a regular basis. As soon as flow drops off PST and empty storm tanks… Put flow rate into a formula on spreadsheet and tells how many PST tanks to run. Done on a daily basis. Not fool proof. Total flow in and tell tanks, but issue with time lag for flow… works to a degree. Need to know rain or not, have tanks open ready for rain, then close down when low flow. Keep consistent speed of flow in plant. If flow is too low and spend too long in system can go septic. Final tanks and aeration takes a few hours… PSDs speed up a bit.. PST overflows into storm tanks… Good to scrape settlement tanks before emptied. Not as much as a smell. Nothing stands out to create odour. Summer is more difficult than winter. Odour control is as good as it can be in Shieldhall. It has become easier to manage storm tanks since staff taken off shifts. More men to put resources towards maintaining. But now site is unmanned at night (on standby) so this can result in issues. Manage PST and storm tanks better than when shifts on. They are putting an RTC system that will manage the whole process better / more efficiently.
Describe any physical measures (and where they were applied) introduced specifically for odour control, e.g. chemical dosing, moving or covering potentially odorous plant, air extraction, odour abatement (e.g. biofilter, scrubber or thermal oxidiser)	Odour control for imported sludge Odour control for desludging PDS. Desludging within a chamber in separate building, underground tanks. Screens and grit removal own building, no odour treatment Keep doors and windows closed & locked. All doors fixed in sludge pipework gallery. Have put covers on inlet and at end of PST to reduce odours.
Do you anticipate making any further investment in odour control?	An odour testing system is due to be installed.
Describe any public engagement measures you have carried out, either regular or one-off. For example, open days, newsletter, public notification ahead of improvement works	None
Describe any public engagement measures you have carried out specifically related to odours	None in past few months.

Note of discussion with environmental protection officer for Shieldhall

A1.2 Ardoch sewage works

Table 11: Ardoch site characteristics

Item	Description
Throughput (population equivalent or m3/day)	Pe 64000 Design 130000
Nature of sewage	Domestic 80% Industrial 20% Main trader is Loch Lomond Distillery
Do you anticipate making any further investment in odour control?	An odour testing system is due to be installed.
Description of sewerage mains	Three pumped flows to works. Castlegreen to Ardoch 2km rising main. Cardross to Ardoch 6km rising main. Dalmoak to Ardoch 1km rising main 4km gravity sewer
What sewage/sludge treatment activities are carried out at the site?	Full biological treatment using fine bubble diffused air. Sludge thickening by drum thickeners
How many residential properties are within 400 m of the site?	Approx. 400
How many verified odour complaints have been received each year for the past 5 years? Please provide details of local authority contact	2009-10 - 33 2010-11 -43 2011-12 - 18 2012-13 - 7 2013-14 (to Feb) 0

Table 11: Continued

Item	Description
Describe the sewage and sludge treatment process. Highlight any specific measures you use to ensure that the process is as effective as possible	Treatment process run via SCADA with control set points. All major kit is in odour controlled buildings (inlet works, screens, grit removal) PST weirs are covered. Sludge thickening, transfer and disposal are in odour controlled buildings.
Describe your procedures for normal site management, including regular inspection, cleaning and other housekeeping measures	Site manned daily Monday to Friday, Critical tasks identified and carried out to ensure works meets consent standards set. All Kit have MST's set
Describe any site management measures (and their frequencies) introduced specifically for odour control, e.g. olfactory surveys, monitoring, control of material residence times	The works was constructed with odour abatement as part of the design.
Describe any physical measures (and where they were applied) introduced specifically for odour control, e.g. chemical dosing, moving or covering potentially odorous plant, air extraction, odour abatement (e.g. biofilter, scrubber or thermal oxidiser)	As above.
Do you anticipate making any further investment in odour control?	Capital maintenance to be carried out on the odour treatment plant during SR15
Describe any public engagement measures you have carried out, either regular or one-off. For example, open days, newsletter, public notification ahead of improvement works	Local Environmental health dept notified of capital work being carried out that may result in odours being generated. Open day held in 2004. Odour forum set up around 10 years ago with local residents, local councillors and SW management team. Lasted about 1 year.
Describe any public engagement measures you have carried out specifically related to odours	Public meetings held about 10 years ago

