Aldwarke STF Qualitative Odour Risk Assessment

Project reference: 331001762

Prepared for:
Yorkshire Water

Prepared by:
Stantec

Document reference number:
331001762-100.2801-5

Report Date

18th August 2022

Revision	Description	Author		Quality Check		Review	
1.0	First Issue	A Saunders	18/08/22	E Stewart	02/09/22		

Table of Contents

1.0 EXECUTIVE SUMMARY

An environmental permit application is being developed for Aldwarke Sludge Treatment Facility (STF) due to changes to the Environment Agency (EA) interpretation of the environmental permitting exclusion for Urban Wastewater Activities (under Environmental Permitting (England and Wales) Regulations 2016 (EPR) Schedule 1, Part 2, Chapter 5, Section 5.4). The EA interpretation now requires that anaerobic digestion (AD) plants with a treatment capacity of over 100 tonnes/day (t/d) are classified as installations for the purposes of EPR. Furthermore, it has been determined that, in calculating digester capacity, there shall be no distinction between imported or indigenous sludges. The Yorkshire Water (YW) Aldwarke STF exceeds the 100 t/d capacity limit and therefore it has been agreed that a new permit application is required in respect of Schedule 5.4 Part A(1)(b)(i) AD treatment activities currently operated on site.

As part of the permit application, an odour assessment is required to assess the risk of odours from Aldwarke STF on the surrounding area. This has been developed in the form of a qualitative odour risk assessment.

The qualitative odour risk assessment for Aldwarke STF has indicated that all considered sensitive receptors are exposed to either a negligible or slight adverse odour effect indicating no receptor is exposed to a moderately adverse odour effect or worse and that the odour effect of the site is considered not significant.

The YW complaints log recorded no odour complaints over the last five years for the site as a whole (i.e. the YW Aldwarke WwTW and STF).

For the overall site, it is considered that Aldwarke STF does not have an adverse odour effect on its surrounding receptors and therefore the odour effect can be considered not significant. As such, no additional odour mitigation is required above the existing measures already observed on site.

2.0 INTRODUCTION

A permit application is being developed for Aldwarke Sludge Treatment Facility (STF) due to changes to the Environment Agency (EA) interpretation of the environmental permitting exclusion for Urban Wastewater Activities (under Environmental Permitting (England and Wales) Regulations 2016 (EPR) Schedule 1, Part 2, Chapter 5, Section 5.4). The EA interpretation now requires that anaerobic digestion (AD) plants with a treatment capacity of over 100 tonnes/day (t/d) are classified as installations for the purposes of EPR. Furthermore, it has been determined that, in calculating digester capacity, there shall be no distinction between imported or indigenous sludges. The Yorkshire Water (YW) Aldwarke STF exceeds the 100t/d capacity limit therefore it has been agreed that a new permit application is required in respect of Schedule 5.4 Part A(1)(b)(i) AD treatment activities currently operated on site.

As part of the permit application, an odour assessment is required to assess the risk of odours from Aldwarke STF on the surrounding area. This has been developed in the form of a qualitative odour risk assessment.

3.0 SITE BACKGROUND

Aldwarke STF is a treatment works on the north bank of the River Don and located approximately 2.5 km northeast of the city Rotherham.

The works is located in an area of residential and commercial/industrial use. It is primarily surrounded by industrial areas and adjacent glass land. The industrial areas are located to the north, east and west with mixed industrial and commercial to the south beyond the River Don. The residential receptors are located to the north and south, mostly beyond the initial surrounding industrial and commercial receptors. The works location is highlighted in Figure 1.

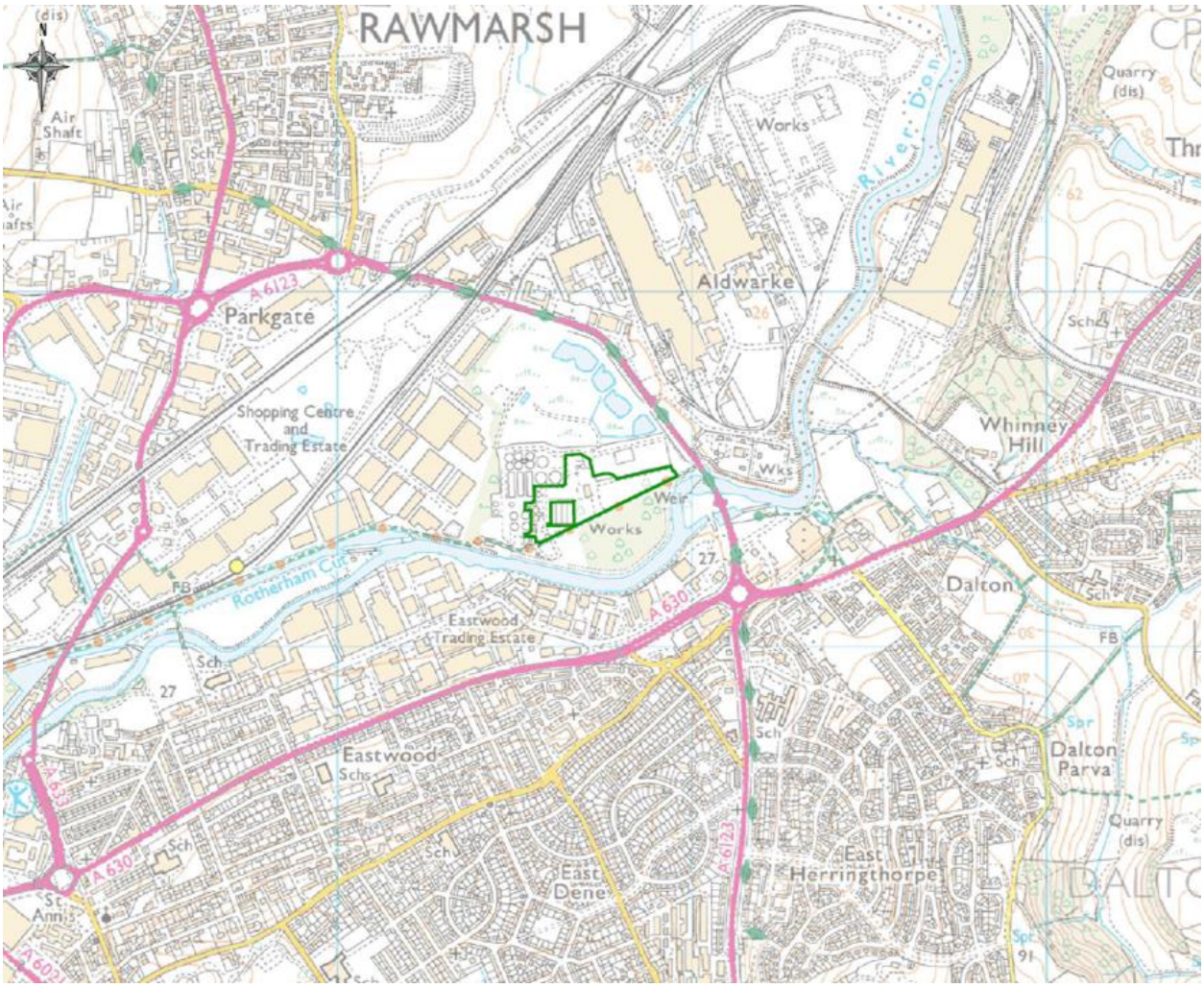

Figure 1: Aldwarke STF Site Location

4.0 PROCESS OVERVIEW

Aldwarke STF treats the following sewage sludges:

- Indigenous primary sludges and surplus activated sludge (SAS) arising from sewage treatment processes operating within the wider Aldwarke WwTW that are piped directly to the STF.

