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ALLIANCE LORNEVILLE

Baseline Odour Survey

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REPORT



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1.0 INTRODUCTION

1.1 Overview

This report presents the results of baseline surveys of existing environmental odour exposure levels undertaken in June 2013 and April 2014 within the residential community that surrounds the Alliance Group Ltd (Alliance) meat processing and export plant. The site is situated at Lorneville, approximately 3 km north of the residential area of Invercargill City and situated off the Lorneville-Wallacetown highway (Figure 1). The processing site is one of the largest ovine meat processing sites in the world and has operated at this location since 1960. The location of the site is shown in Figure 1.

Alliance holds an existing resource consent (Environment Southland Consent No. 95077) that authorises air discharges from the site and which expires on 7 August 2016. The preparation of an assessment of effects due to discharges of contaminants to air from the Alliance Lorneville site is underway. This assessment will assist the processing of an application to the Southland Regional Council for renewal of the existing air discharge consent.

To support the pending assessment of air discharges, baseline studies of background ambient air quality and odour exposure levels (including frequency, intensity, duration, and offensiveness) are required. The assessment of background air quality is reported by Golder (2014).

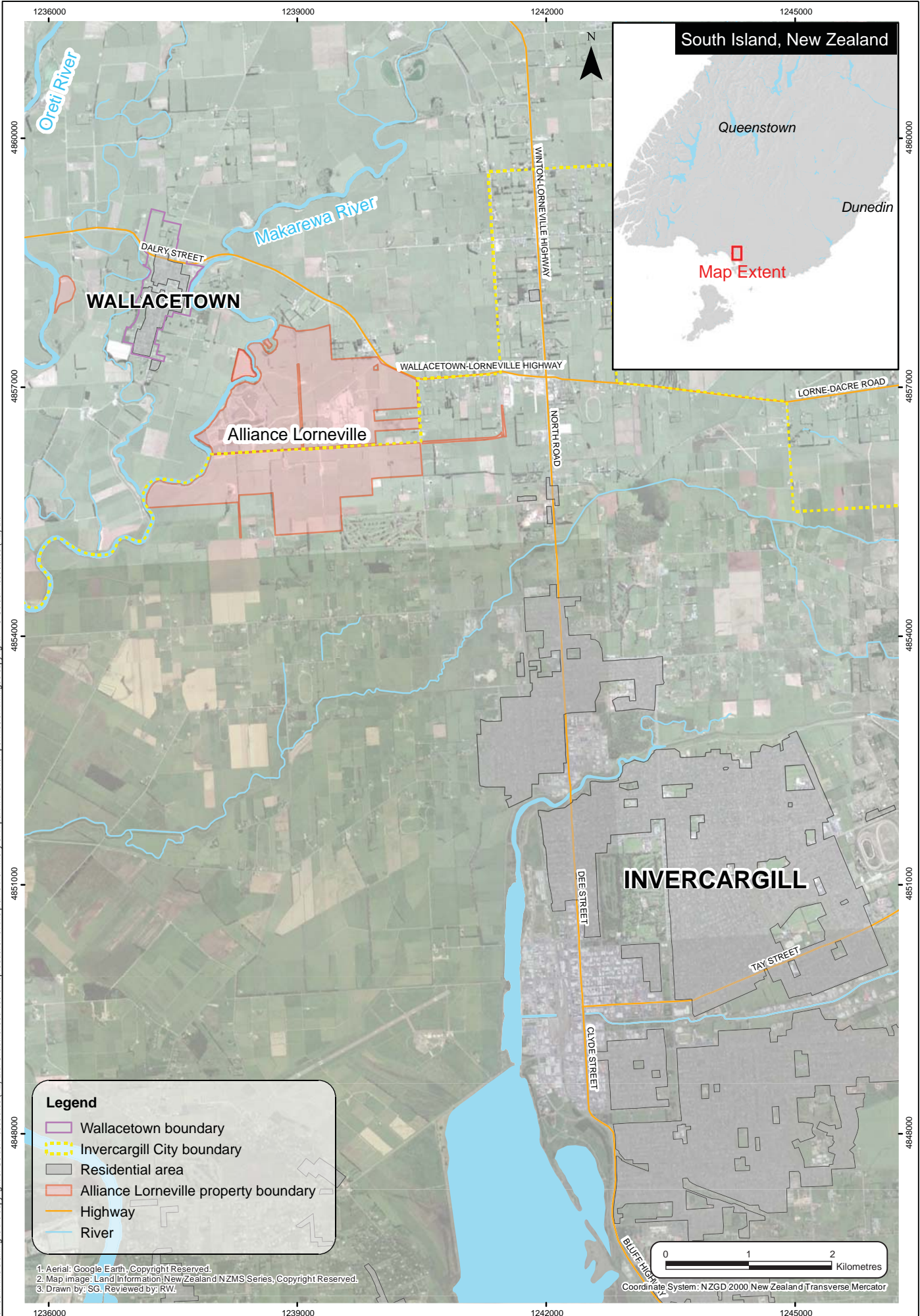
The objective of this report is to provide an assessment of the existing level of environmental odour exposure within the rural and residential community that immediately surrounds the Alliance Lorneville site. An assessment of the significance of these exposure levels is also provided. Note that the term environmental odours refers to ambient odours that are associated with commercial, industrial or agricultural processes and generally excludes natural and many domestic sources of odour such as those from estuaries, the sea, cooking, etc. Environmental odours also tend to have an unpleasant character such as those associated with wastewater treatment or chemical processing as they are invariably associated with commercial processes.

This report presents the results of both the 2013 and 2014 odour surveys and is an update on the Golder report (Golder 2013) which presented the 2013 odour survey reports.

1.2 Baseline Odour Survey

The baseline odour survey data was primarily collected in June 2013 and April 2014 via face-to-face interviews with local residents and a review of existing complaints information that was available, and secondarily through survey responses received by correspondence. The face-to-face interviews followed a standard list of questions (Appendix B) relating to the frequency of odour events and the odour characteristics of specific events they experienced. Each individual residential dwelling was also assessed for potential exposure to waste water treatment plant (WWTP) and rendering process odours using records of hourly wind direction from Wallacetown. The 2013 survey covered a larger number of residential areas surrounding the Alliance site, whereas the 2014 survey focused on those areas that the 2013 survey confirmed to have the higher level of odour impact as a result of Alliance's operations at Lorneville.

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Legend

- Wallacetown boundary
- Invercargill City boundary
- Residential area
- Alliance Lorneville property boundary
- Highway
- River

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 3. Drawn by: SG. Reviewed by: RW.



Coordinate System: NZGD/2000 New Zealand Transverse Mercator



TITLE | **SITE LOCATION**

OCTOBER 2015

PROJECT | 1378104044

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2.0 ODOUR SOURCES

Alliance Lorneville is a large meat processing and export plant that primarily processes sheep and lambs (ovine), and started processing beef renderables and bobby calves (bovine) in November 2013 and July 2014, respectively. Fallen bovine stock rendering will also commence in August 2014. The plant's main processing season runs from November through to June. Winter processing at reduced levels has been introduced for the first time in 2014. Short maintenance shut down periods for different aspects of the operation occur generally in July and October. The plant processes stock mainly from the surrounding farming areas but can draw stock from the whole South Island.

The sources of odour at the site that can potentially cause effects off-site include the following:

■ Stockyards

Sheep and cattle yards have a distinct characteristic animal odour. The odour is due to the animal's urine, faeces and body odour. The main compounds of the odour are ammonia, amines and other nitrogen related compounds. These types of odour are not expected to persist very far from their source. This is because primary odours from stockyards are considered to be nitrogen based (e.g., ammonia and amines), but also the waste solids and the animals themselves contribute to stockyard odours. The raised-floor design of the yards allows for effective routine cleaning out of the waste solids. Furthermore, the use of underfloor oxidizing mist sprays (chlorine dioxide) will significantly reduce the ammonia discharge. These features are expected to retain observable stockyards odours (ammonia, waste and animal) to within the site boundary for the vast majority of the time.

