Seafield WwTW

inlet works and odour improvement projects at the largest wastewater treatment works in the east of Scotland

by Daniel Rudd

Seafield WwTW is the largest treatment works in the east of Scotland, treating waste for a population equivalent of approximately 850,000 people from Edinburgh and the surrounding area. This equates to 300 million litres of wastewater every day – enough to fill 121 Olympic sized swimming pools. Treating this amount of waste in one location generates issues and concerns from the local community. The primary issue was the existing odour problem, followed closely by the effectiveness of the existing inlet works. A £multi-million Odour Improvement Project was approved by the City of Edinburgh Council in May 2008.

Odour control ductwork into the new main odour control unit at Seafield WwTW - Courtesy of Scottish Water

Introduction to the projects

The Odour Improvement Project (OIP) included the provision of a new odour control system which covered the areas of the plant that represent the primary sources of odour, extracting the air, treating the air using a two-stage chemical and activated carbon odour control unit and finally discharging the cleaned air through stacks.

The Inlet Works Improvement Project (IIP) included the installation of new coarse screens and upgrading of the existing fine screens, complete with screenings handling and replacement of the grit classification arrangement. This work was needed to improve the ability of the inlet works to cope with the increased quantities transferred to the plant during heavy rainfall or storm conditions.

The upgrade to the inlet works would have a major positive impact on the overall performance of Seafield WwTW. The removal of more debris and grit at the preliminary treatment works led to a reduction of the wear and tear on other parts of the treatment works along with reducing the potential to produce odour.

Odour Improvement Project - background

Seafield WwTW treats wastewater from Edinburgh and various satellite towns, as well as a substantial amount of trade waste. The works consisted of preliminary, primary and biological treatment as well as disinfection for a proportion of the flow. Discharge is via a long-sea outfall.

Complaints regarding odour emissions from Seafield WwTW had been received over many years. Extensive investigations into odour emissions at the works were carried out by WRc in 2003 and 2004 to identify and quantify the sources of odour. The data collected from the investigation in 2004 was used to estimate the odour emission rate for Seafield for the four seasons (2004 Base Case).

Following this investigation, the secondary treatment pumping station was covered, but the air was not extracted or treated. The resultant total odour emission rate for the site (referred to as the Revised Base Case) was calculated to be 15% less than for the 2004 Base Case.

Following on from the odour source investigation, a number of odour abatement options for reducing odour emissions from the works were identified by WRc in 2004. The options were modelled by WRc in 2005 to determine the reductions in odour emission and impact on the local area. The results were presented in WRc Report UC6809 *'Odour Emissions from Seafield WwTW – Stage 2 Report'* (Hobson et al, 2005). A number of the odour abatement options were included by Scottish Water and Stirling Water in the OIP for Seafield WwTW, which was produced in March 2007.

Odour treatment is provided for a number of sources including the picket fence thickeners, sludge treatment building and PST air lift desludging system. There were two existing odour biofilters and an activated carbon unit on site.

The OIP was developed to comply with the Code of Practice (CoP) on Sewerage Nuisance, Assessment and Control of Odour from Wastewater Treatment Works, and contained measures aimed at improving odour performance by the progressive covering of odour sources. This OIP was approved by City of Edinburgh Council.

Solution

The objective of the design was to achieve a defined level of odour concentration leaving the stack based on collecting and treating odours from prescribed areas.

The proposed solution involved covering and treating the odours from the following areas:

- Inlet works
  - Marine Esplanade Pumping Station (MEPS).
  - Diversion structure.
  - The 5 (No.) coarse screens, 5 (No.) fine screens and associated channels.
  - Screenhouse building.
  - Screenings drainage pumping station.
  - 2 (No.) PST distribution chambers.
- 6 (No.) PST perimeter weirs.
- PST outlet channels.
- Secondary pumping station.
- ASP main distribution chamber.
- 2 (No.) ASP sub-distribution chambers.
- 6 (No.) digester tank spill chambers.

These areas were covered, air extracted, ducted and treated in two Odour Control Units (OCU): the main OCU and the digester spill chamber OCU.