- Liquid sludges generated by other YW Wastewater Treatment Works (WwTW) (with lower capacity or capability for treating sludges on-site) that are imported to Aldwarke STF for additional treatment.

Imported liquid sludge is delivered to site by tanker, which would normally unload at the sludge import area. The maximum load is typically 28 tonnes with unloading taking up to 30 minutes. Only appropriately authorised vehicles can discharge at the site. This is controlled using a 'WaSP' logger; valves on the discharge pipework will only open when a driver presents appropriate authentication to the system. The WaSP logger records the source of the sludge, the time and date of delivery, the total volume discharged and average percentage dry solids of the load.

The existing (but currently unused) sludge import facility comprises two Huber ROTAMAT enclosed rotating screens to screen the sludge prior to transfer to a below ground concrete sump of approximately 80 m^3. Screenings drop into a skip and are disposed of off-site. Imported sludge is then passed forward to the thickener feed tanks.

Indigenous primary sludge and surplus SAS from the wider Aldwarke WwTW is pumped via below ground pipework into the thickener feed tanks (2 no. 1,493 m^3 open topped steel tanks). The liquid sludge is mechanically mixed; the tanks operate in parallel fill mode or operate in fill / draw mode i.e. one fills whilst the other empties.

Liquid sludge from the thickener feed tanks is then transferred to either the gravity belt thickener (GBT) building or drum thickener building via below ground pipeline. Forward feed of sludge to the drum thickeners and GBT is controlled via SCADA and each thickener unit can operate either individually or in any combination.

Within the GBT building, potable water is mixed with powdered polymer (stored in 25 kg bags) within the polymer make up tank (approximate capacity 1.5 m^3 steel tank), before transfer to a dosing tank (approximate capacity 1.5 m^3 steel tank). Both polymer tanks are located on a metal grid above a secondary containment sump within the GBT building. The polymer solution is dosed into the sludge stream and fed into the GBT (1 no.). From here the sludge migrates down the moving, porous belt where excess liquid is able to drain away, leaving the thickened sludge on the belt. Thickened sludge is then scraped from the belt and collected in the thickened sludge hopper. Sludge is typically thickened to 5-7% solids.

Air extracted from the GBT unit is discharged to atmosphere via a vent stack (approximately 6 m in height) adjacent to the north west side of the GBT building. Ambient air from the building is passively vented via louvres in the wall without odour treatment; ambient building air is not odorous under normal operating conditions due to the direct GBT extraction.

The resulting thickener liquor is transferred to the return liquor sump (underground sump approximately 80 m^3 capacity located adjacent to the sludge import facility). From this sump, liquors are pumped back to the WwTW for full treatment.

From the thickener feed tanks sludge is pumped via underground pipework to the drum thickener building. Liquid polymer is normally delivered to the thickener building in 1,000 litre IBCs, or alternatively may be delivered in bulk. The polymer intake point is located outside the thickener building; polymer is transferred for storage to a bulk storage tank (approximately 5 m3 capacity), is mixed with final effluent and transferred to the adjacent holding tank (approximately 2.5 m^3 capacity). Both tanks are GRP and located on a metal grid over a secondary containment concrete sump inside the building. The polymer solution is injected into the sludge stream before being introduced to the thickener drums (2 No.). The polymer encourages separation of water from the sludge as the sludge is rotated in the drum to remove excess liquid. The thickener liquor is transferred to the liquor return sump where it is mixed with the GBT thickener liquor (underground sump approximate 80 m^3 capacity located adjacent to the sludge import facility) prior to transfer back to the WwTW for full treatment.

Air extracted from each of the drum thickener units is discharged to atmosphere via a dispersion stack (approximately 5 m high) located adjacent to the north of the drum thickener building. Ambient air from the building is passively vented via louvres in the wall without odour treatment; ambient building air is not odorous under normal operating conditions due to the direct drum extraction.

The thickened sludge is transferred from the GBT and drum thickener buildings via above and below ground pipework into two digester feed tanks (2 no. open topped 500 m^3 concrete tanks). Sludge within the digester feed tanks is mechanically mixed. The tanks operate in alternate fill and draw mode.

Sludge is pumped from the digester feed tanks to the anaerobic digesters (2 no. 3,167 m^3 concrete tanks, approximately 347 m^3 of each tank's storage capacity is below ground). The anaerobic digesters operate as a continuous process with sludge being added at the bottom, with one tank feeding on the hour every hour and the other on the half hour every hour. Treated sludge extracted out of the top of the digester via the outlet pipe. The digesters are capable of feeding at up to 475 m^3/day combined at 6% dry solids giving a 12-day retention time as required by Hazard Analysis and Critical Control Points (HACCP) controls. The digesters are mechanically mixed.

Sludge extracted from the digesters is transferred via below ground pipe to two centrifuge feed tanks (1 x uncovered 700 m^3 steel/GRP tank (No. 2) and 1 x uncovered 700 m^3 concrete tank (No.

1)). In these tanks the digestate is mechanically mixed, to prevent settlement. The tanks operate as a fill/draw pair. From these tanks the digestate is piped to the centrifuge building, which contains one centrifuge.

The digested sludge is mixed with a polymer solution and then passed to the dewatering centrifuge where the sludge coagulates and supernatant liquor is removed by centrifugal forces. The final digested and dewatered sludge cake is dropped directly from the centrifuge onto a trailer prior to being transferred by tractor/trailer to the sludge cake pad. The cake pad is an engineered impermeable surface, with water runoff collected in drains running along edges of the pad. These liquids are pumped back to the WwTW (via the return liquor wet well (adjacent to the cake pad) and liquor balance tank) for full treatment.

Sludge cake is moved by mechanical loaders into storage rows on the cake pad area. There is no lime addition at Aldwarke; instead, cake is stored in piles according to age and is left for further pathogen reduction according to the Critical Limit in the HACCP plan. The maximum storage capacity of the cake pads is approximately 4,000 m^3; although significantly less than this is stored under normal operating conditions (normally up to approximately 1,500 m^3). Once treatment is complete, sludge cake is removed from site and landspread in accordance with legislative requirements. Samples of digested, matured cake are taken every 3 months and analysed for metals and pathogens to ensure HACCP standards are being met.

The cake pad also serves certain contingency functions, for both operations at Aldwarke and to wider strategic regional sewage infrastructure operated by YW. The cake pad may, under exceptional circumstances (such as the failure of assets or non-availability of normal disposal routes on a temporary basis) be used for storage of treated digestate produced at other YW sites, before being recycled to agriculture. Similarly, other contingency measures could require, under exceptional circumstances such as failure of assets, the interim storage of thickened or dewatered sludge on the cake pad, where that sludge originates from another YW site (or from Aldwarke operations), before that material then undergoes AD treatment in the STF at Aldwarke, or if necessary is removed for further treatment at an alternative AD facility. It is recognised that such operations are abnormal and would require initiation of site contingency operating procedures, with the intention of minimising any potential short term adverse environmental effects and returning to normal operations as soon as practicable.

