



Scottish Water

Seafield Wastewater Treatment Works Strategic Odour Review

Draft Summary of Findings and Recommendations



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Environment
& Infrastructure UK Limited**

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Report for

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1. Introduction

1.1 Purpose of this report

This draft summary report has been produced for the purpose of identifying the key findings and recommendations arising out of the Strategic Review conducted for the Seafield WwTW site in Leith, Edinburgh. It is made available for the stakeholder meeting on Friday 27th October 2017.

As a result of continuing and increased numbers of complaints from the local community in Leith about malodours emanating from the Seafield WwTW site, from 2013 to date, the Scottish Government and Scottish Water commissioned Amec Foster Wheeler and Cranfield University to undertake a strategic review of the operation, design and maintenance of Seafield WwTW and the sewer network that serves it.

The Terms of Reference for the review were drafted by Scottish Water and the Scottish Government and consultations were held with a wide range of stakeholders prior to final agreement and issuing to Amec Foster Wheeler and Cranfield University. A copy of the Terms of Reference is contained in Appendix A of our main report.

1.2 Review Scope

In brief, there were two distinct and related themes to the review:

- ▶ An evidence-based evaluation of the performance and operation of the sewerage network and WwTW assets in relation to odour generation and minimisation; and
- ▶ An engagement exercise with all stakeholders (Scottish Water, Regulators, the Local Community Council, elected representatives and local residents' groups) to elicit information on how odours from Seafield WwTW affect their lives.

The review process commenced in late June 2017 and was concluded in mid-October 2017. On 29th September, personnel from Amec Foster Wheeler and Cranfield University met with a range of stakeholders at Victoria Quay in Leith and presented their study methodology. The purpose of the meeting to provide stakeholders with an opportunity to comment on the methodology and to identify any additional matters for inclusion in the review.

2. Findings of the Review

2.1 Regulation of Seafield – the CoP, OMP and monitoring of the OIP

- ▶ The Seafield site is subject to a “dual regulation” regime in respect of odour: the waste water treatment works (WwTW) processes are regulated under The Sewerage Nuisance (Code of Practice) (Scotland) Order 2006 (CoP) by City of Edinburgh Council (CEC) and the sludge import and treatment centre (STC) is regulated under a Waste Management Licence (WML) by the Scottish Environment Protection Agency (SEPA).
- ▶ The odour management plan (OMP) compiled by the site operator (Veolia) covers the management and control of odours from both the WwTW and STC processes and both CEC and SEPA rely upon the measures in the OMP to assess compliance with their respective two regulatory regimes.
- ▶ Regulation of the CoP by the local authority requires the investigation of complaints. This review shows that the local authority responsibility to monitor and enforce the CoP is being undertaken with significant resource commitments and expertise by City of Edinburgh Council (CEC).
- ▶ Under the terms of the WML, Veolia has compiled and operates a Working Plan (WP), which contains cross-references to the OMP. This is the primary mechanism for management and control of odours from the STC. Seafield sludge treatment plant could potentially fit well under PPC Part A regulation. However, the “UWWTD exclusion” temporary holding position currently excludes these sludge treatment processes from falling under the Industrial Emissions Directive (and requiring a PPC/A permit). So, WML control will continue for the time being. This is perceived as a possible weakness in the regulatory regime, as WML control is not as stringent as regulation under a PPC permit.
- ▶ The Odour Improvement Plan (2008) (OIP) was developed under the requirements of the CoP and deployed an emissions modelling and cost/benefit approach when defining remedial measures for the preliminary and primary wastewater treatment processes. This method informed the design of mitigation measures resulting in a significant reduction in emissions and complaints. The OIP specifically targets the preliminary and primary wastewater treatment processes and not the sludge treatment processes.
- ▶ Requirements within the statutory odour Code of Practice (CoP) make provision for, “The Odour Management Plan (OMP) [to be] regularly reviewed and updated as new equipment or plant is installed... at least once in any 12-month period” (Paragraph 6(3)). It is clear that this is taking place and ongoing. However, use of an emissions inventory and dispersion modelling comparison exercise would have been advisable following completion of the OIP implementation, to review and evaluate the ongoing effectiveness of these controls.
- ▶ Serving a notice to enforce the legislation on nuisance requires the investigating officer to substantiate unacceptable odours off site; attribute the

odour to the site, i.e. from no other source; identify the failure leading to the emission, then define the outcome to be achieved to prevent odour nuisance. This is necessary to demonstrate nuisance. However, by default this is a 'reactive' process as opposed to a 'precautionary' approach. This is also a challenging exercise where the transient nature of intermittent, low-level, dispersing emissions makes demonstrating nuisance difficult.