■ Rendering and Beef Bones Processing

Rendering related odours include the raw offal odour from unloading, offal cooking type odour and meal odours. Of these three categories, the meal odour is not extracted and treated; therefore odours associated with rendering should be of a neutral meal type character (i.e., a blood and bone type odour). The raw offal and cooked offal odours are unpleasant to experience and are therefore extracted and treated so they are not experienced off-site. Soup stock odours are very similar to that generated in a domestic kitchen when meat stock is made from gentle cooking of beef bones and are pleasant to neutral to experience. As with all meal odours, this odour dissipates quickly with dilution in the atmosphere.

During the 2012 / 2013 processing season line one of the new low-temperature rendering plant was commissioned. According to Alliance, various commissioning problems occurred due to high levels of moisture and this resulted in some uncontrolled odour emissions from rendering and associated offsite effects. This has reduced significantly during the 2013 / 2014 season, now that the commissioning issues are resolved and operators have become experienced in running the new plant. The second processing line for beef was commissioned late in 2013 and has been operating most of the 2013 / 2014 season, with no commissioning issues of significance. Upgraded meal processing areas and reception were also installed prior to the 2013 / 2014 season. Odour is released from a number of rendering process stages but these are extracted, cooled and discharged to a new biofilter. The remaining odour emission as from the 2013 / 2014 season would be a "dry meal odour" which is not expected to cause off-site effects.

■ Fellmongery

Discharges to air from the skin processing operations are by way of both natural and forced ventilation, and include hydrogen sulphide and ammonia type odour. The discharged lime bearing liquors have the potential to discharge hydrogen sulphide (rotten egg type odour) when these streams mix with acidified wastewater streams that are also discharged from the Fellmongery. This odour is expected to emanate mainly from the wastewater drains where spent Fellmongery liquors are discharged and to a lesser extent from the venting to atmosphere of air extracted from the processing drums.

An open concrete pit that received all Fellmongery liming and pickle liquors stopped being used for the flotation and settling of solids approximately 5 years ago. Prior to the 2013 / 2014 processing season this pit was altered to enclose all the pipe work and prevent the release of odours. The removal of this



source may have reduced sulphide type odour emissions but may have also transferred the liberation of these odours (albeit at a lesser rate) to other parts of the Fellmongery wastewater reticulation system.

It is noted that the routine discharges of ammonia from the site are mainly from the fellmongery, but also from the stockyards as noted above. There are other minor sources (in terms of potential off-site odour effects), including accidental released of ammonia from the refrigeration plant, emissions from drains and the wastewater treatment plant. These have little potential to cause odour nuisance and are therefore not high-lighted in this report.

■ Primary Wastewater Treatment, Reticulation and Biological Treatment

The primary treatment of various raw wastewater streams and the reticulation pipework produce odour emissions from the processing site. These are often localised but may at times be noticeable at residential dwellings that are due east of the site – these off-site dwellings are the closest to the above processing activities at the site and their associated primary wastewater treatment and drainage systems. The biological wastewater treatment plant (WWTP), located further to the west of the processing plant, commences with the anaerobic pond – this is considered to be the largest source of odour from the Alliance property. This is followed by mechanically aerated ponds (aerated loop) and then facultative ponds before discharging to river.

The anaerobic pond is partially covered in grass (approximately 1/3rd of its area) and the remainder has a substantial fat layer. Commissioning problems associated with the new rendering plant resulted in high organic loadings which caused a disturbed surface of the anaerobic pond. This resulted in increased odour discharges early in the 2013 season.

The aerated “loop” section of the pond system includes several aerators. The initial section of the aerated loop can also result in odours being produced as a result of odorous compounds contained within the anaerobic pond discharge being stripped from the water and into the air via the aeration process. Odours associated with the anaerobic pond and sometimes the initial stages of the aerated loop section can be described as rotten eggs and / or a musty type of odour.

3.0 RECEIVING ENVIRONMENT

3.1 Overview

As shown in Figure 1, the Alliance Lorneville site is located 3 km northeast of the Invercargill City urban boundary and about 1 km southeast of Wallacetown. However, although Wallacetown is about 1 km to the northwest from the Alliance wastewater treatment ponds, it is about 2 km from the processing plant. Figure 1 also highlights the Alliance property boundary, which includes a significant buffer of rural land surrounding the site. This buffer provides a significant mitigation against off-site odour effects.

3.2 Nearby Residential Dwellings

The Alliance site is surrounded by predominately small rural blocks with residential dwellings within a range of directions from northwest, north, east and south of the processing and WWTP sites. The nearest private residential dwelling is located east of the processing site and is close to the Alliance property boundary. However this dwelling is approximately 700 m away from sources of odour within the processing site itself and over 2 km from the wastewater treatment pond system.

3.3 Wind Patterns

Wind roses from the Invercargill Airport and Wallacetown monitoring sites are shown in Figure 2. The distribution of wind speed and direction differs slightly between the sites due to their differing proximities to



the New River Estuary and the coast. However, both sites have predominant westerly and southwesterly components due to their exposure to large-scale weather systems approaching from the Tasman Sea and the Southern Ocean. High winds from other directions also occur as weather systems pass over the region, but the most frequent wind flow is predominantly west to east.

The area also experiences land- and sea-breezes, and terrain-driven flows. Although the terrain within 20 km of Invercargill is quite flat, drainage flows are likely from the north (via Winton) and northwest (via Gore and Mataura). These are likely to be relatively weak when they reach Invercargill and Wallacetown, as the flow is no longer channelled along a valley. However, there is a signature of weaker winds with speeds up to 2-3 m/s from the north and northwest in the wind roses at both sites. These flows are in the same general direction of the Makarewa and Oreti River flows towards the New River Estuary. In periods of low wind speed (particularly on cold days when there is very little vertical mixing), the general air flow is expected to be towards the southwest approximately following the river system.

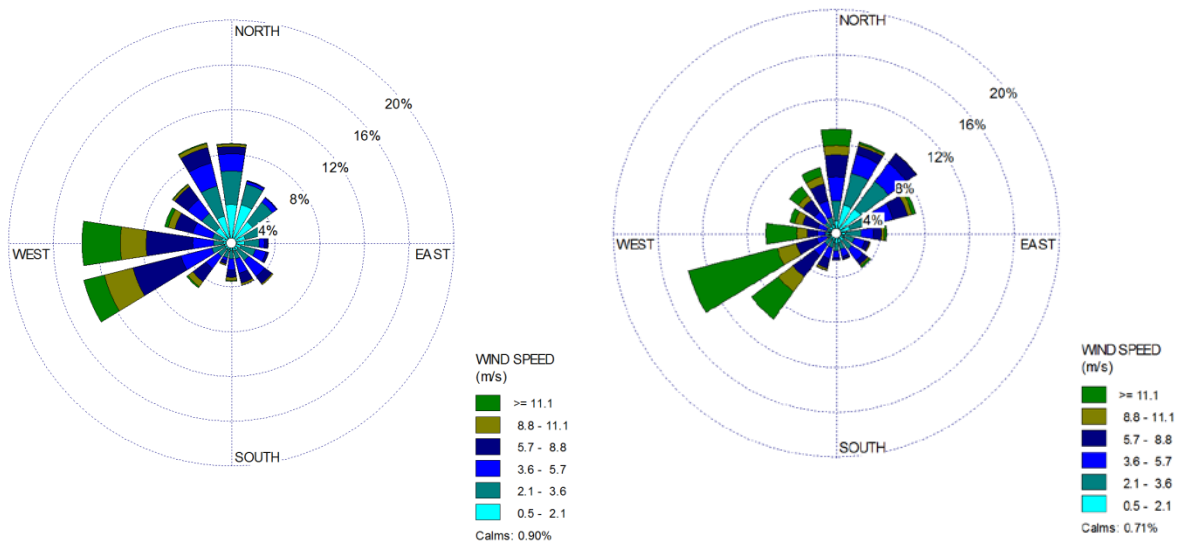


Figure 2: Wind roses from climate station data: (left) Invercargill Airport 2011, (right) Wallacetown 2012.