5.0 METHODOLOGY

This qualitative odour risk assessment relies on subjective judgement but uses the generic guidance methodologies provided and referenced in documents such as the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Odour for Planning, the Scottish Environmental Protection Agency (SEPA) Odour Guidance 2010, the Environment Agency's Horizontal Guidance Note 1 H1 Environmental Risk Assessments for Permits, and Annex A of H1 – Amenity & accident risk from installations and waste activities.

These guidelines use the Source-Pathway-Receptor concept in which it evaluates the relationship between source(s) of odour, the pathway or transmission route by which exposure may occur at a given receptor(s) who may be affected/impacted.

How well a qualitative odour risk assessment predicts the odour impact for a scenario is dependent on how well the Source-Pathway-Receptor approach can be assessed and scored. This type of assessment is based on subjective judgement and therefore, robust assessment criteria are required. Where subjective judgement for a criterion could be considered broad, sub-criteria have been determined to provide a more detailed judgement.

The below sections outline the assessment criteria for each key area and how it will be applied.

5.1 SOURCE ODOUR POTENTIAL

The odour potential of a source can be broken down into three key considerations:

- How inherently odorous the compounds present are.
- The unpleasantness of the odour.
- The magnitude of the odour release

When trying to determine the offensiveness of an odour source, site-specific odour sampling should be considered in the first instance. In the absence of source odour emission data, the assessment criteria will consider the Environment Agency's Horizontal Guidance Note (H4). H4 looks to categorise how offensive odours are with sources/processes/activities that are considered 'most offensive' odours include septic effluent or sludge and biological landfill odours. All raw sludge treatment processes would be considered to have a high odour offensiveness unless source-specific odour sampling is undertaken demonstrating a low level of odorous compounds. Processes containing the below material are considered to represent a high odour offensiveness:

- Indigenous sludge
- Sludge imports (liquid and solid)

- Sludge liquors

Processes containing the below material are considered to represent a medium odour offensiveness:

- Rags and screenings
- Digested sludge
- Digested sludge liquors
- Digested sludge cake (stored)

No processes on a STF are considered to store material that represents a low odour offensiveness.

The unpleasantness of an odour can be used in defining the source odour offensiveness. This is typically achieved through source material hedonic tone assessments, however; these types of assessments are not typically available for a site. As no source material hedonic tone has been undertaken for Aldwarke STF, it has not been included in the assessment criteria.

The magnitude of the odour release considers the operation of the asset and how likely odours will be released. Whilst the magnitude of odour release is dependent on a number of factors such as source surface area, turbulence of source material, age of source material; the source odour mitigation and control measures have been determined as the defining criteria for magnitude of odour release. For conservatism, all open sources are considered to have a high magnitude of odour release regardless of process operation. Processes with good cover containment that have the headspace odours extracted via a fan are considered to have a low magnitude of odour release. Processes that are covered without fan extraction will have a magnitude of odour release dependant on the source odour offensiveness. This could vary between a low and high odour magnitude of odour release however, for this assessment, it would be considered to represent a medium risk.

Table 1 includes the criteria risk scoring for determining the source odour potential.

Table 1: Source Odour Potential Criteria Risk Scoring

Criteria	Risk Ratings		
	High	**Medium**	**Low**
Odour Offensiveness	Very odorous compounds (H2S, Mercaptans) with low odour threshold. Unpleasant odour - "Most Offensive". Unpleasant hedonic tone. Large permitted process / Surface Area.	Compounds involved are moderately odorous. Unpleasantness - process classed in H4 as "Moderately Offensive" or where odours have neutral or slightly unpleasant hedonic tone. Smaller permitted process / Surface Area.	Compounds involved are only mildly offensive. Unpleasantness - process classed in H4 as "Less Offensive". Neutral to positive hedonic tone.
Mitigation / Control	Open air operation with no containment. Reliance solely on good management techniques and best practice.	Some mitigation measures in place but significant residual odour remains.	Effective mitigation measures in place (e.g. BAT, BPM) leading to little or no residual odour.

5.2 PATHWAY EFFECTIVENESS

When considering the effectiveness of the odour pathway as a source transport mechanism through the air to a receptor, a number of factors need to be considered. Any factor that increases the source dilution or dispersion into atmosphere from source to receptor will reduce the odour concentration at the receptor, and hence reduce odour exposure. Several factors need to be considered including:

- The distance from source to receptor
- Wind direction and frequency
- Source release effectiveness of dispersion to atmosphere
- Topography and terrain between source and receptor

The highest likelihood of impact for a given source will be present when the predominant wind direction is present, the sensitive receptor is close to the emission source, the emission source is located at ground level with limited dispersion and there are no emission mitigation measures in place.

Table 2 includes the criteria risk scoring for determining the source pathway effectiveness.

Table 2: Source Pathway Effectiveness Criteria Risk Scoring

	Risk Ratings		
	High	Medium	Low
Distance from Site	< 50m	50 - 300m	> 300 m
Wind Direction Frequency	> 10%	5 - 10%	< 5%
Source Dispersion	Open processes with low level releases	Releases are elevated but compromised by building effects.	Releases are elevated and dispersed via stack/vent and not compromised by surrounding buildings.

When determining the odour risk criteria for a site, consideration should be given to any past studies that identify an odour impact boundary or any sensitive locations of odour complaints. As there is no recent history of odour complaints associated with the YW Aldwarke site as a whole (i.e. the Aldwarke WwTW and Aldwarke STF), generic risk values have been used for the receptor's distance from site. It has been considered that any receptor within a 50 m radius from the STF permit application boundary would be considered in a higher risk location whereby any receptor beyond a 300 m radius would be considered in a lower risk location. Whilst it is recognised that receptors far enough away from site will not be subject to odour impact associated to the works, no maximum distance cap has been included. However, it has been loosely considered that any receptor more than 1 km away from the works will not be considered in the assessment.

When considering pathway effectiveness, consideration is given to whether the receptors are downwind of the source and what the predominant prevailing wind direction is. Whilst the main consideration is typical for the predominant prevailing wind direction, odour impact tends to occur with low wind speeds or stable atmospheric conditions. When conditions are not stable, it will be the downwind receptors that are affected. When considering prevailing wind conditions, annual meteorological data sets from representative meteorological stations local to the site or from Numerical Weather Predicted (NWP) data for the site containing wind direction and frequency should be considered.

When considering the source dispersion risk, consideration is given to whether there will be sufficient dilution in reducing the odours as they transverse towards the sensitive receptors. A source at ground level that is open to atmosphere would likely have poor dispersion of odours and be reliant on other factors such as distance from receptor or low odour offensiveness to manage the risk of likely odour effect at receptors. Sources at height would be considered to have an increased dispersion but could still present a risk. Sources that are either fully contained or fan extracted through an emission stack are considered to have a low dispersion risk.

The topography and terrain surrounding a site can influence the air movement and create an increased risk of odour effect at receptors. The presence of topographical features such as hills and valleys, or urban terrain features such as buildings can affect air flow and therefore increase or inhibit dispersion and dilution. For this assessment, the terrain surrounding the works has not been considered.

5.3 RECEPTOR SENSITIVITY

Within the IAQM guidance document, receptors are placed into one of three categories depending on land use, duration of exposure, and the anticipated level of amenity.