2.2 Stakeholder observations and opinions

- ▶ Many positive characteristics of the neighbourhood were cited; the historical significance of Leith as an industrial area and working port; its strong connection with the history of social movements and the heritage of its industrial architecture. The sporting legacy and the history of Leith Links in establishing the rules for golf, plus in more modern times the role of the Port and hosting the Royal Yacht Britannia.
- ▶ Many residents spoke of their enjoyment of the local area, the presence of a local community and the qualities and strengths of being part of the community. This included newcomers as well as long-term residents.
- ▶ The Leith Links area, park and allotments are valued greatly as they provide opportunities for individual sport and teams, recreation, community and social events as well as educational activities within a densely populated area.
- ▶ There was general agreement that the OIP had made a significant reduction in odours. Prior to this, the Leith Links had a significant reputation for sewage odours from Seafield, which many described as horrendous. Stakeholders reported impacts prior to the OIP including watering and stinging eyes, having to close windows, unable to hang out washing, not using gardens, not inviting neighbours, visiting friends away from the area and householders leaving the area. Householders described the land and housing area affected extending beyond the Links, and at times covering much of Leith.
- ▶ For all of the householders interviewed in the Leith Links area Seafield WwTW continues to cause problems. However, there was general agreement that problems were less intense, with the worst instances caused by either, specific site instances, or aggravated by local weather or prevailing wind conditions, notably the Haar or sea fret, i.e., a cold sea fog where dispersion is significantly reduced and odours remain close to source.
- ▶ Where residents cited examples of specific incidents, notably sludge spills, the siloxane filter regeneration events and the April/May 2017 low flows, reports of the impact were consistent in their increased intensity. Impacts included, 'being woken up in the night', having to close windows at all times', 'hosting events for families and friends away from the house', not being able to 'hang out washing'. It is also relevant to note that the breadth of examples given including, cancelling barbecues & social events, personal reputation, use of gardens & gardening, children noticing odours, and the effect on visitors varied between respondents.
- ▶ An ongoing concern expressed by many individuals in the stakeholder interviews was the extent to which it was perceived that there was a poor

demonstration of control over operations to prevent odour emissions. Confidence in the reliability of odour control was poor, despite in some instances there being a good knowledge of the operational procedures reported to control odour.

- ▶ Experience of the complaints system reflected concerns about the split responsibility differing between ownership and operation as well as dual-regulation.
- ▶ Many interviewees expressed confidence in the attention given to responding to complaints and the professionalism given to complaint investigation. However, few expressed confidence in any improvement or there being a likelihood of enforcement resulting from complaining. It was evident that specific locations had notably high levels of complaints. These were suspected by many to match the exposure pattern and dispersion corridors of site emissions.
- ▶ Many reported frustration that 'an authorised officer' was required to attend in order to substantiate that an odour was present and causing a nuisance. This was recognised by some as an unavoidable requirement for a legal process, whereas others felt this conveyed a lack of trust of a resident's experience. Overall, a strong common view was that the community had to endure and report complaints before action, if any, would take place, i.e. a 'reactive' system of odour regulation, despite the CoP being in place.
- ▶ Some respondents amongst the household groups were aware of the dual-regulation by the local authority and SEPA. All those aware of this expressed concern about the consistency of approach and information sharing. These concerns were also expressed by many non-resident respondents. Amongst some members of the community there was concern about the lack of transparency over decisions to serve a notice or prosecute.
- ▶ The current complaint system was often reported as time consuming and slow, particularly when compared to the transient nature of odour emissions during 'low-level' incidents. Examples were given where individuals had not bothered to complain where they had in the past. The reasons cited were the time taken and low expectation of change, i.e., complaint fatigue. Feedback on the final outcomes of complaints were often reported as 'limited'. Other respondents explained how they had been encouraged to complain, particularly recently to ensure there was a record of impact. The majority expressed an increased likelihood of complaining again if odours persisted.
- ▶ When asked about what would be recognised as improvement, 'no odour' was the common statement. However, a number of people also explained that a marked difference from low-level persistent odours and control over major incidents would be noticed.