Note of discussion with environmental protection officer for Ardoch

A1.3 Dalmuir sewage works

Table 12: Dalmuir site characteristics

Item	Description
Throughput (population equivalent or m3/ day)	650,000 pe 150,000 – 380,000 m3 per day
Nature of sewage	Mostly domestic, 95% Of industrial 3/4 are a few big industries. Devro, sausage skins manufacturer. DRX, (Scottish water), Irn Bru and a distillery,
Description of sewerage mains	Mostly gravity mains 1 pumping station at Partick for city centre sewage 70% gravity. Info with Scottish Water Mains is mixed, sewage and rain water. So need to include that in questionnaire… issue with concentration and speed. Q how much rain water run off or are they separate network or mixed network?
What sewage/sludge treatment activities are carried out at the site?	Pre-treatment (filtering) Primary: settlement, grease treatment Secondary: aerated activated sludge Tertiary: nitrification Sludge treatment: Sludge thickening, pumped to Daldowie for incineration.
How many residential properties are within 400 m of the site?	Lots Map of area for each site… flats on Dunbarton road, between here and plant is roughly 400 m. Includes blocks of flats…. Hundreds, 300ish?
How many verified odour complaints have been received each year for the past 5 years? Please provide details of local authority contact	5-10 pa. Complaint through Scottish Water sent to them and west Dunbartonshire council. Go on site… usually linked to network odour issue or doing something special on site. Pat Hoey is contact from West Dunbartonshire Council (pat.hoey@west-dunbarton.gov.uk). Pat has suggested to use SAUR as an example of a plant that is working well…

Table 12: Continued

Item	Description
Describe the sewage and sludge treatment process. Highlight any specific measures you use to ensure that the process is as effective as possible	Similar to 4th question… Details can be found in the Dalmuir odour management plan
Describe your procedures for normal site management, including regular inspection, cleaning and other housekeeping measures	Odour management plan. Area by area, risk assessment on odour undertaken. Divided up into areas with proper processes to reduce or minimise odour. Developed in house. Occurs at each SAUR site, but specific to location. Share with city council in Clydebank. Pay Hoey has added comments.
Describe any site management measures (and their frequencies) introduced specifically for odour control, e.g. olfactory surveys, monitoring, control of material residence times	All in document odour management plan Have online monitoring. Have odour treatment on site. All covered. H2S and hydro carbon monitor at neck and end of stack. Odour treatment to wash gas. Gas taken from all areas where strong odour, pre-treatment and sludge treatment mainly. 3 other treatments. Contaminated air is collected and taken to tower, undergoes recirculation; gas washed; caustic soda and bleach, react with H2S = H2SO4, that is why add caustic soda, neutralise acid. Higher pH better to catch H2S gas and mercaptans. Captured at higher pH. Main treatment. Activated carbon treatment also. Sludge is mix of both treatments, chemical scrubber and active C…. More details in the odour management plan.
Describe any physical measures (and where they were applied) introduced specifically for odour control, e.g. chemical dosing, moving or covering potentially odorous plant, air extraction, odour abatement (e.g. biofilter, scrubber or thermal oxidiser)	Ferric sulfate best treatment for odour. Catching phosphate and H2S precipitation of FeS catch in water and no odour… part of process. If don't include will generate more odour. Odour performance on site is linked to its use. Not specific of odour but has impact on odour as using it… change injection point during summer to catch odour… Was known already, all French WWTP use it. Also known as chemical dosing… Chemical dosing main one… in odour management plan…
Do you anticipate making any further investment in odour control?	Yes, one area where there is odour generation, going to cover and treat. Distribution chamber between pre and secondary treatment… turbulence and waterfall and in summer smell. Going to cover and odour treatment. 2-3 years… link to other treatment system. Local but same treatment as exits.
Describe any public engagement measures you have carried out, either regular or one-off. For example, open days, newsletter, public notification ahead of improvement works	Annual city council audit and odour management plan on site… all odour complaints go through SW.
Describe any public engagement measures you have carried out specifically related to odours	None. They are in the process of looking for ISO14001, looking at reducing impact on environment. Take into account all interested parties. Communicate policy in terms of pollution to environment, from outfall to odour around the area. Target Oct 2016, but optimistic, end of year submission

Note of discussion with environmental protection officer for Dalmuir

A1.4 Seafield sewage works

Table 13: Seafield site characteristics

Item	Description
Throughput (population equivalent or m3/day)	Average flow ~ 300,000 m3/d
Nature of sewage	Domestic. Minimal industrial flows.
Description of sewerage mains	The site is served by two major gravity sewers (the western and eastern interceptors). These flows converge at a siphon house prior to the works from which they are fed directly to the inlet works. There is also a pumped main delivery ~10% of the flows which arrives at the site and is lifted by two Archimedes screws.
What sewage/sludge treatment activities are carried out at the site?	Sewage treatment is by means of coarse and fine screening; grit removal; primary settlement and FBDA activated sludge. Sludge treatment includes picket fence thickening of primary sludge; belt thickeners for secondary and imported sludge; thermal hydrolysis for all sludge followed by anaerobic digestion. The final sludge product is de-watered by centrifuges.