4.0 METHODOLOGY

4.1 Odour Assessment Tools

Various odour assessment tools are discussed in MfE (2003). For assessing the existing level of effects of odour emissions from the Alliance Lorneville, only some of the available assessment tools were considered practical, due to the low population density surrounding the site.

The appropriate odour assessment tools for the Lorneville site are listed below:

- Community consultation / surveys – Odour Exposure Survey
- Independent Downwind Surveys
- Wind patterns and terrain
- Historical Community Feedback:
 - Odour diaries



- Complaint records
- Experience and review of management and operation (best practicable option)

Odour annoyance surveys were not considered to be practical given that the most impacted receptors live in low density semi-rural situations that do not lend themselves to the use of a community annoyance survey tool. These surveys are only useful when there is a significant population in the vicinity of the odour source who are the main consideration regarding potential effects.

Odour modelling is also of limited use (unless using extensive back calculation data) due to the difficulty in establishing reliable odour emissions from the anaerobic pond. Dispersion modelling is not regarded as a 'high priority' tool (MfE, 2003) for assisting with the assessment of odour impacts for existing operations, where direct community feedback is available or can be generated for establishing the existing effects. Odour dispersion modelling may be useful to back-calculate odour emissions from the WWTP and use these to assess the benefits of proposed upgrades to the existing WWTP.

So while this tool is not proposed for the current assessments, it may be utilised in the future to assess WWTP process changes further if considered necessary.

The consideration of other site experience and knowledge of processes is not considered to be useful for this investigation of baseline odour exposure and effects. Industry experience is recommended in the MfE odour assessment guideline primarily for the assessment of proposed facilities that are known to produce odour. For an existing site, the most relevant experience of odour effects is that obtained for that site.

4.2 Applied Approach

4.2.1 Overview

The assessment aimed to assess the potential effects of both chronic and acute odour exposures at residential locations surrounding the Alliance site and the WWTP. This approach utilised feedback from survey respondents regarding the frequency, intensity, duration and offensiveness (FIDO factors) of odours they experience from the Alliance site and the WWTP.

While there is a considerable database of odour flux emissions test results from the WWTP's anaerobic pond (i.e., the main source of odour), these data are not expected to enable reliable modelling of the existing level of odour exposure. There are also odour diaries completed up to about 2003, but these have only been used to provide broad review of historical odour effects when emissions from the WWTP appeared to be much higher than current levels.

The significance of odour exposure effects can be estimated by considering the FIDOL factors (MfE, 2003) – the last factor relates to the land-use activity where the odour exposure occurs. In this instance, these are all residential dwellings with a relatively high sensitivity to environmental odour exposures. The combination of the first three FIDOL factors can be used to estimate the percentage of hours in a year where odour from the WWTP or Alliance processing plant may be recognisable (i.e., odour hours or percentage time of recognisable odour).

There are "VDI" (*Verband Deutscher Ingenieure* - Association of German Engineers) based guidelines for the maximum percentage of odour hours, which can be used as an indicative guide for evaluating the significance of the estimated time of recognisable odour. The VDI guideline for urban areas is up to 10 % of odour hours. However, the VDI method of estimating the odour hours involves repeated independent assessments by odour scouts at set locations throughout the year. The actual personal exposure frequency to environmental odours (as measured by this survey) can be less than 50 % of the actual fraction of time that these odours were present at a residential location. Furthermore the German criterion relates to industrial odours impacting on urban areas of Germany. Because of these factors, the German VDI guideline value of 10 % odour hours is reduced by a factor of 3.3 to provide a more applicable criterion for odour hour frequency (i.e., 3 %), which is then used to indicate the potential for chronic odour exposures



(assessed in this survey) to be objectionable. Further explanation of this factor's derivation is provided below.

Odour diary results are typically used to calculate the absolute frequency of long term odour exposure (% time). An equivalent odour hour frequency (% hours) value is likely to be much higher than the recorded odour diary value. This is because an odour hour does not have continuous recognisable odour for the whole hour – in fact it may only have odour present for as low as 10 % of an hour. Furthermore, it is Golder's experience that odour hours typically result in recognisable odours for up to 1/3rd of time during a specific hour.

Given the above, an appropriate odour hour criterion for New Zealand could be up to 3 times higher than an appropriate numeric criterion for assessing odour diary based results. For odour diaries, our experience is that reported diary results indicating that odour exposures are < 1 % time, then the associated level of odour effect is usually minor. Therefore given this and the relationship between equivalent criterion (in terms of effects), then an appropriate odour hour criterion would be < 3 % odour hours. Therefore, odour diary experience in New Zealand suggests that the European odour hour criterion of < 10 % needs to be reduced by a factor of 3.3 to be more appropriate for application in New Zealand.

Chronic odour exposures are recognisable occurrences of odour that are repeated over a long term period (typically for a year or more) – chronic odours are deemed to be objectionable based on a consideration of FIDOL that is related to a season, annual periods or longer. The above 3.0 % odour hour criterion is driven by long term values of the first three FIDO and is therefore an indicator of chronic odour effects.

Acute odour exposures relate to a single event (minutes to a number of hours) of odour that is relatively strong in its intensity. An acute odour event is deemed to be objectionable or offensive based on a consideration of the FIDOL factors that are specific to the short term period of that odour event. That is a FIDOL assessment that relates to a short term period that is typically in the order of several hours or sub-hourly. There are no national guidelines or standards for defining acceptable exposure frequency for unpleasant odours. The DSL Environmental Handbook provides some guidance that has been recommended by Golder (DSL, 2009). This recommends a maximum frequency of around 0.5 % of the time for strong or higher intensity odours of unpleasant character. In addition to this criterion, individual events of strong or higher intensity unpleasant odours for continuous periods exceeding 2-3 hours could be deemed objectionable or offensive.

Therefore strong odours of unpleasant character that exceed either of these aforementioned exposure-time based parameters at residential locations, have the potential cause effects that may be deemed objectionable and / or offensive.

4.2.2 Survey details

Golder undertook face-to-face surveys of people living in neighbouring areas surrounding the Alliance site and where there had been documented complaints. A copy of the survey questionnaire is provided in Appendix B. These surveys were firstly carried out in 2013, and then repeated in 2014 focusing on those areas that were considered the most affected based on the 2013 results.

The first survey was carried on 17 and 18 June 2013 and 18 face-to-face interviews were completed and 30 questionnaires were dropped in mailboxes with a self-addressed envelope. Of these, 17 were filled out and returned by the end of July 2013 resulting in a total of 35 completed questionnaires.

In 2014, a total of 27 face to face interviews were completed during 16 and 17 April and a further 13 were dropped in mailboxes with a self-addressed envelope. Of these, 3 were returned by beginning of May 2014, resulting in a total of 30 surveys being completed.

The locations of the 2013 survey respondents are shown in Figure 3, while the locations of both 2013 (green circles) and 2014 (yellow circles) survey respondents are shown in Figure 4.