2.3 Operation of Seafeld WwTW

- ▶ The site operator, Veolia, on the basis of our site inspections and discussions with managers and operatives over the period late June 2017 to end September 2017, is in good day to day control of the Seafeld site.

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- ▶ All staff are familiar with the contents of the OMP and are aware of the pressing need to control odour emissions from the site and to ensure that operations are strictly in accordance with the OMP.
- ▶ The OMP is comprehensive, was last updated in November 2016, and provides an acceptable level of detail in respect of odour risk assessment of individual unit processes and activities. In particular, the sections on Operational Maintenance Site Tours to control odour are detailed and explicit.
- ▶ There is a good system of “odour relevant” procedures in place, including:
 - ▶ The daily site inspection check list;
 - ▶ The odour assessment check sheet;
 - ▶ The odour site investigation procedure;
 - ▶ The odour complaint investigation report;
 - ▶ The operational procedure for odour sensitive tasks
- ▶ Odour incidents caused by new equipment and processes are dealt with ‘reactively’ by identifying the cause, defining and implementing mitigating measures that then lead to a reduction in odour. A more pro-active approach to assessing the risks of odour from these sources is recommended. Incidents such as sludge spills and digester gas pressure releases could have been foreseen and prevented.
- ▶ The review of current site controls shows that these are understood by managers and operators, in use and appropriate. However, it is evident that there is a lack of awareness of the significance of low-level emissions off-site. These are not addressed specifically within the OMP, other than through best practice operation of the WwTW and STC processes.

2.4 Analysis of odour complaints

- ▶ There are strong links between odour complaints, onshore winds, periods of low raw wastewater flow in April-May 2017, raw wastewater septicity levels, readings from the boundary H₂S monitors and sludge blanket levels in the primary settlement tanks.
- ▶ During the exceptionally dry April-May 2017 period, there were elevated baseline odour emissions from the open processes (detritors, PSTs, ASP, storm tanks), owing to low wastewater flows and septicity in the incoming wastewater. This low level of rainfall (4 mm in April 2017) is very unusual. However, there are other months from 2012 onwards with peaks in complaints where, for the majority of days, there was no or very little rainfall.
- ▶ This primary cause of odour during April and May 2017 was compounded by increasing sludge blanket depths in the PSTs, sludge spillages and unplanned digester gas releases. This does not, in our opinion, represent best practice operation of Seafeld WwTW during this period.
- ▶ Emissions of odour from regeneration of the resin filter of the PpTek biogas siloxane removal unit have, in the recent past, contributed strong and

noticeable odours in the Leith residential areas. A vent air burner has now been commissioned (July 2017) and this thermally oxidises the emissions from the siloxane filter regeneration in a high-temperature enclosed flare.

2.5 Network

- ▶ Fugitive emissions of wastewater odours from manhole chambers and pumping stations in the sewerage network serving Seafeld WwTW are a possibility but there is no firm evidence that these could be the source of complaints from the community. The vent pipe on the 1889 Water of Leith sewer on the Ropeworks development site could be a source of odour but it has not yet been determined if it is still connected to the sewer.
- ▶ Trade effluent discharges make up approximately 3.8% of the total daily wastewater flow into Seafeld WwTW and approximately 6.7% of the polluting load, expressed as BOD₅. There are no evident discharges of particularly odorous chemicals that could significantly influence odour emissions from Seafeld WwTW. The results of check monitoring on samples of trade effluent indicated a very high level of compliance with the consented discharge limits, with a few minor exceptions.
- ▶ It is known that sludges are discharged into the network: primary sludge at Prestonpans pumping station and surplus activated sludge at Penicuik.
- ▶ A survey of H₂S levels in manhole chambers at four locations in the sewer network during September 2017 identified relatively modest concentrations over this period, notably at Wallyford, the Siphon House and Portobello, where similar-timed peaks in H₂S levels were observed, coinciding with rainfall events and increased flow turbulence in the sewers. H₂S levels at MEPS, the main lift pumping station at Seafeld WwTW inlet, were negligible over the same period.