Table 13: Continued

Item	Description
How many residential properties are within 400 m of the site?	I do not have a no. but from a very basic assessment I would say no more than 30 properties.
How many verified odour complaints have been received each year for the past 5 years? Please provide details of local authority contact	2013/14 = 15 2014/15 = 11 2015/2016 = 14 All complaints verified by site inspection by City of Edinburgh Council.
Describe the sewage and sludge treatment process. Highlight any specific measures you use to ensure that the process is as effective as possible	See above.
Describe your procedures for normal site management, including regular inspection, cleaning and other housekeeping measures	The Veolia BMS requires daily and weekly checks across the site. This is supported by management audits undertaken at least monthly. The Odour Management plan also includes strict requirements for responding to spillages,
Describe any site management measures (and their frequencies) introduced specifically for odour control, e.g. olfactory surveys, monitoring, control of material residence times	All activities are covered by the site OMP. This includes checks of odour control units, olfactory sampling in response to complaints or detection of odour, the cleaning of storm tanks and conditions for undertaking any works with a high potential for odour.
Describe any physical measures (and where they were applied) introduced specifically for odour control, e.g. chemical dosing, moving or covering potentially odorous plant, air extraction, odour abatement (e.g. biofilter, scrubber or thermal oxidiser)	A drawing showing the extent of the site where odour control is in place is included. There are numerous odour control plants ranging from activated carbon, chemical scrubber and biological processes.
Do you anticipate making any further investment in odour control?	No.
Describe any public engagement measures you have carried out, either regular or one-off. For example, open days, newsletter, public notification ahead of improvement works	A yearly stakeholder meeting takes place which is attended by representatives of local residents and politicians. We also host site visits for key stakeholders; specifically MPs and MSPs.
Describe any public engagement measures you have carried out specifically related to odours	A sitev visit by the local MSPs is scheduled for June the 17th.

Note of discussion with environmental protection officer for Seafield

Odours from the Seafield works have been a long-established problem for many years, going back before East of Scotland Water handed over to Scottish Water.

SG has been involved since 2003, at which point there were 400-500 complaints received per year. At that time it was viewed as an urgent priority by City of Edinburgh Council (CEC).

CEC issued an Abatement Notice, which was appealed by Scottish Water. This was prior to the introduction of the Code of Practice. The outcome of the lengthy appeal process was that the Abatement Notice was quashed, and SW and CEC were given 6 months to sort out the problems. SG considers that the Abatement Notice process was not helpful to speedy resolution of the odour problems, and probably delayed a satisfactory resolution. SG's view is that the problems experienced in Edinburgh led to the introduction of the statutory Code of Practice.

A key problem was that residents expected that the £100m investment to meet EC directive requirements for water treatment would result in the complete elimination of odours. SW has been involved at the site since the mid-1990s. At that time, there was always an odour in the vicinity of the site, whereas now there is normally no odour detectable other than in the near vicinity of the primary tanks. This represents a massive improvement. However, odours have not been completely eliminated – some problems always occur – and despite the improvement, many residents feel let down by the process. At the time of the Abatement Notice, there was a groundswell of opinion that people felt left behind and expected better environmental conditions. An organised group was pressing for improvements.

A steering group was set up to discuss and agree the way forward. The Steering Group considered 32 options for improvement. Under the new legislation which introduced the CoP, odour management measures had to be introduced on a "best value" basis, i.e. with regard to cost. An £18m investment programme was agreed. This was designed to deliver a 70% reduction in odour emissions and complaint numbers, based on modelling analysis. To secure a further 2% reduction would have required a further £10m investment, so this was clearly indicated as the "best value" solution.

Delivering the agreed improvements took 3-4 years. This has been effective in reducing odour impacts and complaints. However, people continue to be dissatisfied whenever odours occur, and are quick to make complaints. One problem was that meetings in the early days were not well handled. The site management at that time were perceived as not taking complaints seriously. Scottish Water stepped in to improve liaison with residents.

The residents have access to an independent expert paid for by

Scottish Water. This has been a useful step in giving residents confidence in the investments being carried out, and the expert has been able to meet and discuss with residents individually. However, this has been a mixed experience for CEC.

The investments carried out have focused on improvements to inlet works, covering of inlet works and detritors, and partially covering the primary tanks. Odour control is applied to air extracted from these sources. If further steps were to be carried out, this would presumably involve complete covering of primary tanks. As well as the cost, this would have significant problems with regard to health and safety, tank cleaning etc. The key to dealing with odours from primary settlement is to manage them properly and avoid the build-up of sludge.

The Odour Improvement Plan has delivered to the expectation of CEC, but not to the expectation of local residents. Complaints are currently running at c.80 per year. There was a spike in 2012, resulting from four separate management incidents.

There is a lot of useful material in the Code of Practice – e.g. guidance on how to measure odour. However, SG identified two key issues with the Code of Practice.

(a) The CoP requires odours to be minimised, whereas residents expect odours to be eliminated. There is a cost element, particularly as any improvements have to be paid for by ratepayers and/or taxpayers.