Design solution for PST perimeter weir covers

The PSTs are approximately 50m in diameter and include half bridge scrapers and perimeter outlet weirs. The PST scraper bridges incorporate a rotating brush screenings-removal system and in addition, there is internal ladder access within each tank.

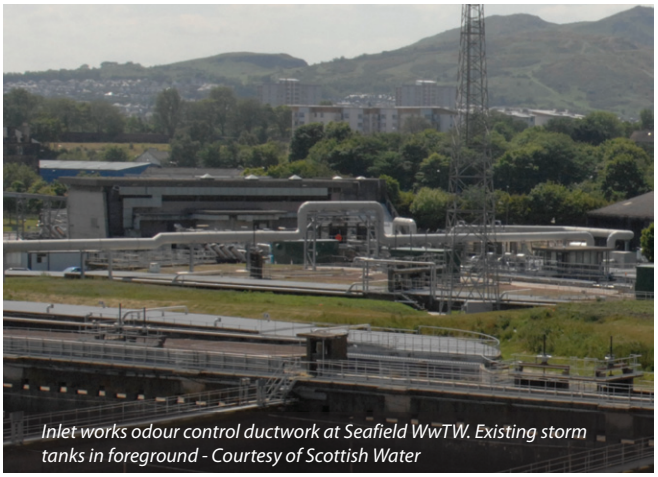
The project requirement was to provide odour control covers which were designed to allow access along the length of the perimeter weirs for inspection and cleaning by operations. The covers were designed to enable current scraper bridge operation to be maintained.

The original design proposal was to provide rotating covers fixed to the rotating half bridge scraper, however, initial design issues were highlighted with regards to the suitability of the existing bridge to incorporate the additional loads which would be imposed by the covers.

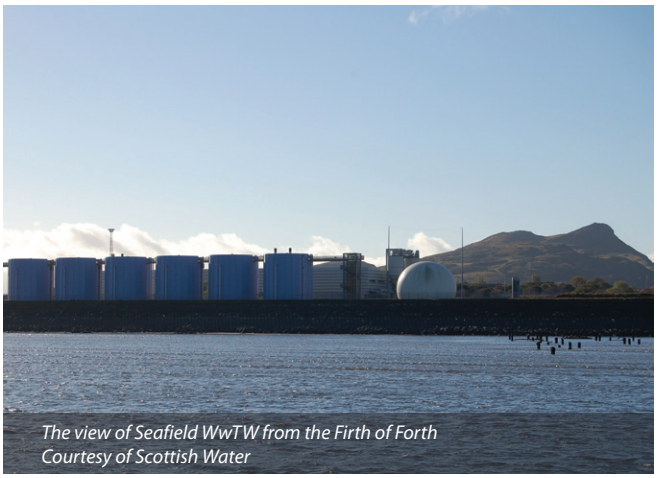
Prior to contract award, MWH undertook a number of on-site trials to identify a more suitable solution. Following manufacture of three different prototypes it was agreed, with Site Operations and Stirling Water, that a fixed cover option could be a suitable alternative. This

The final settlement tanks at Seafield WwTW - Courtesy of Scottish Water

New main odour control unit at Seafield WwTW Courtesy of Scottish Water



Inlet works odour control ductwork at Seafield WwTW. Existing storm tanks in foreground - Courtesy of Scottish Water



The view of Seafield WwTW from the Firth of Forth Courtesy of Scottish Water

design incorporated a brush seal through the centre of the cover to enable the existing weir cleaning brush to remain operational. Further to this, eyelets were provided on each cover around the tank to ensure that the weirs could be inspected from outside of the tank.

Main OCU

The main OCU treated air from the inlet works, all open channels (including storm channels) up to secondary PS, PST distribution chambers and weirs, secondary pumping station and ASP distribution chambers.

		Average	Peak
Extraction Flow	m^3/s	13.6	
H_2S	ppm	2.7	14.2
Mercaptans	ppm	0.4	1.0
Ammonia	ppm	0.2	1.1
VOCs	ppm	3.3	5.8
DMS	ppm	0.5	1.0
Contaminant	**Maximum discharge concentration**		
Odour	2,000 OU/m^3		

The odorous gas enters the packed tower and is contacted counter-currently with the scrubbing liquor (a solution of sodium hypochlorite stabilised with sodium hydroxide) over the mass transfer media.