4.2.3 Analysis of survey information

The survey responses were used to estimate the percentage of odour hours in the year for each of the survey locations. An hour is marked as odour hour if there is a clear odour perception in at least 10 % (6 minutes) of that hour (VDI 3788 Part I, 2000).

The frequency of events (Q1 of survey, Appendix B) and typical duration of events (Q2 of survey, Appendix B) reported by a respondent has been used to determine the number of odour hours in the year. This value was increased to account for the percentage of time that people are away from home (based on the answer to Q10). A summary of the assumptions and calculations used to estimate the number of odour hours in a year is provided in Appendix C. This number was then divided by the total number of hours in a year to give the percentage of odour hours per year for each survey respondent. As discussed previously the odour hour criterion for assessing odour hour information is specified at 2.5 % (i.e., a quarter of the time used in Germany).

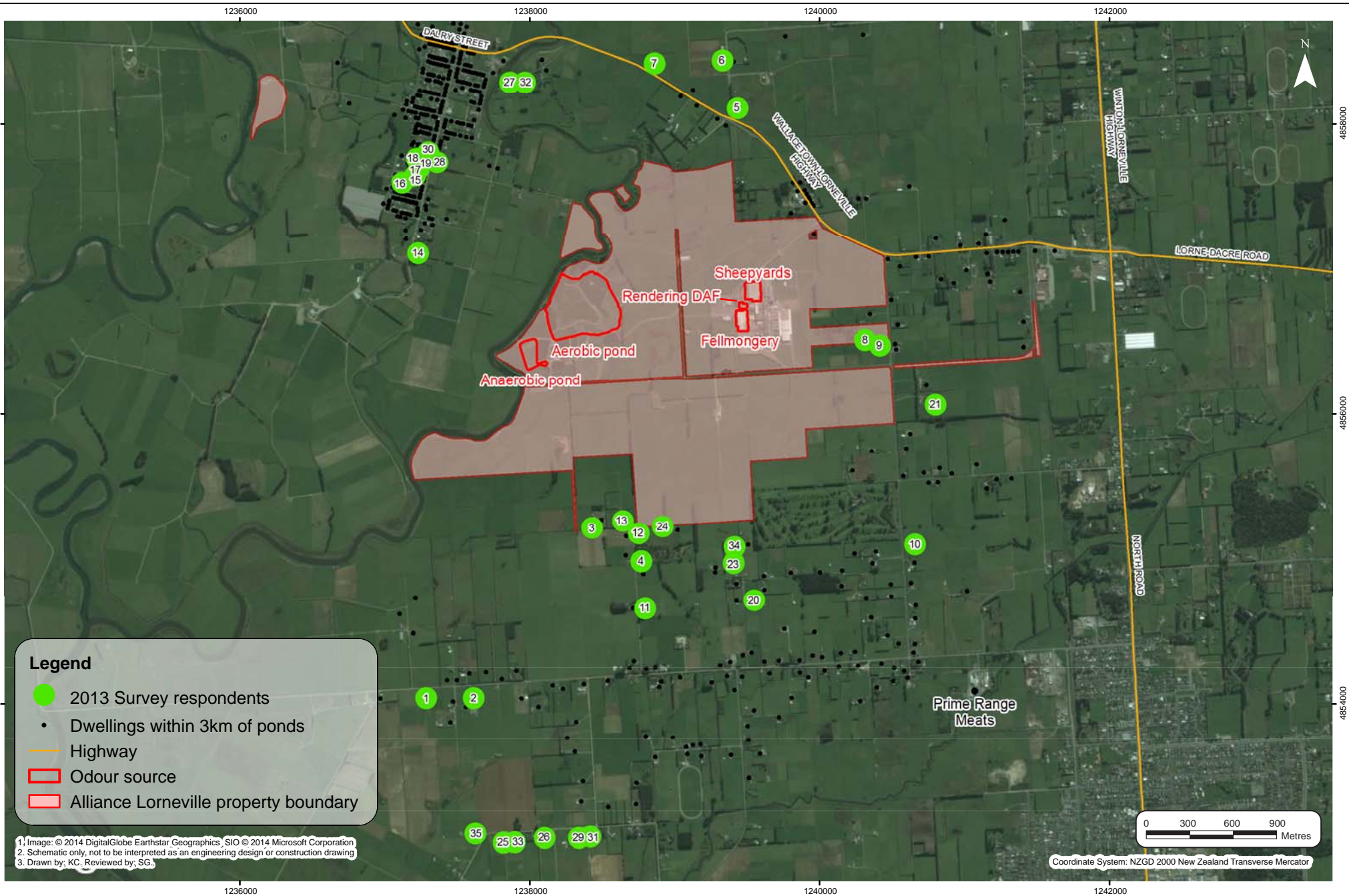
The typical FIDOL factors reported by the respondents have also been utilised to help assess the likely significance of long term odour exposure levels in 2013 and 2014 (i.e., chronic odour effects). The survey also provided information from respondents on the weather conditions, the intensity and character of the odour as well as comments on the perceived sources of odour for typical odour events. This information is used to assess the likely significance of any high intensity short term odour exposures (i.e., acute odour effects). Finally, the general comments provided by respondents regarding their tolerance of existing odour effects provides key additional information that can be reconciled against the FIDOL information.

4.2.4 Downwind frequency

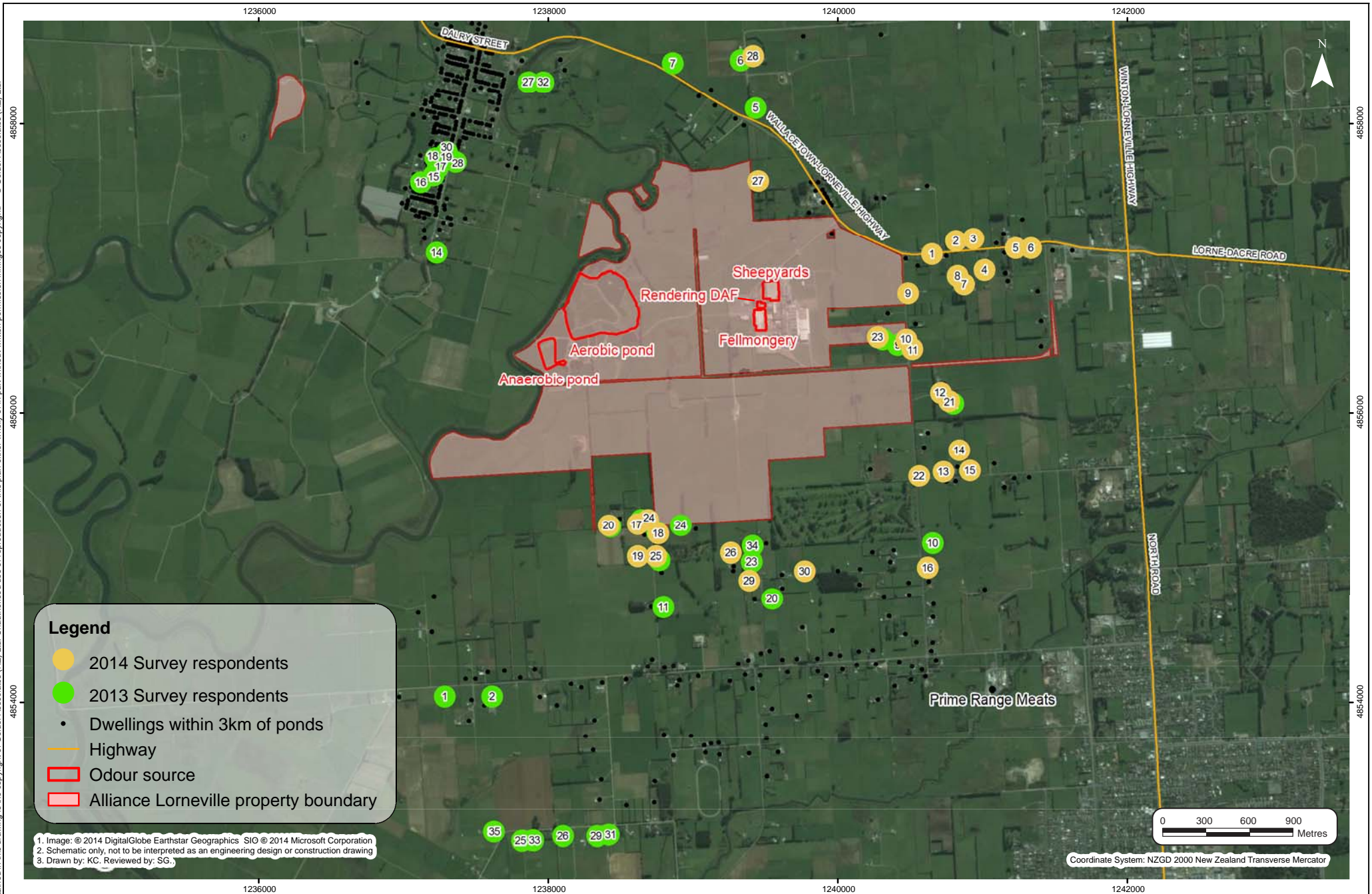
A consideration of prevalent wind patterns and terrain is used to assess the frequency of which nearby residential dwellings are downwind of the processing site or the WWTP. However, wind monitoring data can be less reliable under calm conditions, which can include the occurrence of drainage flow of cold air. Given this, the direction of drainage flows is sometimes best inferred from terrain contours and feedback from neighbours regarding their experience of odour under such conditions.