(b) In the event of an odour incident, if the operator can show that they have remedial measures in place, this does not constitute a breach of the CoP. E.g. CEC issued an Enforcement Notice a few years ago regarding a spillage from the containment building which caused a substantial odour. This was appealed, and CEC was advised that they should not contest the appeal, because the operator had put clean-up measures in place, and thereby complied with the CoP. This is viewed by residents as effectively a licence to cause odours: as long as remedial measures are in place, there is no sanction on the operator for causing what could be a substantial odour incident. There is no law of private nuisance in Scotland, so individuals cannot bring their own proceedings.

SG's view is that all the investments in odour control at the site have been effective in managing odour, but good site management is the biggest single factor. E.g. ensuring no build up of sludge in the primary tanks. E.g. managing the storm tank cleaning process when the wind is blowing offshore, but stepping in to process effluent in the storm tanks before it turns septic if necessary – this may cause a short-term problem, but prevents a much greater problem which would arise if the effluent turns septic.

CEC carries out a monitoring and response programme.

1. Handling complaints: CEC operates a laboratory next to the works, and can respond to a complaint in as little as 15 minutes. This enables complaints to be verified, and any odours potentially traced back to the works. Mostly, officers detect no smell on arrival.

2. Routine assessment visits: Now down to 1-2 visits per month. Drive around 12 points close to the site, and sample at each location following CoP protocol. This enables a response to be made to complainants. The cost of the current regime is c.£6-7k per year, but was up to £70k/year in the past.

CEC has not looked into the use of electronic nose technology.

The odour complaint protocol is that calls are handled by the call centre. There is a defined workflow which sends complaints to Public Health dept and Veolia Control. This allows the operator to verify and investigate. There are standby teams available at night, but this is under significant financial pressure at present.

Liaison meetings are held on a 6 weekly basis. These include SEPA representatives, and Craig Carr from Scottish Water.

One-off activities are managed using an established protocol. The Council is made aware of plans, and a daily report is provided on activities at the site (e.g. level of sludge in the primary tanks). The operator takes account of the best available meteorological forecasts, and has a contingency plan in place in the event of a change in wind direction.

Summary

- The Code of Practice requirement for "minimisation" rather than "elimination" of odours does not meet residents' expectations.

- The Code of Practice provisions which allow a smell to be caused as long as steps are being taken to deal with the odour makes the authorities look bad, and could reduce the incentive for the operator to manage the site effectively.

- It is difficult or impossible to publish, or for the regulator/ operator to take credit for, improvements in odour control.

A1.5 Seafield sewage works

Table 14: Levenmouth site characteristics

Item	Description
Throughput (population equivalent or m3/ day)	Consent pe = 402,000 Actual pe (2015 average @ 60g/h BOD) = 125,000 Consent DWF = 88.5 Ml/d Actual Flow (2015 average) = 58M//d
Nature of sewage	Originally 50% trade, 50% domestic However, paper mill decline has put this at approx. 15% trade, 85% domestic
Description of sewerage mains	Rising mains (PFI assets) = 1.5 miles Gravity sewer (SW assets) = 15 miles (approx.)
What sewage/sludge treatment activities are carried out at the site?	Preliminary, secondary and tertiary. High rate activated sludge, thickening, dewatering and thermal drying.
How many residential properties are within 400 m of the site?	Approximately 200 properties.
How many verified odour complaints have been received each year for the past 5 years? Please provide details of local authority contact	Complaint numbers received: 2012- 168 2013- 173 2014- 46 2015- 29 2016- 4 None of these complaints were verified by either SEPA or the Local Authority. Details of all complaints received by Scottish Water were passed to the regulators. Local Authority primary contact: Don Taylor, (Don.Taylor@fife.gov.uk or duty.officerppt@fife.gov.uk).
Describe the sewage and sludge treatment process. Highlight any specific measures you use to ensure that the process is as effective as possible	A wide combination of pumping, screening, de-gritting, biological oxidation, settlement, UV, dewatering, drying and pelletising. Site manned 24/7 with comprehensive Control Room SCADA facilities that monitor process parameters. EM&I partners provide out of hours call-out service to deal with priority breakdowns. On site 7d/w manned laboratory that carries out daily sample and analysis on a wide variety of areas across the waste water treatment process. Daily results produce a rich and ready appraisal of process health and performance to which staff can make sound judgements for change or corrective action.
Describe your procedures for normal site management, including regular inspection, cleaning and other housekeeping measures	Site manned 24/7 with a combination of shift/daily/weekly/monthly operational routines.
Describe any site management measures (and their frequencies) introduced specifically for odour control, e.g. olfactory surveys, monitoring, control of material residence times	All sludge and odour treatment processes are regulated under PPC where specific environmental management and environmental limit conditions are to be complied with. The sites' OMP also falls under the licence conditions. Site manned 24/7 with SCADA control room monitoring of various plant, equipment and instrumentation. This includes process conditions, site boundary H2S and stack H2S emission levels.
Describe any physical measures (and where they were applied) introduced specifically for odour control, e.g. chemical dosing, moving or covering potentially odorous plant, air extraction, odour abatement (e.g. biofilter, scrubber or thermal oxidiser)	Preliminary – all enclosed in dedicated building with channel/tank coverings with odour extraction. Influent sewage is monitored for septicity and chemical dosing is applied when required. Secondary – all RAS de-sludge chambers and channels covered with odour extraction. Tertiary – all sludge holding tanks and storm channels are covered with part odour extraction. Preliminary, secondary and tertiary has dedicated odour treatment consisting of bio-filters and chemical scrubbing. Sludge Treatment Building has various point source odour extraction points and general building ventilation to a combination of chemical scrubbing, activated carbon filters and thermal oxidation. Sludge cake export operations (when required) are done inside a building with odour extraction. This is also supplemented with a bespoke chemical dosing treatment to minimise cake odours from lorries. 2015 – Replacement of 2 x 15m odour stacks to 30m stacks.
Do you anticipate making any further investment in odour control?	Not at this time but is constantly reviewed under BAT, emerging technology and continuous improvement.