2.6 Wastewater treatment processes

- ▶ Examination of measured odour emissions from unit processes at the Seafeld WwTW site identified two past surveys (WRc in 2003/4 and Mott MacDonald in 2013). Neither of these is representative of how the site is operated today. A further emissions survey was conducted in September 2017.
- ▶ The results of the surveys were compared against each other and with typical values contained in UKWIR¹ and our own in-house odour emissions database for WwTW sites in the UK. The lowest odour emission rates were found in the 2017 survey, the highest in the 2013 survey, with the 2003/4 survey results between these former two.
- ▶ A review of the proportional contribution of the individual unit process to off-site odour concentrations has identified that the PSTs and storm tanks are high-risk in terms of the potential for triggering off-site odour complaints. For the PSTs, this is because of the large surface area of exposed wastewater and emissions from the sludge uplift carbon filters and their sensitivity to the quality of the incoming wastewater and the sludge blanket levels in the tanks. For the storm

¹ United Kingdom Water Industry Research

tanks, although the procedures now adopted by the site operator for emptying and cleaning will minimise the risk of odour annoyance, there is still the risk of this occurring, given the time-in-use of the storm tanks during a typical year and the scale of the likely odour emission rates.

- ▶ The ASP and FSTs, under normal operational circumstances, are not considered to present a significant risk of causing annoying odours off-site, given the relative inoffensiveness of odours from these sources. This observation is consistent with our experience of such unit processes elsewhere in the UK.
- ▶ It is considered, from observations made during the course of this review, that there is definite potential for fugitive odours to escape from the sludge cake pad building, based upon odours experienced at the adjacent site boundary and odours noticed on Leith Links under light onshore wind conditions in July 2017.
- ▶ Observations of sludge deliveries by road tanker revealed that, at the end of the tanker discharge period, there was a period of a few minutes when air was discharged from the tanker body direct to atmosphere. In addition, because of the arrangement of the coupling pipework from the sludge tank inlet valve to the tanker, there was an inevitable small spillage of sludge when the flexible pipework was disconnected. However, during all the observations, the spillages were cleaned-up quickly by the tanker drivers;
- ▶ The odour control units on the site have been found, in general, to be operating efficiently, with a number of small exceptions, and are not considered to present a significant risk of causing annoying odours off-site.

2.7 Dispersion modelling to assess the impact of Seafield

- ▶ An updated odour dispersion model for the Seafield WwTW site has been compiled and has been used to assess the impact upon residential areas in Leith of the different sets of emissions referred to above. This shows that, for the residual "Option A" abatement scenario WRc emissions, there would still likely be sufficient levels of odour in the community to prompt complaints.
- ▶ Turning to the emission levels measured in 2013, these produce an odour "footprint" larger than the 2003/4 emissions. Use of averaged emissions from our in-house database produces a footprint somewhere between the two.
- ▶ However, it should be noted that these two above odour emissions "scenarios" are not representative of the site as it is today. When the model is run using the measured emissions from the September 2017 survey, a much smaller footprint is derived.
- ▶ The results of this modelling show, in essence, that odour concentrations in the Leith residential areas at times have been at levels that would likely generate annoyance and complaints, even taking into account the low level of emissions measured in September 2017.
- ▶ This is not a continuous occurrence – these odour concentrations would only arise when the wind is in an onshore direction, which occurs for approximately

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25% of the hours in a typical year and then, only when the wind speed is relatively low and emissions are at a level sufficient to produce odour concentrations off-site likely to generate complaints. In addition, the modelling assumes that the emissions remain constant throughout the year. In reality, these will vary from day-to-day, depending upon weather, wastewater flow and operating conditions. It is noted that there were no recorded complaints in August 2017 and two complaints in September 2017

- ▶ In summary, therefore, there exists the potential, under onshore winds and varying odour emission rates from the unit processes (particularly the PSTs, storm tanks and, to a lesser extent, the detritors), for odours at annoying levels to occur in Leith from time to time. Earlier this year, this was exacerbated by a long dry period and other, uncontrolled releases of odour. These latter emissions should be controllable, moving forward. However, the risks of odour arising from the remaining uncovered sources remains.