Notwithstanding the above comment, the percentage time of being downwind of the process plant or WWTP provides a cross check on the reported odour exposure frequency and inferred percentage of odour hours (%) that is obtained from the 2013 and 2014 community odour exposure surveys.

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4.3 Historical Information

In past years Alliance ran an odour diary programme (finishing in 2003). The results of this diary programme have been reviewed and indicate that the past level of odour exposure was likely to have been higher than is currently occurring. Therefore, this data was not used to determine the current level of odour exposure in the areas surrounding the Alliance site. There have been relatively few odour complaints in recent years attributed to the Alliance site (see Section 6.0). However, these escalated during the summer of 2012 / 2013 when the new rendering plant was having commissioning difficulties

5.0 SUMMARY OF SURVEY RESPONSES

A summary of the responses collected during the 2013 and 2014 odour exposure surveys is provided in this section. The combined responses for all locations are compared for each survey year. However these comparisons need to account for the 2014 survey data arising from the more impacted areas to the east and south of the site. This is done through the specific discussions regarding each figure presented below. By comparison the 2013 data consists of a great portion of respondents living further away from the site and therefore from areas that are less impacted. In Section 7.0, an assessment of exposure frequency and other factors is provided for areas where odour effects are most pronounced (i.e., to the east and south of the Alliance site and WWTP) as confirmed from the 2013 survey results.

Figure 5 compares the frequency of odour events that are noticed by respondents in 2013 and 2014 (Question 1 of the survey). The higher fraction of people saying “never notice odour” in 2013 is a result of more distant areas being surveyed in 2013 compared to 2014. Otherwise the 2014 survey results indicate a similar or possibly lower frequency of odour events being noticed than in 2013. Therefore the **frequency** of odour events appears to have reduced in 2014 compared to 2013 for individuals who are close enough to notice odours on occasion.

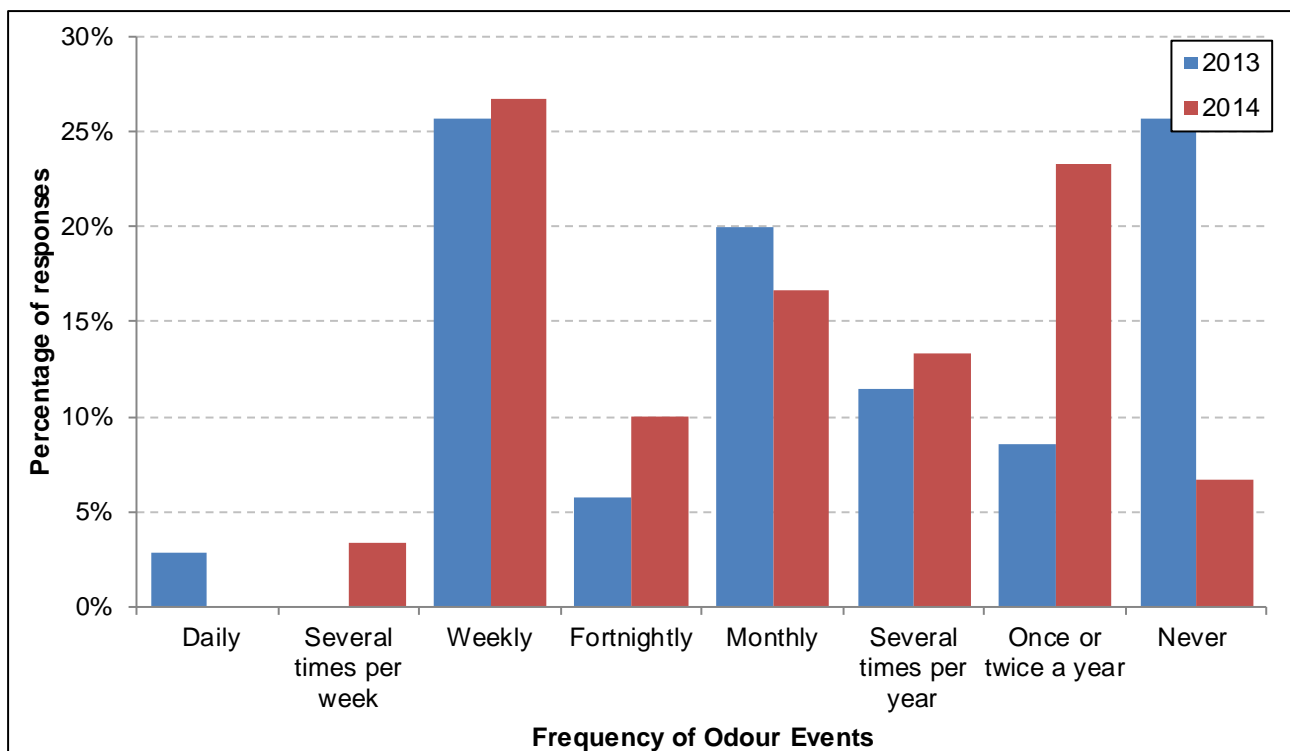


Figure 5: Frequency of odour events experienced by respondents.



A comparison of the typical duration of individual odour events noticed by respondents in 2013 and 2014 is shown in Figure 6 (Question 2 of the survey). Note that those who responded “never” to frequency of odour event are not included in this or following figures relating to the typical experience associated with odour events. Considering respondents who did notice odour events from Alliance (i.e., did not respond “never” to Question 2), there were a total of 26 responses in 2013 and 28 in 2014. For 2013, half a day is the most frequent duration of each odour event experienced. Whereas for 2014 respondents, the typical length of odour events was identified as “less than 1 hour”, “2-3 hours” and “half a day”. Therefore the **duration** of odour events for people who notice odours appears to have reduced in 2014 compared to that reported in 2013.