Table 14: Continued

Item	Description
Describe any public engagement measures you have carried out, either regular or one-off. For example, open days, newsletter, public notification ahead of improvement works	Stakeholder group set up consisting of local elected Councillors, MSP, MP, Environmental Health, SEPA, representatives from the local action group (FLAG), representatives from the PFI Company's and Scottish Water. Notifications of any onsite activities that could impact on the local community distributed via email to the stakeholder group. Letter drops carried out in the local area to advise improvement works onsite that would be visible in the community. Over 7000 newsletters distributed within the community to provide updates regarding onsite activities. Dedicated Levenmouth WWTW internet page set up on the Scottish Water website. SW and CELTS employees have carried out volunteer work within the local area.
Describe any public engagement measures you have carried out specifically related to odours	Site based SW Community Liaison Officer employed for 18 months to investigate odour complaints, liaise with the local community and conduct odour surveys in the area. Contact cards distributed to residents to allow real time reporting of perceived odour issues and prompt investigation. Information evening events held in local community centres that were open to all residents with representatives from both Scottish Water and CELTS in attendance. These were advertised in the local media and on SW website. Notifications sent out to the stakeholder group advising of any activities onsite that could potentially have an impact on odour. Stakeholder group notified of any offsite activies eg cake export lorries from the site that could potentially be noticed by the community. JHI conducted social study through customer focus groups to allow residents to freely express their opinions regarding odour issues at the site and the impact on the community. SW Customer Contact Centre telephone customers following investigation of odour complaints to provide feedback. Regular Odour Working Group meetings held representing SW, PFI, SEPA and Fife Council to discuss operations, compliance and communication. 2013/14 – Odour Action Group formed consisting of multi-representation from SW and PFI independently chaired by leading expert. Various in-depth technical studies and actions carried out under a holistic root-to-branch approach from operation and management of SW catchment assets through to the PFI treatment works and assets. SW customer communication was also focused on.

Note of discussion with environmental protection officer for Levenmouth

Key points:

1. Site commissioned in 2004. Not enough attention paid to odour control at that stage: odour modelling was carried out, but on an optimistic basis. People were promised "no odours" – this made it harder to regain trust
2. Complaints arose from the word go. This sensitised the population and made future odour management much more time-intensive and expensive
3. Following initial complaints, odour controls were put in place. Not much change to processes, as the site was already more or less state of the art.
4. Complaints carried out after these investments from 2007. Partly due to sensitised population
5. Professor Jackson carried out a study, and highlighted that the main issue was to do with influent. The sewage comes from a wide area with a long flow time (up to 14 hours) with part of one sewage main above ground. Consequently, don't have diurnal peaks in flows, and sewage can arrive at the site having undergone anaerobic decomposition.
6. Some measures have been implemented to improve influent quality: 2 stormwater works on the sewage main; introduced some pre-treatment (chemical dosing) to reduce septicity. Telemetry to provide real time data on BOD, COD, suspended particles, H2S. Dose if needed. H2S trigger level of 5 ppm. This has a cost implication
7. Ideally, DT would like to see the above ground sewage main buried, but this would be very costly. Upstream treatment may be an alternative option.
8. Housekeeping at the site is good. DT considers that Dave Thomson and the PFI team manage the site well. Other sites are not so good, e.g. interceptor chamber cover left open.
9. Prof Jackson also highlighted topography influences. The site is in a bowl, ground rises to the east. Consequently, taller stacks have been constructed on the drier building and sludge processing.
10. A lot of complaints referred to a "burnt" sewage smell.
11. The site has in the past employed a liaison officer. She was effective and did a good job, although some "hard core" residents remained aggrieved.
12. Site has a liaison group with local residents, Councillors, MSP, council officers etc. This has been worthwhile.
13. A sociologist at James Hutton Institute carried out an analysis from sociological perspective. This was interesting.
14. The Council used to go straight out in response to every complaint received. No longer do this, as the odour problem is less severe than previously, and resource issues. The Council has not identified an odour nuisance for over a decade.