- High Sensitivity – High level of amenity expected, prolonged or continuously present within the area, examples include residential dwellings, schools, hospitals and tourist/cultural.
- Medium Sensitivity – Reasonable level of amenity expected, no prolonged or continuously present within the area, examples include a place of work, commercial/retail, playing recreational fields.
- Low Sensitivity – No reasonable level of amenity expected or transient exposure, example include farms, industrial premises, footpaths/roads.

5.4 ASSESSMENT OUTPUT

For the above qualitative odour risk assessment, the risk of odour exposure at a receptor can be determined and used to determine a receptor's sensitivity risk of 'likely odour effect'. The risk of odour exposure is summarised in the below expressions:

- Negligible Effect
- Slight Adverse Effect
- Moderate Adverse Effect
- Substantial Adverse Effect

As referenced by the IAQM, "Guidance on the assessment of odour for planning" Version 1.1 – July 2018, when discussing qualitative odour risk assessments, "the EIA regulations require that an assessment reaches a conclusion on the likely significance of the effects. Where the overall effect is greater than "slight adverse", the effect is likely to be considered significant. Whilst this assessment will consider the risk of odour exposure for each receptor in the assessment, an overall judgement will be made for the whole site. As such, the result of the assessment will be considered binary on whether the site has significant or no significant risk of odour effect at surrounding receptors. Where the overall effect is greater than "slight adverse", the effect is likely to be considered significant. Concluding that an effect is significant should not mean, of itself, that it is unacceptable rather, it should mean that careful consideration needs to be given to the consequences, scope for securing further mitigation, and the balance with any wider environmental, social and economic benefits that the proposal would bring.

The risk matrix approach outlined by the IAQM and adopted for this assessment is outlined in Table 3 and Table 4.

Table 3: Risk of odour exposure at specified receptor locations

		Source Odour Potential		
		Low	Medium	High
Pathway Effectiveness	Highly Effective Pathway	Low Risk	Medium Risk	High Risk
	Moderately Effective Pathway	Negligible Risk	Low Risk	Medium Risk
	Ineffective Pathway	Negligible Risk	Negligible Risk	Low Risk

Table 4: Likely magnitude of odour effect at the specific receptor location

Risk of Odour Exposure	Source Odour Potential		
	Low	Medium	High
High Risk of Odour Exposure	Slight Adverse Effect	Moderate Adverse Effect	Substantial Adverse Risk
Medium Risk of Odour Exposure	Negligible Risk	Slight Adverse Effect	Moderate Adverse Effect
Low Risk of Odour Exposure	Negligible Effect	Negligible Effect	Slight Adverse Effect
Negligible Risk of Odour Exposure	Negligible Effect	Negligible Effect	Negligible Effect

6.0 ASSESSMENT

6.1 SOURCE ODOUR POTENTIAL RESULTS

6.1.1 Site Operation

An odour survey has been undertaken providing some indicative information on odorous compounds present on uncovered and channelled emission sources. Where there is no source odour emission data available, the Environment Agency's Horizontal Guidance Note (H4) has been adopted. H4 considers sources/processes/activities that are considered 'most offensive' odours including septic effluent or sludge and biological landfill odours.

As a number of sources are adjacent to each other, it is not realistic to consider the odour effect at a receptor based on individual sources. This assessment has considered all sources as a combined single area. The pathway effectiveness has been determined based on the receptor being closest in distance to the permitted boundary / nearest source. Figure 2 shows the permit application boundary for the STF.

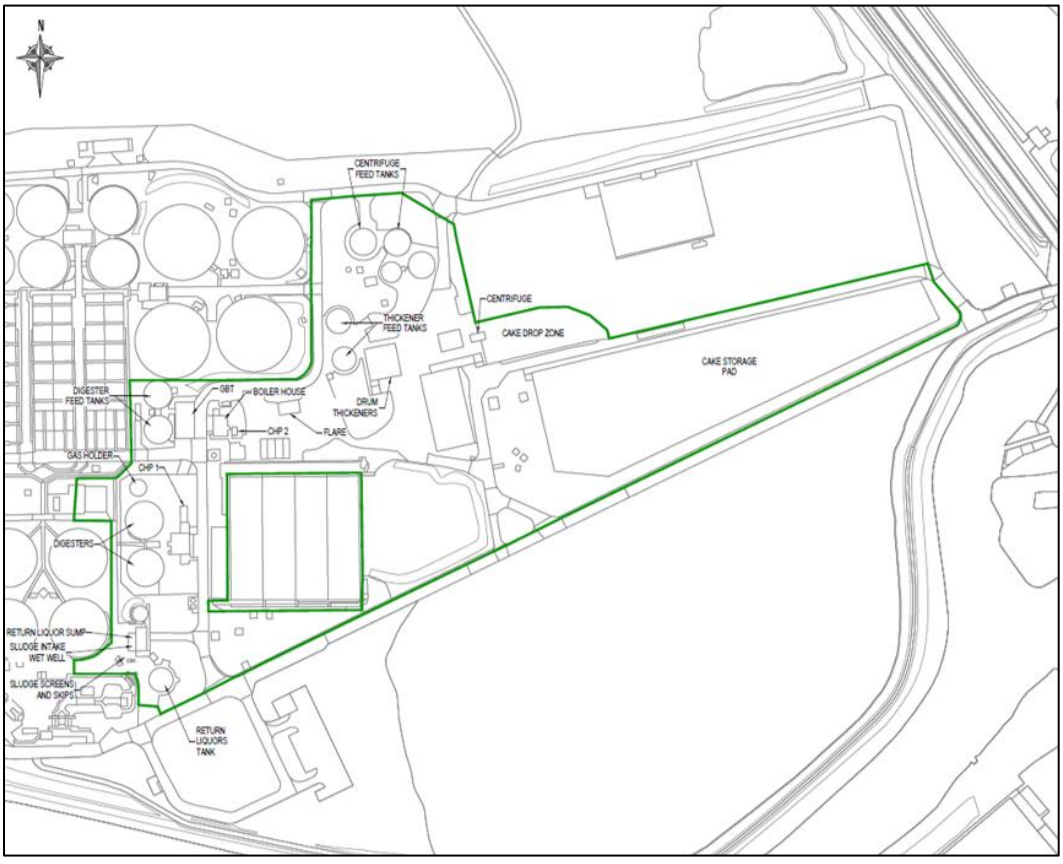

Figure 2: Aldwarke STF Odour Source Areas

There are no odour control units present on site. There are two extraction and dispersion stacks on site. Odours from the drum thickeners are extracted and dispersed to atmosphere via a 5 m (approximately) tall stack. Odours from the GBT are extracted and dispersed to atmosphere via a 6 m (approximately) tall stack.

The drum thickeners and GBT are considered to hold a negative pressure to mitigate fugitive emissions. The sludge screens, sludge wet well, dewatering centrifuges and return liquor balance tank are covered without extraction presenting only partial mitigation of odours. The sludge screenings skip, thickener feed tanks, digester feed tanks, centrifuge feed tanks and cake storage area are all open to atmosphere with no mitigation of odours.

6.1.2 Odour Survey Results

The results of an odour survey considering source odour potential are presented below for both fresh digested cake, stored digested cake and other uncovered sources. The odour survey consisted of two samples per day taken on two different days in April 2022.

A summary of the survey results is included in Table 5.