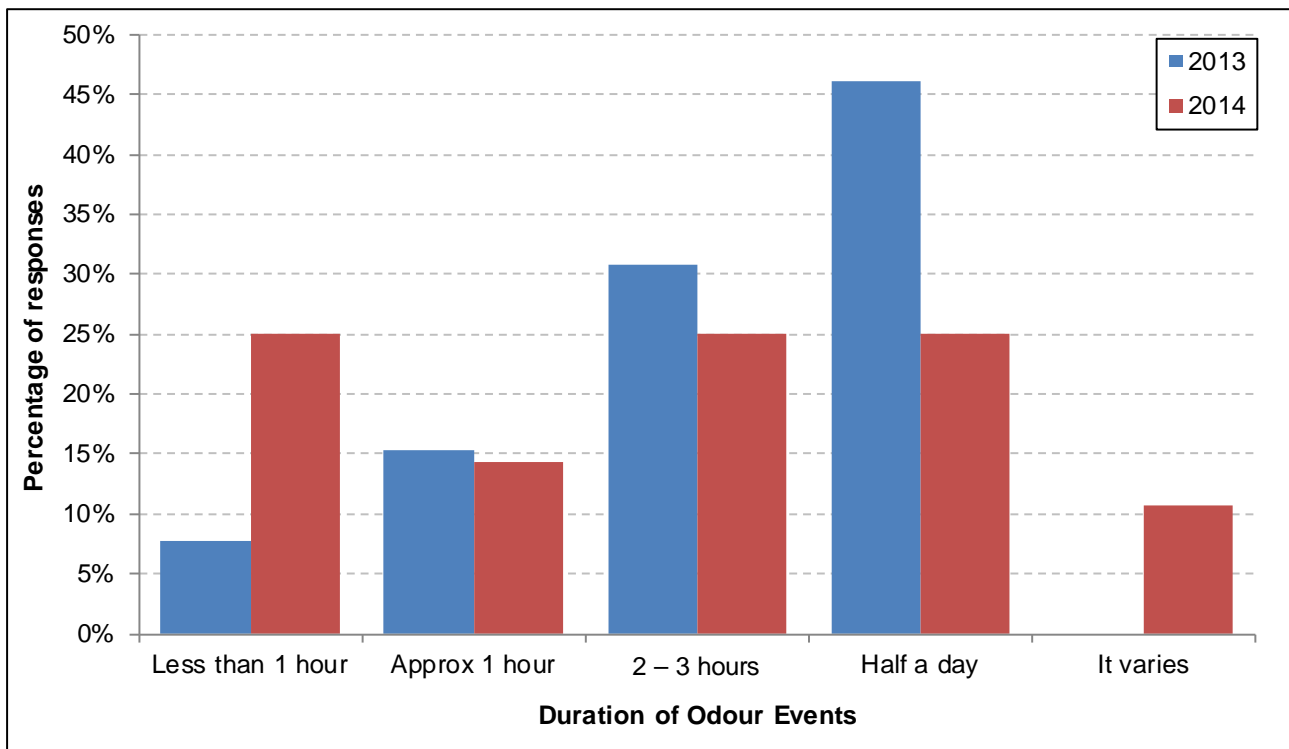


Figure 6: Duration of typical odour events experienced by respondents.

Figure 7 compares the reported continuity of the odour experienced by respondents in 2013 and 2014 (Question 3 of the survey). Continuity is a measure of how consistently an odour is present during the duration of the event. Figure 7 shows that a higher level of continuity was experienced in 2014 compared to 2013 (i.e., a greater fraction of people reporting the odour is present all the time during the event). A higher level of continuity is consistent with the shorter **duration** of odour events reported in 2014 (i.e., typically sub hourly to hourly) compared to 2013 (i.e., typically several hours to ½ a day).

Figure 8 compares the times of day that the odour was typically observed by respondents in 2013 and 2014 (Question 4 of the survey). The results for 2014 show a shift towards evening and night time odour events compared to 2013 results. In 2013 most respondents typically observed odour during the morning, with late afternoon being the second most frequent time of day when odour events occurred.

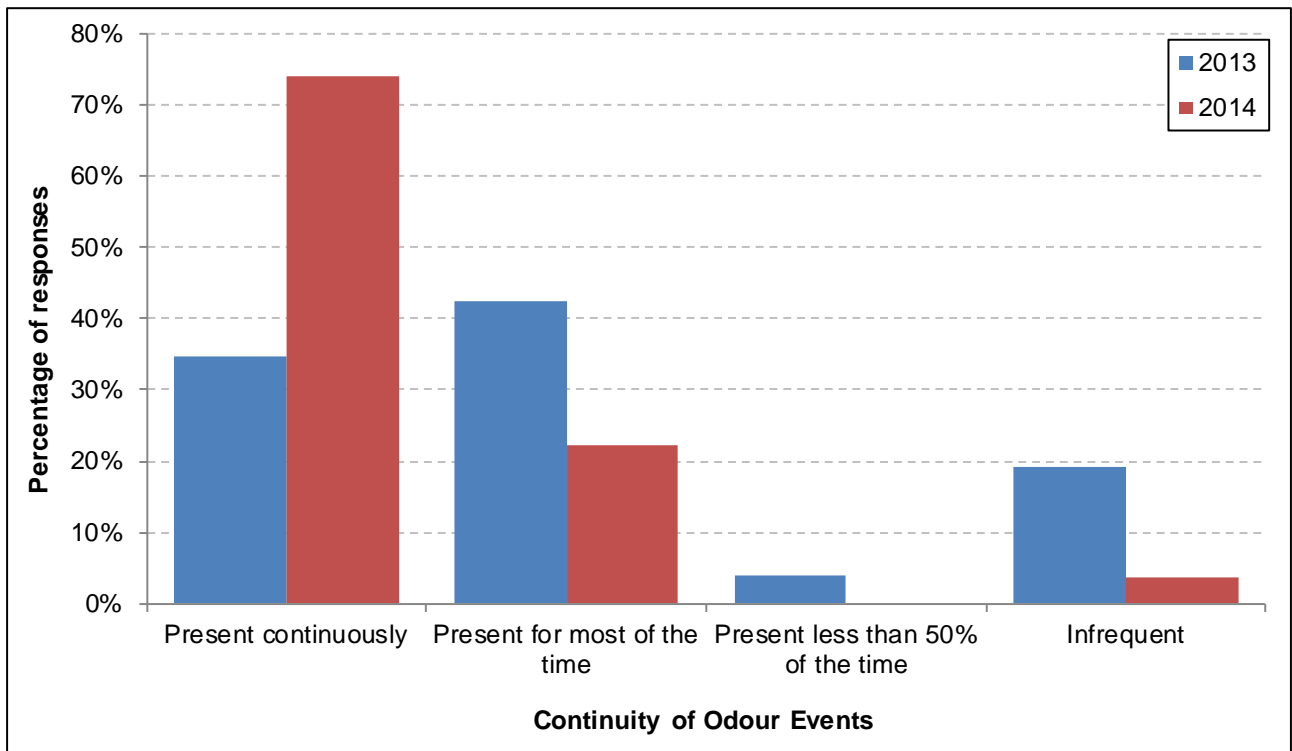


Figure 7: Continuity of typical odour events experienced by respondents.