15. Some key learning points:

a. Don't promise no odour
b. Be very conservative at the design stage, particularly when designing on the basis of odour model results – this will save a lot of time, effort, investment later
c. Consider and manage influent issues
d. Important to get odour control right from the start, otherwise it is difficult or impossible to fully recover trust of local communities

A1.5 Professor Robert Jackson

A meeting was held with Professor Robert Jackson. Professor Jackson has acted on behalf of Scottish Water and local residents groups in relation to the assessment and control of odours at sewage works. The notes of this meeting are as follows:

RJ has been involved with sites at Seafield, Dalmuir and Levenmouth. He is currently working with the local community at the Nigg site in Aberdeen.

Seafield

RJ's acted here from 2003 as independent consultant for the residents, paid for by Scottish Water. His role was to ensure that information provided by/on behalf of SW was robust – "not pulling the wool over their eyes."

A report was produced by WRc which was the focus of investment plans. RJ's advice to Edinburgh City Council was to highlight that there was an odour problem, but leave the identification and implementation of solutions to Scottish Water. ECC did "step up to the plate" by issuing an abatement notice. However, in the event, ECC identified which of the measures in the WRc report they thought SW should implement.

Consequently, while measures implemented have been effective, SW has not implemented the most far-reaching and expensive option, of fully covering the primary settling tanks. SW has also not addressed the issues that can occasionally occur when cleaning the storm tanks, and the wind direction changes to blow odours towards site neighbours.

Site investments have led to a substantiasl reduction in complaint numbers. This is the only metric we have to judge effectiveness of interventions. RJ considers that the key factor in relation to odours is frequency. Duration, type, intensity are relevant, but frequency is the key factor.

The model of using an independent expert funded by the company is useful. The key factors are trust in the impartiality of the expert, and confidence in the expert's competence.

RJ's role at Seafield has therefore been:

- Review WRc report
- Attend stakeholder meetings (this gives comfort to residents that the steps being taken are worthwhile.) These meetings are now quarterly.
- Dealing with ad-hoc calls from residents as and when new problems arise.

Levenmouth

RJ's role here was as chair of a task force to evaluate odours and develop solutions. The task force comprised the contractor, Scottish Water, sewerage network managers and trade effluent producers. RJ considers that getting the stakeholders together to inspect each others' installations was instrumental in securing improvements to the overall performance of the network and sewage works. This enables each operator to understand the constraints that other parties are operating under, and to take steps to improve the management of sewage. Managing the sewerage network and treatment plants as one is very important in dealing with odour issues.

One of the key issues here is the extensive catchment area, and solar gain in above-ground pipework, leading to "cooking" and septicity of the sewage before it arrives at the site. Previously, two paper mills in the area contributed significantly to sewage flows. These have now closed, resulting in a decrease in solids and flow through the system, and hence an increase in flow times. The closure of the paper mills also means that there is not enough demand to run the driers continuously. This can cause issues due to the intermittent nature of this source, and the need to stockpile material to ensure that there is enough to operate the driers. The drier stacks at Levenmouth were recently raised. One key benefit of this is that it is a visible measure, and residents can see the difference.

RJ considers that the Levenmouth works is now well managed. It has a small footprint and is energy intensive due to the range of processes carried out at the site. The Levenmouth site is located in a housing estate – this leads to problems.

The operator monitors the oxygen level in the sewage and doses to reduce septicity when needed. This system is useful, but it is better to prevent issues arising at source if possible.

The operator employed a liaison officer at the site for a period of time – developed an approach based on "phone don't moan". She was effective, and took the time to meet with complainants. Local residents appreciated the personal contact, and this was very positive.

Dalmuir

RJ was involved at Dalmuir many years ago, but has not worked there since SAUR has been operating the site. There was an issue related to storm tank cleaning at that time.

Nigg (Aberdeen)

RJ is now working at Nigg as independent consultant for the community council – a statutory consultee on development proposals (equivalent of the parish council in England)

A "Torrey Odour Response Officer" is employed at Aberdeen, similar to the liaison officer at Levenmouth. The TORO can speak directly to Scottish Water and get action on specific issues. This has again been effective, but contract expires in September, and not clear what arrangements for reporting odours will follow.

Summary

- Odour management is not about assigning blame, it's about understanding causation and taking action.
- A holistic approach is often required, ensuring that Scottish Water, the PFI contractor and network teams work together.
- Half is engineering/science; half is communications and public engagement
- A good Odour Response Officer can be very helpful in dealing with problems as they arise, and dealing with complaints.
- An independent expert can be useful in giving residents confidence in measures being taken. It is particularly helpful if the expert is willing and able to speak to the media.
- Honesty in giving bad news is helpful. RJ often takes the view that "the more problems we identify, the better," as it enables action to be taken.
- Stakeholder meetings can be useful, but tend to have a political element which may not be helpful. An independent (non-political) chair can be useful.