Table 5: Odour Survey Averaged Results

Source	Odour Concentration	Odour Emission Rate	Hydrogen Sulphide	Ammonia	Volatile Organic Compounds	Mercaptan	Dimethyl Sulphide
	(ou_E/m^3)	($ou_E/m^2/s$)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Fresh Digested Cake	739	7.7	0.007	3.8	0.1	< 0.1	< 0.1
Stored Digested Cake	189	2.0	0.006	0.6	< 0.1	< 0.1	< 0.1
Thickener Feed Tank	1,384	14.0	0.410	< 0.1	0.3	0.1	< 0.1
Digester Feed Tank	945	10.0	0.140	< 0.1	0.3	0.1	< 0.1
Centrifuge Feed Tank	530	5.5	0.010	0.5	0.3	< 0.1	< 0.1

Source	Odour Concentration	Odour Emission Rate	Hydrogen Sulphide	Ammonia	Volatile Organic Compounds	Mercaptan	Dimethyl Sulphide
	(ou_E/m^3)	($ou_E/m^2/s$)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
Centrate Well[1]	226	2.3	0.007	1.5	< 0.1	< 0.1	< 0.1
Thickener vent stack	258,886	67,633	31.8	<0.1	7.1	3.6	<0.1
GBT vent stack[2]	258,886	81,290	31.8	<0.1	7.1	3.6	<0.1

Contaminant sampling was undertaken for hydrogen sulphide, ammonia, volatile organic compounds, mercaptans, and dimethyl sulphide. Hydrogen sulphide is considered to be the main contaminant in sludge emissions with high source odour potential. Depending on the source material, the detection threshold for hydrogen sulphide is highly variable. For the purpose of this report, Environment Agency's "Review of odour character and threshold" is used to define a compound hydrogen sulphide detection threshold of 0.0005 ppm with a recognition concentration of 0.0047 ppm. The odour survey results indicate that under all operating conditions, hydrogen sulphide concentrations from each form of sludge asset are within the detection range.

The survey results indicate a distinct difference in odour generation potential depending on whether the odour source is undigested or digested sludge and sludge liquors:

- Both the centrate well and centrifuge feed tanks (digested sludge sources) were low odour sources and not likely to contribute to off-site odours.
- The thickener vent stacks, thickener feed tanks and digester feed tanks have the highest odour emission rates with notable compound concentrations of hydrogen sulphide and VOCs.

The results indicate that the sludge cake had low odour emission rates and was comparable to typical emissions expected for sludge cake. Sampling has been undertaken on other Yorkshire Water STFs and digested sludge cake emission rate has been observed to be between 1 and 10

[1] Monitoring at the return liquor balance tank was not possible due to the significant height of this tank. The tank is covered. Therefore, sampling was undertaken at the (covered) centrate wet well located adjacent to the cake pad, which directly feeds the return liquor balance tanks and therefore is assumed to have the same characteristics.

[2] Note that monitoring at GBT vent stack was not possible as the GBTs were not operational at the time of the sampling visit (due to maintenance work being carried out). Data for the drum thickener vent has been used as both thickener facilities draw from the same feed tank and therefore have the same characteristics.

ouE/m2/s, (based on data from Blackburn Meadows, Esholt, Lundwood and Woodhouse Mill). Whilst the results indicate a higher ammonia concentration for digested cake (particularly for fresh cake) when compared to other contaminants, it does not indicate an increased odour risk when compared to other contaminants as the measured ammonia concentrations for fresh digested cake are lower than the limit of detection of 17 ppm set in the Environment Agency's "Review of odour character and threshold". The measured ammonia concentration for stored digested cake is considerably below this limit.

Each type of stored sludge cake exhibits concentrations of odorous compounds low enough to not cause nuisance or adverse effects local to the source and as such, would not be considered to cause adverse effects to local receptors. Whilst this means the sludge cake could potentially be considered as an asset with low odour offensiveness, for the purpose of this assessment, and to add a level of conservatism, the digested sludge and cake storage are considered to have a medium odour offensiveness.

As part of the odour survey, monitoring and sniff tests were undertaken at eleven locations surrounding and within the STF operational area. The odour description for the majority of the samples was 'no odour' however, there were samples where odour was described as either 'faint', 'slight', 'moderate' or 'strong'. The monitoring identified four locations within the STF where hydrogen sulphide was found to be above the detection threshold (highest 0.019 ppm hydrogen sulphide, south of the thickener building). Three locations where hydrogen sulphide was detected above this threshold are local to the sludge thickening tanks or thickener buildings with the fourth local to the liquor balance tank. It is noted that this latter sample location is between the liquor balance tank and the inlet for the main WwTW. Therefore, it is highly likely that odour from the WwTW inlet is contributing to the odour detected at this location (the odour at this location was described as 'odour from inlet works'). Hydrogen sulphide detected at other locations is likely due to emissions associated with thickened sludge. It is noted that YW is committed to installing OCUs to mitigate emissions from these sources (refer to Proposed Permit Improvement Conditions).

The STF operational area survey results are located in Appendix A.

6.1.3 Source Odour Potential Assessment Results

Table 6 includes a summary of the likely source odour potential with the detailed assessment in Appendix B. This assessment has been based on the approach outlined in section 5.1.

Table 6: Likely magnitude of odour effect at the specific receptor location

Source	Odour Offensiveness	Mitigation/Control	Source Odour Potential
Main Treatment Area			
2 No. Sludge Screens	High Risk – Imported (undigested) Sludge	Medium Risk - covered without extraction process	Medium
Sludge Screening Skip	Medium Risk - Screenings	High Risk - open to atmosphere	Medium
Wet Well	High Risk – Imported (undigested) Sludge	Medium Risk - covered without extraction process	Medium
2 No. Thickener Feed Tanks	High Risk - Undigested Sludge	Open to atmosphere	High
2 No. Drum Thickeners	High Risk - Undigested Sludge	Low Risk - covered and extracted processes	Low
Drum Thickener Ventilation Stack	High Risk - Undigested Sludge	Medium Risk - Ventilation stack with no treatment	High
1 No. GBT	High Risk - Undigested Sludge	Low Risk - covered and extracted processes	Low
GBT Ventilation Stack	High Risk - Undigested Sludge	Medium Risk - Ventilation stack with no treatment	High
Return Liquor Sump	High Risk - Undigested Sludge Liquors	Medium Risk - covered without extraction process	Medium
2 No. Digester Feed Tanks	High Risk - Undigested Sludge	High Risk - open to atmosphere	High
2 No. Centrifuge Feed Tanks	Medium Risk - Digested sludges	High Risk - open to atmosphere	Medium
Dewatering Centrifuge	Medium Risk - Digested sludges	Medium Risk - covered without extraction process	Medium
Return Liquor Balance Tank	Medium Risk – Digested Sludge liquors	Medium Risk - covered without extraction process	Medium
Cake Storage	Medium Risk - Digested sludges	High Risk - open to atmosphere	Medium

Of the fourteen processes on site, two are considered to have a low source odour potential, eight are considered to have a medium source odour potential and four are considered to have a high source odour potential.

Of the fourteen processes within the STF, it is considered that this area is best represented with an odour source potential of a medium risk.

6.2 RECEPTOR SENSITIVITY RESULTS

For the assessment, before the pathway effectiveness can be determined, the discrete receptors need to be identified. Discrete receptors should typically consider complaint locations and areas of specific interest. The Aldwarke site as a whole has historically received odour complaints from the south of the site however, no odour complaints have been received at site level in the last 5 years (2018 to 2022).