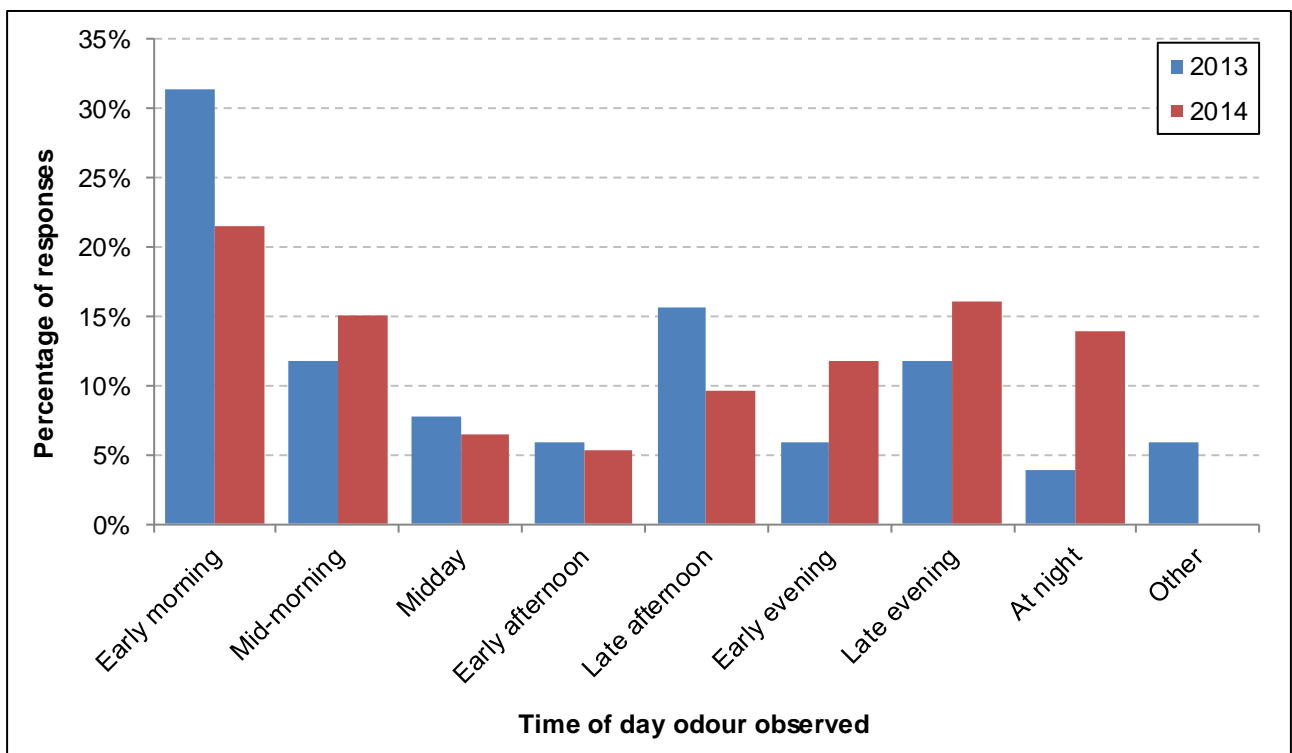


Figure 8: Times of day when odour is typically experienced.



A comparison of weather conditions that were considered to be typical during odour events observed by respondents in 2013 and 2014 (Question 5 of survey) are shown in Figure 9. For both years, still, calm or light winds associated with cool or cloudy skies were the most typical conditions associated with odour events. Clear skies and sunny weather were conditions least associated with odour events for both years. This is expected for odour sources which discharge at ground level, (includes all process and wastewater treatment sources) and is consistent for the prevalent times of day when odour events occur (i.e., early mornings and evening periods). The change in percentage of responses between 2013 and 2014 for odours during windy conditions equates to only several survey responses – this is not considered a significant change especially as the location of respondents was more biased towards those living downwind of south-westerly conditions for the 2014 survey (see Figure 17).

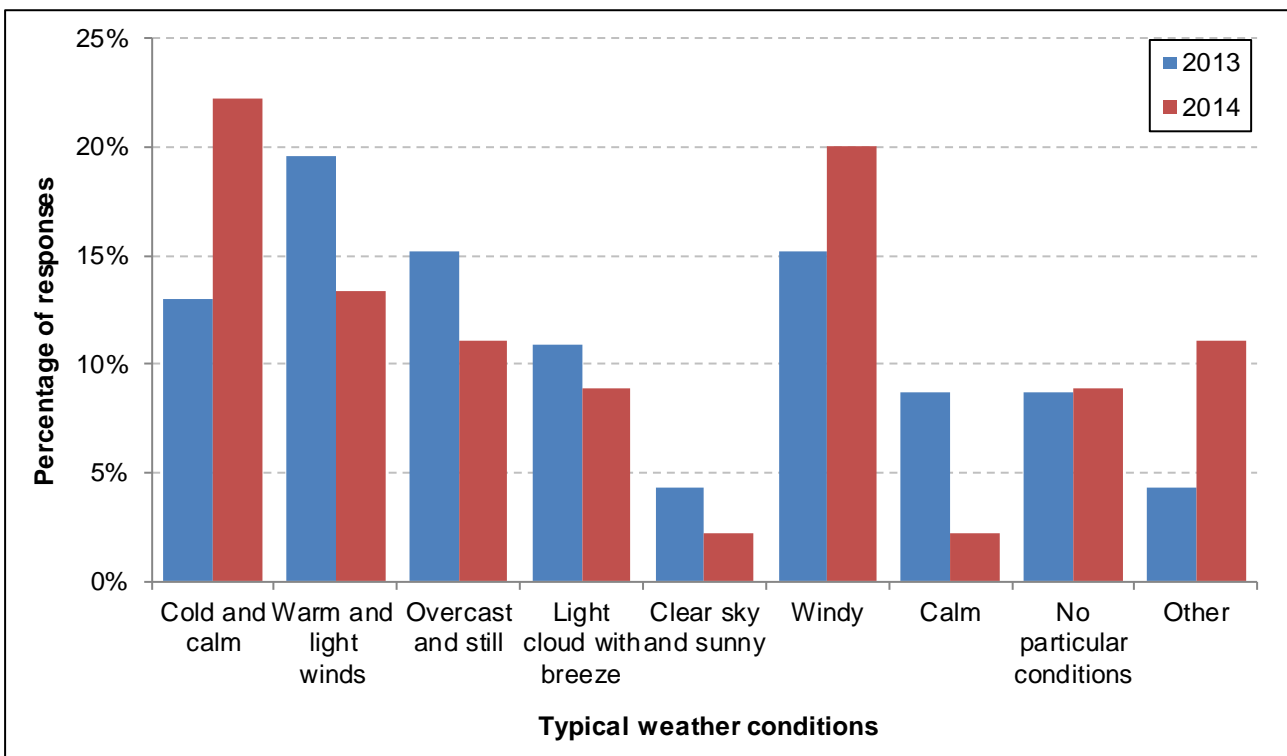


Figure 9: Weather conditions odour when is typically experienced.

Figure 10 compares the typical intensity of the odour events observed by respondents in 2013 and 2014 (Question 6 of survey). Figure 10 shows that most survey respondents described the typical intensity of the odour as “distinct” and “strong” in both 2013 and 2014. Overall, there does not appear to be a significant change between the 2013 and 2014 results with respect to the average strength (**odour intensity**) of odour events.

Figure 11 compares the descriptions used for the odour events observed by respondents in 2013 and 2014 (Question 7 of survey). In 2013, the descriptions sulphur / hydrogen sulphide (H₂S), wastewater / septic tank, rendering / cooking and dead animals / rotting were all identified equally. In 2014 the reported odour descriptions appeared to be biased towards rendering / cooking, followed by sulphur / hydrogen sulphide (H₂S) and ammonia. This increased bias towards rendering odour descriptions in 2014 was expected given the greater attention to surveying respondents living to the east of the site in 2014 compared to 2013 (see Figure 17).