Appendix 2: Odour control workshop notes

CREW Odour management workshop 25th August 2016; University of West of Scotland, Paisley.

The bullet points summarise the discussion that took place following each presentation. It does not reflect the contractor presentation itself; which was circulated to delegates following the workshop. The text has been anonymised as far as possible.

Study context: Dr Richard Allen

No discussion

Overview: Dr Brian Quinn

- Some of those attending classified their sites based on the proposed risk matrix. One site, which is a high risk site, would be classified as a low risk site based on this matrix.

- Distance from WWTW to receptor: there can be odour complaints from outwith 400m.
  - **Action:** This will be reviewed if it can be shown there is a need to do so.
    Update: Changed to refer to wider area (750 m) and near field (100m) zones

- Complaint history: One site in Scotland was the most complained about in Scotland due to one person calling every day; an EHO will investigate to determine if the complaint is warranted, if it's not then it won't count of LA numbers but for returns to the Scottish Government it does. It was felt that this toll may not be useful if a site is classified as 'low risk' but there are complaints about odour from the site.

- Verification: It would be beneficial if the term 'verify' had a definition. Any complaint from a stakeholder / public it is a valid complaint. It would be difficult to maintain credibility with the public if complaints are dismissed.
  - **Action:** A definition of 'verify / verification' will be added to the text.
    Update: The term "verified complaint" is already in use, so an alternative term "genuine complaint" has been introduced and defined.

- There appeared to be confusion as to why there needs to be a new matrix given that there is an odour matrix in the Code of Practice (CoP) and confusion to what it's there to do e.g. that it won't help with Statutory Nuisance complaints. It was noted that this matrix is not there for Statutory Nuisance complaints.
  - **Action:** There needs to be a disclaimer saying that there is a matrix in the CoP and that the two matrices are not the same thing and should to complement each other – i.e. one does not overrule the other.
    Update: Added

- It was suggested that the descriptors may need to be changed because it would become a public document and therefore the wording needs to be clarified to ensure that there is no confusion, particularly the 'history of verified complaints'.
  Update: See comment on "verification" above. The term "odour risk matrix" has been changed to "odour potential matrix"

- There was a discussion on the addition of topography and prevailing wind direction to the matrix however there was a lack of consensus amongst delegates. It is likely that the wind direction will change depending on season and weather e.g. at Seafield the prevailing wind generally takes odour out over the sea however on hot days there may be stagnant, non-moving air.
  Update: the influence of topography and prevailing wind direction has not been included in the odour potential matrix. Reference has been made to the importance of considering these factors in Section 3.2.2.

- It was felt that there is no resource to apply this matrix at every site therefore the history of complaints will be where they start. As a tool for understanding current concerns it may be beneficial to have a flow chart to show where you start and the steps that need to do, i.e. where do as EHOs prioritise. However that is outwith the scope of the brief of the project. It will be up to Scottish Government to advise how they envisage this guidance should be used, and for regulators, Scottish Water and contractors to implement accordingly.
  - **Action:** Recommend that the matrix provides a framework for users but that there needs to be a discussion on how this will be applied.
    Update: Comment added in Section 2.
  - Also recommend review of call handling procedure/phone logging form including taking e-mail addresses and targeted approach on number of complaints.
    Update: Comment added in Section 3.8.1

Case Studies – Dr Mark Broomfield

The following bullet points summarises the discussion that took place following the case studies presentation:

- Members of the public can distinguish between sewage smell and other odours. Those who have lived near the site for a while don't tend to complain however some new residents may complain as they are not used to it. Also sewerage odour has a particular resonance with the public and may not accept that odour is from another source
  Update: Reference made to sewerage odours in 3.8.1

- There can be network issues; after a dry season and the first flow there will be complaints as there are vented sewer covers. It was raised that when a customer phones Scottish Water the call handler follows a script i.e. is there a WWTW nearby? There isn't a discussion about the network. It was agreed that the level of investigation only depends on the information given by the public.
  Update: Comment and recommendation added in Section 3.8.1

- Problem with sludge

- Code of Practice (CoP) doesn't specifically refer to storm tanks.

- The CoP also refers to 'minimisation' whereas residents expect 'elimination', which can make it problematic explaining that as a regulator / operator that everything has been done to minimise odour when an odour still exists. If the CoP is implemented then it does make a difference e.g. only 1 complaint in July and 2 in August compared to hundreds before however the residents aren't buying into it. It would be beneficial for short document for residents to summarise the CoP and make it more understandable.
  - **Action:** Scottish Government may wish to consider producing a summary guide to the CoP for members of the public

- There was discussion on how often and associated time and costs of when an odour survey is carried out. Currently it's done as and when; there is a duty to respond when there is a complaint so will try and deal with in real time (if possible) by sending out an officer to smell. In favourable circumstances (e.g. Seafield site, where there is a Council laboratory at the sewage works site), this can be achieved in as little as 10 minutes. Timewise it takes about an hour and a half to do full circuit of monitoring locations around the Seafield site.