As the complaints are historic, all discrete receptors considered in this assessment are based on distance from the site and then categorised on sensitivity. Where a number of discrete receptors are in the same location, a single receptor has been selected, considering the likely highest sensitivity receptor, to represent the area. Table 9 and Figure 3 present the receptor sensitivity and location. This assessment has been based on the approach outlined in section 5.3.

Table 9: Receptor Type and Sensitivity

Receptor Name	Receptor Map Reference	Receptor Type	Receptor Sensitivity
Canal Boat Docking Area	D01	Residential / Boat Docking	High
Packaging Supply Shop	D02	Industrial	Low
Logistics Warehouse	D03	Industrial	Low
Waterside Cottages	D04	Residential	High
Freight Forwarding Service	D05	Industrial	Low
Ashwell Grove	D06	Residential	High
Car Restoration Service	D07	Commercial	Medium
Oak Meadows	D08	Residential	High
Manufacturer	D09	Manufacturing	Low
Retail Park	D10	Commercial	Medium
Doncaster Rd	D11	Residential	High
Supermarket	D12	Commercial	Medium
Electrical Sub-station	D13	Industry	Low
Steel Fabricator	D14	Industry	Low
Steel Fabricator (Offices)	D15	Offices	Medium
Insulation Materials Shop	D16	Manufacturing/ Warehouse	Low

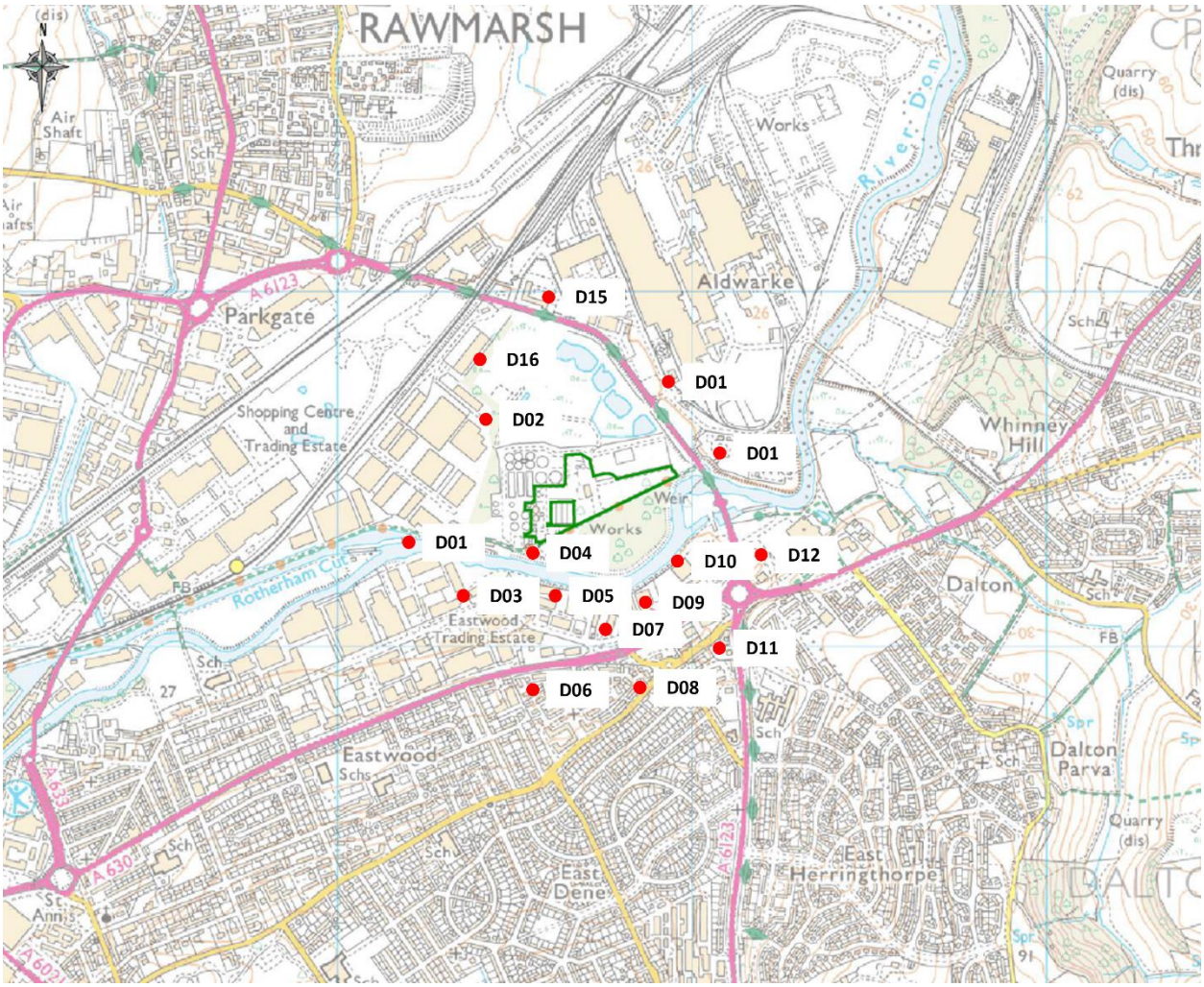

Figure 3: Location of Sensitive Receptors

Of the sixteen discrete receptors included, five are residential receptors and are considered to be highly sensitive. Residential receptors can be found towards the south and south-west of the STF. The main residential areas of consideration are to the south of the site due to their volume and proximity to the STF.

Four receptors are considered to be of medium sensitivity and represent commercial and recreational areas. The site is surrounded to the east, south and west by commercial areas.

Seven receptors are considered to be of low sensitivity and represent industrial areas.

6.3 PATHWAY EFFECTIVENESS RESULTS

6.3.1 Wind Direction

When considering the pathway effectiveness from source odours to an identified receptor, a number of factors have to be determined. Meteorological data from Doncaster Sheffield Airport meteorological station(meteorological station year 2019) has been used to predict the wind direction frequency for Aldwarke STF. Whilst this met. station is located approximately 22 km east of the site, it is likely to experience similar wind directions and frequencies to be considered acceptable for this qualitative assessment. The distance between source and receptor is shown in Appendix B. The breakdown of the wind direction frequency and risk for Doncaster Sheffield Airport meteorological station year 2019 are summarised in Table 10.

Table 10: Meteorological Data Wind Direction Frequency

Wind Direction	Sample Count	Frequency (%)	Wind Direction Frequency Risk
North to South	889	10.1%	High
North-East to South-West	374	4.3%	Low
East to West	510	5.8%	Medium
South-East to North-West	955	10.9%	High
South to North	1979	22.6%	High
South-West to North-East	1500	17.1%	High
West to East	1558	17.8%	High
North-West to South-East	995	11.4%	High

6.3.2 Source Dispersion

When considering the source dispersion risk, a dispersion risk needs to be defined for the STF as a whole. Table 11 considers the dispersion risk from each individual process.