3. Recommendations

3.1 Overall regulatory context

We are aware that Scottish Water operates within a regulatory framework established by the Scottish Parliament in which Scottish Ministers, acting on behalf of the people of Scotland, set the objectives for the industry to be delivered at least cost to customers. A key player in this regulatory framework is Scottish Water's economic regulator, the Water Industry Commission for Scotland. The Commission is a non-departmental public body with statutory responsibilities. Its role is to manage an effective regulatory framework which encourages the Scottish water industry to provide a high-quality service and value for money to customers. It acts independently of Ministers.

The current regulatory control period runs over a six-year period from April 2015 to March 2021. The next period runs until 2027.

There are also cost and benefit issues to consider, particularly in relation to some of the measures that could possibly be implemented in the medium term. For example, if there were to be a longer-term vision for major redevelopment of Seafeld WwTW and STC, either on the current site or on a new site, it may not be cost-effective to implement medium-term solutions if these issues would be solved by longer-term measures. That precise balance of costs and benefits is for Scottish Water and the Scottish Government to consider.

With this in mind, we have made our recommendations on the basis that short-term measures to improve the odour climate around Seafeld WwTW, that is, over the next 0 - 2 years, will be unlikely to feature any high-cost capital measures. Rather, the thrust of the recommendations is focused upon generating evidence-based proposals to coincide with future capital investment that could be considered for the next regulatory control period(s). Therefore, short term measures focus upon a 0 to 2 years' time scale, medium term means 2 to 7 years (7 years being the middle of the next regulatory control period) and long term means 7 to 20 years. This is explained in greater detail in our main report.

3.2 Summary of recommendations

Short-term measures

These are focused upon the next 2-year period and involve a combination of measures to address odours from the sewer network, Seafeld WwTW and STC and a set of engineering and technical feasibility studies, incorporating cost/benefit assessments, which would feed into and facilitate medium-term and long-term measures. These cover engineering and technical capital matters, operational aspects and communication.

Sewer network

- ▶ Develop a contingency plan for dosing the network at key locations during periods of low or no rainfall to alleviate septicity, with the objective of having this in place for Spring 2018.

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- ▶ Re-commission and implement the Nutriox dosing installation at Wallyford. Re-commissioning the Nutriox dosing would reduce septicity in the downstream network.
- ▶ Install and implement ferric chloride dosing facility at MEPS. This can be used to mop-up sulphide in the incoming wastewater and reduce odour emissions from the PSTs during treatment.
- ▶ Install H₂S monitoring at the Siphon House. Ferric dosing at MEPS to "mop-up" generated sulphides in the incoming wastewater (see above item) could be controlled by monitoring at the Siphon House.
- ▶ Investigate further the status of the vent pipe on The Ropeworks development site. A search of Scottish Water plans and documents has revealed little and the construction company on the Ropeworks site is unaware of the status of the vent. A detailed search of Scottish Water archives will be needed to ascertain exact status, possibly also involving intrusive investigations.
- ▶ Undertake an initial feasibility and cost/benefit study for providing treatment of wastewaters at intermediate points in the network. This should focus upon the provision of secondary treatment at Wallyford (additional land required and note that new-build residential is already encroaching closer to the site) and also for the coastal towns network. Land availability and acquisition and public acceptance will be significant issues.
- ▶ Extend the septicity survey in the sewer network. A 10-day survey was conducted at four locations in September 2017. With the acquisition of the OdaLog instruments, Scottish Water has the ability to conduct additional studies which will feed into the dosing locations and intermediate treatment studies.
- ▶ Review the practice of feeding sludges into the network at Prestonpans and Penicuik in the light of the above sewer network septicity survey.

Seafield WwTW and STC – technical & engineering

- ▶ Engineering and cost/benefit feasibility study for conversion of the storm tanks to sequential and selective filling and for installation of automated cleaning procedures (scrapers, AmJets, SwingJets).
- ▶ Engineering and cost/benefit feasibility study for reconfiguration of Primary Settlement Tanks (PSTs) – identification of alternative processes and options for providing enclosed or covered process.
- ▶ Carry out a detailed ventilation, air flow and damper evaluation of the current covered and extracted areas of Seafield WwTW (inlet works, PST weirs & launders, inlet channels, secondary pumping station, ASP main distribution chamber, ASP sub-distribution chambers).
- ▶ Undertake a review of sludge storage capacity on the Seafield site and determine what additional capacity is required. In the majority of cases where high PST sludge levels have occurred, this has been a consequence of issues with downstream processing or storage capacity. Additional storage, even of a temporary nature, with appropriate odour control, is desirable.