- It was noted that if an odour moves up the political agenda (i.e. because residents contact their Elected Member) then monitoring may need to increase. There would be a cost associated with increased monitoring, that would need to be agreed as an additional spend, or allocated within operational budgets.

Dalmuir WWTW: Frederic Carbonnier: Saur Dalmuir

- There was discussion on extra capacity for storm water. It appears that Seafield is the only site in Scotland with extra tanks but that is due to the money being spent to manage odour.

- Delegates were asked if operators meet up with the network providers to discuss odours that don't arise from the WWTW plant but from the network? Yes and there has previously been discussion for some form of CoP for networks but there wasn't the appetite to have one; statutory nuisance would not apply because odour from sewerage networks is not released from a premises as specified in the nuisance regulations.

Discussion Session 1: Controlling by managing sewage treatment process

- When a site is compliant from the outset then it's generally going to be fine all across the process. There needs to be action up front to ensure the front end of the process is correct. It is when things go wrong that you need to start investigating why/how it is wrong i.e. firefighting. There is a knock on effect if one thing goes wrong. The front end of the plant must work correctly. This is reflected in the integrated approach to odour management exemplified throughout the report

- There needs to be public engagement; it may not necessarily be a compliance issue or odour from WWTW. You need to show the community that you are complying with the odour management plan.
  Update: Comment added to Table 9 measure 2

- There was recognition at one site that improvement work had to look at the inlet works; therefore they had to be fixed at the same time as the odour improvement i.e. the work had to be done as a package. This is reflected in the integrated approach to odour management exemplified throughout the report

- Nothing had to be changed or included in the 'Process Management Table'.

- Delegates were asked what chemicals were used, e.g. some sites use ferric sulphate or ferric chloride to form a complex with incoming waste. Other chemicals have been used e.g. hydrogen peroxide, potassium permanganate. At one site a large volume of chemicals is used because of their small footprint. Using ferric sulphate does have disadvantages including chemical cost, potential risk of explosion depending on amount of ferric and downstream systems, other H&S risks, SEPA discharge limits and creation of more sludge. It was commented that ferric sulphate is not always the preferred option.
  Update: comment in 3.5.1 expanded to reflect discussion

- A discussion on H&S considerations followed. With regards to the storm screens as soon as you cover something you create a confined space, and a lot of consideration needs to go into the risks associated with the confined space from the perspective of monitoring performance, maintenance etc. If working in a closed building then there needs to PPE breathing apparatus and ensuring the temperature isn't too high for workforce. Total shutdowns are an option but can open doors which can create an odour but you need to find a balance. You need to ensure that none of the buildings create an explosive environment (under DSEAR) e.g. methane from untreated sludge.
  Update: comment in 3.6.1 expanded to reflect discussion
  Discussion Session 2: Effective communication and public engagement

- It is important that the public is aware of the actions taken to remove odour through careful, scientific explanation however it is a slow process as it has been found that if one issue is resolved members of the public will move on to a different issues.

- Operators and regulators do have meetings with all stakeholders however non-PFI sites do not necessarily communicate with the public well. It was agreed that there is a lot to gain if you proactively engage with the public when something goes wrong (covered under Table 9 Measure 3).

- There was discussion on using social media to communicate. This would have to be maintained at a corporate level but more work needs done to hone the message
  Update: reference to social media added to Table 9 measure 8

- Communication is a good thing particularly if there is a problem or maintenance is being carried out. The difficulty is when people buy houses in an area their expectation of what they want may not meet what can be physically done at the plant.

Discussion Session 3: Monitoring methods, their applicability and abatement

- Unless there is some form of adequate ventilation / extraction then tanks will rot as you are dealing with a very corrosive environment. In terms of a skip then it may work as it's emptied within a day; it won't work for permanent installations. Also simply covering skips may not necessarily work but there is perception benefit and it also stops seagulls taking things off site. Update: comment expanded in 3.5.1 and 3.5.2 to reflect discussion. Options for covering without ventilation removed from Table 4

- Staffing costs also need to be taken into consideration e.g. a technician that does a check first thing in the morning or a night shift.
  Update: comment expanded in 3.7.2 to reflect discussion

- In terms of capital investment there are constraints in terms of budget cycles and that needs to be recognised. Also covering channels can work but there is still an odour.

- In terms of odour treatment processes there can be a problem due to displaced air from tanker discharges; as tankers are all different sizes there is not an industry standard size extraction unit that could be used; at present Shieldhall is the only place a tanker can be discharged in an enclosed environment.
  Update: comment expanded in 3.7.2 to reflect discussion

- With regards to sludge cake exporting one site employs a bespoke treatment where it is treated before going on the lorry
  Update: comment expanded in 3.5.1 to reflect discussion

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