Table 11: Source Dispersion Risk

Source Dispersion Risk		
2 No. Sludge Screens	Covered, ground level	Medium
Sludge Screening Skip	Open to atmosphere, ground level	High
Wet Well	Covered, ground level	Medium
2 No. Thickener Feed Tanks	Open to atmosphere, elevated	Medium
2 No. Drum Thickeners	Local containment and extraction of thickeners, no building extraction	Low
Drum Thickener Ventilation Stack	Discharge stack is approximately 5m high with fan assisted dispersion	Low
1 No. GBT	Local containment and extraction of thickener, no building extraction	Low
GBT Ventilation Stack	Discharge stack is approximately 5m high with fan assisted dispersion	Low
Return Liquor Sump	Covered, ground level	Medium
2 No. Digester Feed Tanks	Open to atmosphere, elevated	Medium
2 No. Centrifuge Feed Tanks	Open to atmosphere, elevated	Medium
Dewatering Centrifuge	Covered, within a building	Low
Return Liquor Balance Tank	Open to atmosphere, elevated	Medium
Cake Storage	Open to atmosphere, ground level	High

It is considered that a medium dispersion risk would be most applicable for the STF.

6.3.3 Pathway Effectiveness Assessment Results

The pathway effectiveness for each defined sensitive receptor is summarised in Table 12 with detailed assessment in Appendix B.

Table 12 Pathway Effectiveness Assessment

Receptor Name	Distance Risk	Direction From Installation	Wind Direction Frequency	Source Dispersion Risk	Pathway Effectiveness
Canal Boat Docking Area	355	SW	4.3%	Medium	Ineffective Pathway
Packaging Supply Shop	237	W	5.8%	Medium	Moderately Effective Pathway
Logistics Warehouse	226	SW	4.3%	Medium	Moderately Effective Pathway
Waterside Cottages	105	SW	4.3%	Medium	Moderately Effective Pathway
Freight Forwarding Service	125	S	10.1%	Medium	Moderately Effective Pathway
Ashwell Grove	356	S	10.1%	Medium	Moderately Effective Pathway
Car Restoration Service	240	S	10.1%	Medium	Moderately Effective Pathway
Oak Meadows	421	S	10.1%	Medium	Moderately Effective Pathway
Manufacturer	269	S	10.1%	Medium	Moderately Effective Pathway
Retail Park	272	S	10.1%	Medium	Moderately Effective Pathway
Doncaster Rd	411	S	10.1%	Medium	Moderately Effective Pathway
Supermarket	304	SE	11.4%	Medium	Moderately Effective Pathway

Receptor Name	Distance Risk	Direction From Installation	Wind Direction Frequency	Source Dispersion Risk	Pathway Effectiveness
Electrical Sub-station	113	E	17.8%	Medium	Moderately Effective Pathway
Steel Fabricator	209	NE	17.1%	Medium	Moderately Effective Pathway
Steel Fabricator (Offices)	416	N	22.6%	Medium	Moderately Effective Pathway
Insulation Materials Shop	381	NW	10.9%	Medium	Moderately Effective Pathway

7.0 ASSESSMENT RESULTS

The results of the qualitative odour risk assessment are summarised in Table 13 and based on section 5.4.

Table 13: Qualitative Odour Risk Assessment Results

Receptor	Source Odour Potential	Pathway Effectiveness	Odour Exposure	Receptor Sensitivity	Likely Odour Effect
Canal Boat Docking Area	Medium	Ineffective Pathway	Negligible Risk	High	Negligible Effect
Packaging Supply Shop	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect
Logistics Warehouse	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect
Waterside Cottages	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
Freight Forwarding Service	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect

Receptor	Source Odour Potential	Pathway Effectiveness	Odour Exposure	Receptor Sensitivity	Likely Odour Effect
Ashwell Grove	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
Car Restoration Service	Medium	Moderately Effective Pathway	Low Risk	Medium	Negligible Effect
Oak Meadows	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
Manufacturer	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect
Retail Park	Medium	Moderately Effective Pathway	Low Risk	Medium	Negligible Effect
Doncaster Rd	Medium	Moderately Effective Pathway	Low Risk	High	Slight Adverse Effect
Supermarket	Medium	Moderately Effective Pathway	Low Risk	Medium	Negligible Effect
Electrical Sub-station	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect
Steel Fabricator	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect
Steel Fabricator (Offices)	Medium	Moderately Effective Pathway	Low Risk	Medium	Negligible Effect
Insulation Materials Shop	Medium	Moderately Effective Pathway	Low Risk	Low	Negligible Effect

8.0 SUMMARY

A qualitative odour risk assessment has been undertaken for Aldwarke STF considering fourteen process activities across the STF and potential odour effect on sixteen receptors. The assessment has been based on a Source-Pathway-Receptor approach and is primarily based upon professional judgement.

As the sludge assets are within the same area of the Aldwarke site, the assessment has considered all sources as a combined single area. Consideration has been given to existing site operation for odour mitigation and source dispersion, and combined with receptor location and meteorological conditions, a pathway effectiveness has been determined for each sensitive receptor. This has allowed, with the use of risk matrices, a receptor specific likely odour effect to be determined.

The qualitative odour risk assessment for Aldwarke STF has indicated that all considered sensitive receptors are exposed to either a negligible or slight adverse odour effect indicating no receptor is exposed to a moderately adverse odour effect or worse and that the odour effect of the site is considered not significant.

The YW complaints log recorded no odour complaints over the last five years for the site as a whole (i.e. the YW Aldwarke WwTW and STF).

For the overall site, it is considered that Aldwarke STF does not have an adverse odour effect on its surrounding receptors and therefore the odour effect can be considered not significant. As such, no additional odour mitigation is required above the existing measures already observed on site.

8.1 APPENDIX A – ALDWARKE STF AREA SURVEY

2.10 Boundary Survey Results

The ERF boundary surveys were taken at the points shown in Figure 3 below:

Figure 3: Boundary Survey Points

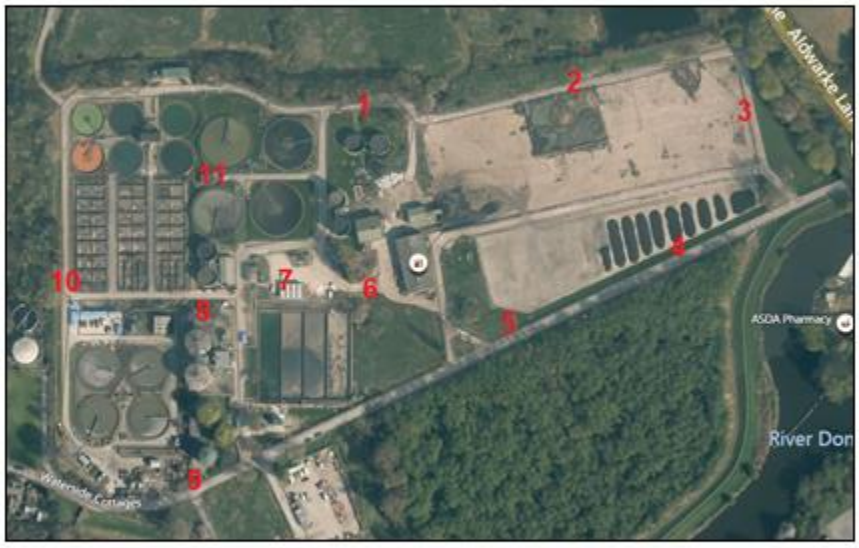

Table 10: Boundary Survey Weds 27th April AM 09.30 to10.00 NE Wind Thickener **Not** Running