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- ▶ Carry out a detailed air balance and ventilation study on the sludge cake building to identify improvements to achieve better containment of air during normal operation.
- ▶ Undertake a detailed review of the quality of sludge thickening and dewatering liquors and their potential impact upon odour emissions from the PSTs. Identify options for pre-treatment prior to return to the wastewater flow upstream of the PSTs.

Seafield WwTW & STC - operational

- ▶ Introduce a tight H₂S emission limit value (of the order 0.1 to 0.5 ppm) on the measured emissions from the air uplift carbon filters on the PSTs. Measured H₂S concentrations during the September 2017 site survey were 5.1 ppm on PST 3 and 7.8 ppm on PST 5. Odour concentrations were 41,868 and 48,900 ouE/m³ respectively.
- ▶ Carry out annual odour emissions surveys and dispersion modelling to assess the ongoing odour footprint of Seafield WwTW and STC.
- ▶ Develop or acquire a medium-term (1-10 days) weather forecasting system form which it is possible to identify forthcoming dry periods.
- ▶ Develop a HAZOP-type odour risk identification procedure for any changes in plant/process operation or introduction of new processes on-site.
- ▶ Carry out a sludge tanker drivers' odour education and awareness induction programme and ensure that new drivers are identified and inducted.
- ▶ Following the annual emissions survey, review with the Odour Liaison Group what additional controls to employ if 5ouE/m³-98 percentile exceedances occur. Where necessary, prioritise measures to bring the site to within these limits.

Seafield WwTW & STC – communication

- ▶ Develop an interactive web site for Seafield WwTW for secure public access. Publish a regular newsletter about the site and personnel and celebrate successes and challenges. Provide access to odour and process-related reports, including data from the boundary monitors and also performance data for processes and OCUs. Publish the minutes of liaison meetings. Conduct annual surveys of public experiences and attitudes.
- ▶ Consider adding a real-time odour dispersion model display to the web site.
- ▶ Develop the complaints response system to be more response-friendly and to provide more positive information.
- ▶ Publish anonymised complaint records alongside key on-site performance data and weather patterns, e.g. sludge levels, onshore winds, low wind conditions.
- ▶ Within the future vision for the site, consider plans for educating schools, colleges and HE institutions about water treatment, process engineering and pollution control.

Medium-term measures

- ▶ Depending upon the outcomes of the feasibility study, identify options for the conversion of storm tanks with scrapers and SwingJets to automate cleaning and enable sequential filling. Eventual covering of tanks may be considered.
- ▶ Identify options for re-development of sludge cake/dryer buildings. This would involve clearing-out of the redundant equipment from the former dryer building, establishing an incoming/outgoing sludge transport vehicles airlock system, upgrading the air extraction and abatement system, re-organising the sludge cake discharge arrangements, so that sludge discharge directly into covered/enclosed skips (to avoid current practice of double-handling).
- ▶ From the outcome of the review, identify options for provision of additional sludge storage capacity at Seafield WwTW, should this be deemed necessary.
- ▶ Contingent upon the conclusions of the feasibility study, identify firm options for a phased approach to redevelopment of the open PSTs at Seafield with either covered or enclosed, high-rate, small footprint settlement processes, with additional odour abatement plant.

Longer-term measures

- ▶ Depending upon the outcomes of the feasibility study, identify options for provision of intermediate wastewater plants in the vicinity of Wallyford and for the coastal towns.
- ▶ Develop a long-term vision and strategy for the Seafield site, involving re-development of the entire Seafield WwTW site, either with or without accelerated asset replacement, with replacement of each of the preliminary, primary, secondary and tertiary wastewater treatment processes and sludge treatment processes, with state-of-the art high-rate, low footprint, low energy processes. The re-development would proceed based on an architectural competition design brief, incorporating sustainable construction practices and materials and designing-in renewable energy (wind, solar, biogas) generation, with added potential for gas clean-up and grid injection. The site would be compatible with potential future planned land uses in the Port of Leith area and could be a flagship development for Scottish Water, the Scottish Government and the local community including schools and higher education. It is also consistent with the future vision planning of the Leith area.

Review the potential relocation of Seafield WwTW and STC to a site remote from population (greenfield/brownfield) and establishment of an entirely new treatment facility.