Hydrogen sulphide, dimethyl sulphide, mercaptans and other soluble odorous compounds are absorbed into the liquid phase. Liquor saturated with odour compounds collects in the column sump where slow oxidation of the compounds takes place. The liquor in the column sump is recirculated back over the mass transfer media.

The liquor leaving the sump is dosed with 14.7% sodium hypochlorite and 32% sodium hydroxide solution to replenish liquor concentrations after the required oxidation reaction has occurred, and prior to the liquor re-entering the packed column.

A percentage of the recirculating liquor is wasted to keep oxidation products and carbonate levels below that at which precipitation occurs. The wasted liquor is discharged to the head of the works, via site drainage.

In order to comply with Code of Practice (CoP) on Sewerage Nuisance a polishing carbon OCU was added, located prior to the stack outlet.

Digester spill chamber OCU

The digester spill chamber OCU treats air from the spill chambers located on the outlet to each of the 6 (No.) digester tanks. Gas is passed through an annular bed carbon adsorption unit. Non-soluble VOCs and other odorous compounds, which cannot be

		Average	Peak
Extraction Flow	m^3/s	0.18	
H_2S	ppm	4	5
Mercaptans	ppm	0.93	1
Ammonia	ppm	6	7
VOCs	ppm	3	4
DMS	ppm	0	0
Contaminant	**Maximum discharge concentration**		
Odour	500 OU/m^3		

removed by the bioscrubber, are adsorbed onto the carbon, and thus removed from the gaseous phase. Air entering the carbon bed is pre-heated to reduce the relative humidity, and prevent damage to the carbon.

Inlet Works Improvement Project

The objective of the Inlet Works Improvement Project was to address the following key issues:

- High peak screenings loadings during first flush storm events caused overload of the screenings handling plant and screens. This led to opening of band screen back doors (allowing unscreened flows to detritors and downstream processes and equipment) and overwhelming of the screenings conveyance and handling systems.
- Physical damage to the fine screens and screenings dewatering plant, which results in high maintenance requirements.
- Band screen problems - labour intensive maintenance, back doors opening during storm events and grit build up upstream and within the band screen channels.
- High grit loading not being removed by the grit systems.
- Overflow screenings being diverted to the works drainage pump station and causing blockages in this area.
- Screenings from the compactors not effectively washed, grit not washed, and many channels not effectively covered.

The following works were delivered:

- Address any areas of current and potential odour release in conjunction with the Odour Improvement Project.
- The installation of 3 (No.) new 50mm bar spacing coarse screens and replacement of the existing fine band screens with escalator screens.
- Manually operated stone traps with lifting facilities for the channels upstream of the screen house.
- Improvement to the screenings conveying and distribution systems to reduce blockages and overflow from the launders.
- Launder grit traps to reduce the wear and damage experienced on downstream screening conditioning plant.
- Replacement of existing screenings handling washpactor system and increase the screenings conditioning capacity with 7 (No.) 12m^3/hr washer/compactors for all fine screenings.
- Dedicated screenings drainage pump station to handle screenings conditioning units drainage flows and any screenings overflows in these areas.
- New grit removal pumpsets and altered pipework configurations.
- Automation of the grit pumpsets duty/standby operations.
- New grit classifiers with washing facility and return of waste liquors back upstream of the detritors.
- Relocation of the below ground MCCs for the grit systems to new purpose built above ground kiosks.
- Upgrade of the pressurised washwater supply to the inlet works area.

Summary

The £multi-million design and build Seafield WwTW Odour Improvement and Inlet Works Improvement Projects have both been delivered for Stirling Water by MWH.

The project is an excellent example of improving existing assets to reduce the negative impact a WwTW can have on a local community by creating a cleaner and fresher environment.

The Editor & Publishers would like to thank Daniel Rudd, Senior Proposals Engineer with MWH Treatment for providing the above article for publication.