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
1	North Dewatering Feed Tanks	0.001	<0.1	<0.1	No Odour	Upwind
2	North of Cake Pad	0.001	<0.1	<0.1	No Odour	Upwind
3	East of Cake Pad	0.001	<0.1	<0.1	No Odour	Upwind
4	South of Cake Pad	0.002	<0.1	0.1	Faint	Downwind Cake
5	South of Cake Pad	0.002	<0.1	0.1	Faint	Downwind Cake
6	South of Thickener Building	0.002	<0.1	<0.1	No Odour	Thickener Not Running
7	By Control Building	0.002	<0.1	<0.1	No Odour	
8	By Digester Feed Tanks	0.002	<0.1	<0.1	Faint	Odour from ASP
9	By Liquor Balance Tank	0.005	<0.1	<0.1	Odour	Odour from Inlet Works
10	West of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	
11	North of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	Upwind

Table 11: Boundary Survey Weds 27th April AM 11.30 to 12.30 NE Wind Thickener **Running**

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
1	North Dewatering Feed Tanks	0.002	<0.1	<0.1	No Odour	Upwind
2	North of Cake Pad	0.004	<0.1	<0.1	Slight	Upwind
3	East of Cake Pad	0.001	<0.1	<0.1	No Odour	Upwind
4	South of Cake Pad	0.001	<0.1	<0.1	No Odour	Downwind Cake
5	South of Cake Pad	0.002	<0.1	<0.1	No Odour	Downwind Cake
6	South of Thickener Building	0.017	<0.1	<0.1	Strong	Thickener Running
7	By Control Building	0.007	<0.1	<0.1	Moderate	
8	By Digester Feed Tanks	0.011	<0.1	<0.1	Strong	Tank Filling
9	By Liquor Balance Tank	0.002	<0.1	<0.1	No Odour	Odour from Inlet Works
10	West of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	
11	North of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	Upwind

Table 12: Boundary Survey Thurs 28th April AM 09.30 to10.00 NE Wind Thickener **Not** Running

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
1	North Dewatering Feed Tanks	0.001	<0.1	<0.1	No Odour	Upwind
2	North of Cake Pad	0.001	<0.1	<0.1	No Odour	Upwind
3	East of Cake Pad	0.001	<0.1	<0.1	No Odour	Upwind
4	South of Cake Pad	0.002	<0.1	0.1	Faint	Downwind Cake
5	South of Cake Pad	0.002	<0.1	0.1	Faint	Downwind Cake
6	South of Thickener Building	0.003	<0.1	<0.1	No Odour	Thickener Not Running
7	By Control Building	0.002	<0.1	<0.1	No Odour	
8	By Digester Feed Tanks	0.002	<0.1	<0.1	Faint	Odour from ASP
9	By Liquor Balance Tank	0.006	<0.1	<0.1	Odour	Odour from Inlet Works
10	West of Digester Feed Tanks	0.001	<0.1	<0.1	No Odour	
11	North of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	Upwind

Table 13: Boundary Survey Thurs 28th April AM 12.00 to 13.00 NE Wind Thickener **Running**

		H_2S	TVOC	NH_3	Odour	Comments
		ppm	ppm	ppm		
1	North Dewatering Feed Tanks	0.001	<0.1	<0.1	No Odour	Upwind
2	North of Cake Pad	0.004	<0.1	<0.1	Slight	Upwind
3	East of Cake Pad	0.001	<0.1	<0.1	No Odour	Upwind
4	South of Cake Pad	0.001	<0.1	<0.1	No Odour	Downwind Cake
5	South of Cake Pad	0.002	<0.1	<0.1	No Odour	Downwind Cake
6	South of Thickener Building	0.019	<0.1	<0.1	Strong	Thickener Running
7	By Control Building	0.006	<0.1	<0.1	Moderate	
8	By Digester Feed Tanks	0.014	<0.1	<0.1	Strong	Tank Filling
9	By Liquor Balance Tank	0.002	<0.1	<0.1	No Odour	Odour from Inlet Works
10	West of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	
11	North of Digester Feed Tanks	0.002	<0.1	<0.1	No Odour	Upwind

8.2 APPENDIX B – DETAILED ASSESSMENT

Table 14: Likely magnitude of odour effect at the specific receptor location

Source	Odour Offensiveness	Mitigation/Control	Source Odour Potential
2 No. Sludge Screens	High Risk - Imported Sludge	Medium Risk - covered without extraction process	Medium
Sludge Screening Skip	Medium Risk - Screenings	High Risk - open to atmosphere	Medium
Wet Well	High Risk - Imported Sludge	Medium Risk - covered without extraction process	Medium
2 No. Thickener Feed Tanks	High Risk - Indigenous, Imported Sludge, SAS	High Risk - Open to atmosphere	High
2 No. Drum Thickeners	High Risk - Indigenous, Imported Sludge, SAS	Low Risk - covered and extracted processes	Low
Drum Thickener Ventilation Stack	High Risk - Indigenous, Imported Sludge, SAS	Medium Risk - Ventilation stack with no treatment	High
1 No. GBT	High Risk - Indigenous, Imported Sludge, SAS	Low Risk - covered and extracted processes	Low
GBT Ventilation Stack	High Risk - Indigenous, Imported Sludge, SAS	Medium Risk - Ventilation stack with no treatment	High
Return Liquor Sump	High Risk - Indigenous sludge liquors	Medium Risk - covered without extraction process	Medium
2 No. Digester Feed Tanks	High Risk - Indigenous, Imported Sludge, SAS	High Risk - open to atmosphere	High
2 No. Centrifuge Feed Tanks	Medium Risk - Digested sludges	High Risk - open to atmosphere	Medium
Dewatering Centrifuge	Medium Risk - Digested sludges	Medium Risk - covered without extraction process	Medium
Return Liquor Balance Tank	Medium Risk - Sludge liquors	Medium Risk - covered without extraction process	Medium
Cake Storage	Medium Risk - Digested sludges	High Risk - open to atmosphere	Medium

Table 15 Pathway Effectiveness Assessment

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Source Dispersion Risk	Pathway Effectiveness	Notes
Canal Boat Docking Area	355	Low	SW	4.3%	Medium	Ineffective Pathway	Pathway considered ineffective due to distance from source and low wind direction frequency.
Packaging Supply Shop	237	Medium	W	5.8%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Logistics Warehouse	226	Medium	SW	4.3%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Waterside Cottages	105	Medium	SW	4.3%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Freight Forwarding Service	125	Medium	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Source Dispersion Risk	Pathway Effectiveness	Notes
Ashwell Grove	356	Low	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Car Restoration Service	240	Medium	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Oak Meadows	421	Low	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Manufacturer	269	Medium	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Retail Park	272	Medium	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Doncaster Rd	411	Low	S	10.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.

Receptor Name	Distance from Site (m)	Distance Risk	Direction From Installation	Wind Direction Frequency	Source Dispersion Risk	Pathway Effectiveness	Notes
Supermarket	304	Low	SE	11.4%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Electrical Sub-station	113	Medium	E	17.8%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Steel Fabricator	209	Medium	NE	17.1%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Steel Fabricator (Offices)	416	Low	N	22.6%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.
Insulation Materials Shop	381	Low	NW	10.9%	Medium	Moderately Effective Pathway	Pathway considered moderately effective due to distance from source and medium source dispersion risk.