The 2014 survey obtained a larger number and greater portion of respondents living to the east of the plant where rendering odours from the commissioning of the new plant in 2013 would have been most noticeable. A lower portion of respondents were surveyed in locations that have been historically more exposed to



wastewater plant odours. Therefore, respondents for the 2014 survey would have far less potential for exposure to wastewater pond odours compared to 2013 survey respondents and, consequently, it is expected the 2014 survey to have a greater prevalence of rendering as a source of odour noted by the respondents compared to 2013. Furthermore, it is suspected that some respondents attributed process odours from the fellmongery (including sulphurous / sulphide) to the rendering operations. This is based on observations during the interviewing of respondents in 2014, where a number of respondents seemed to link sulphide type odours to the rendering plant – few seemed aware of the potential for the fellmongery to cause this type of odour. The fellmongery was also known to have had some issues with sulphide (rotten-egg type odours) on some Monday mornings, which process changes appear to have mitigated.

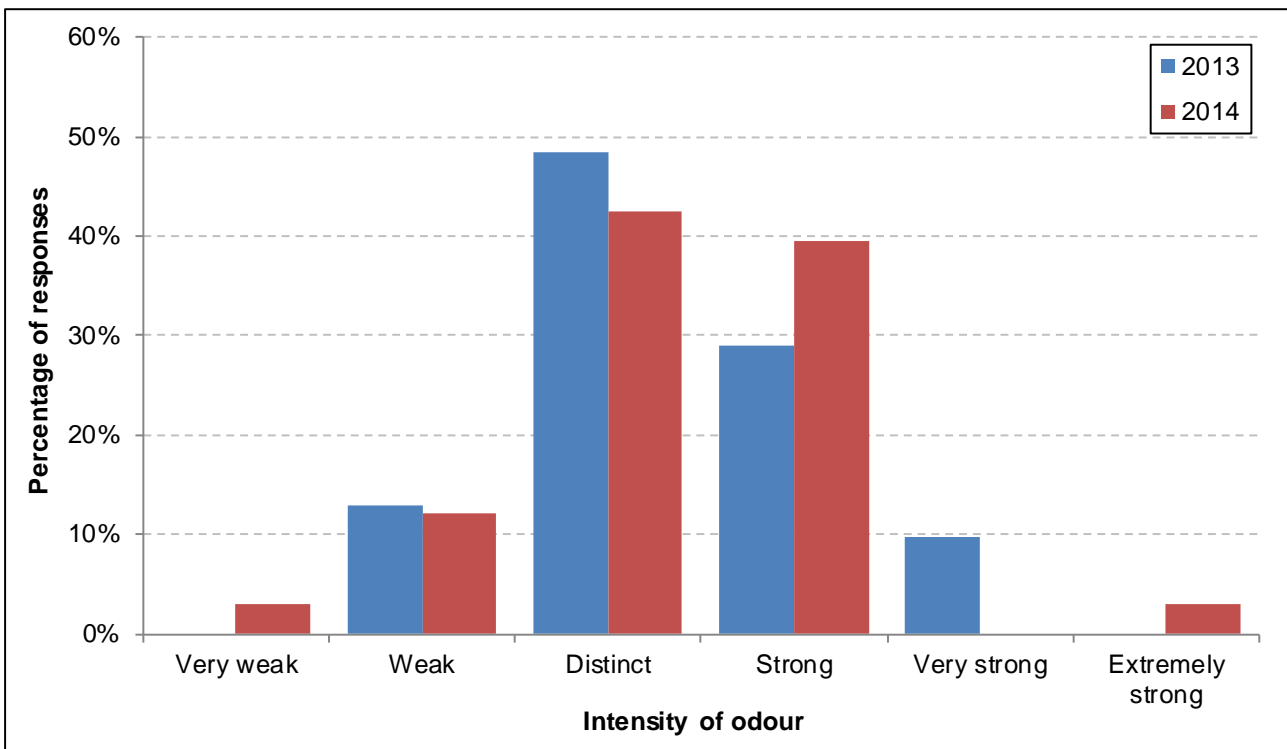


Figure 10: Typical intensity of odour during odour event.

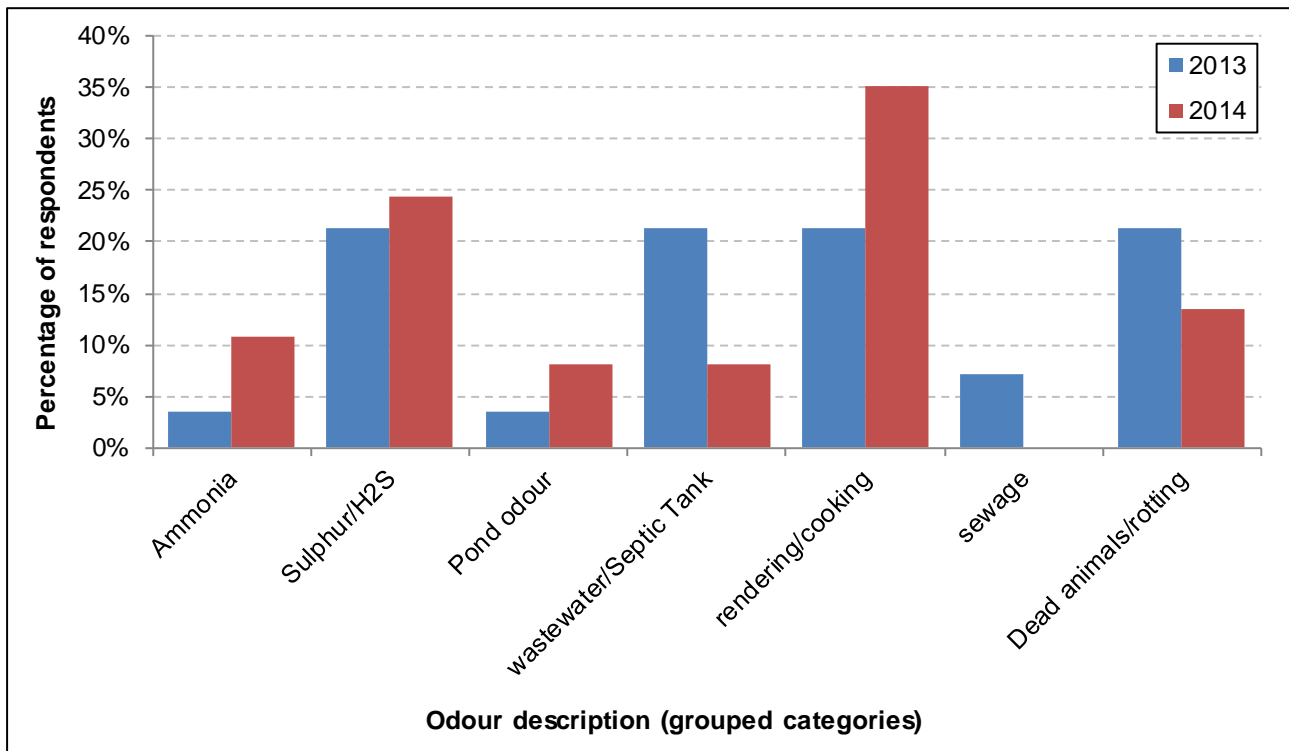


Figure 11: Typical odour description.

A comparison of the most frequently noticed sources of odour observed by respondents in 2013 and 2014 (Question 8 of survey) are shown in Figure 12. The respondents were asked to rank the odours they experience at home from 1 (most frequently noticed odour) to 5 (least noticed odour), out of the main Alliance odour sources and one option of “Other non-Alliance source”. Since a lot of the respondents were only able to identify the top two sources of odour, only the distribution among Ranks 1 and 2 are shown in the graph. The change in distribution between 2013 and 2014 responses seems significant, but again, this is a reflection of the change in location of where respondents were surveyed with respect to the plant. The great prevalence of rendering odours as the most frequently noticed source (which could be largely driven by Fellmongery odours) in 2014 compared to 2013 is therefore expected because there were more surveys undertaken to the east of the plant in 2014.

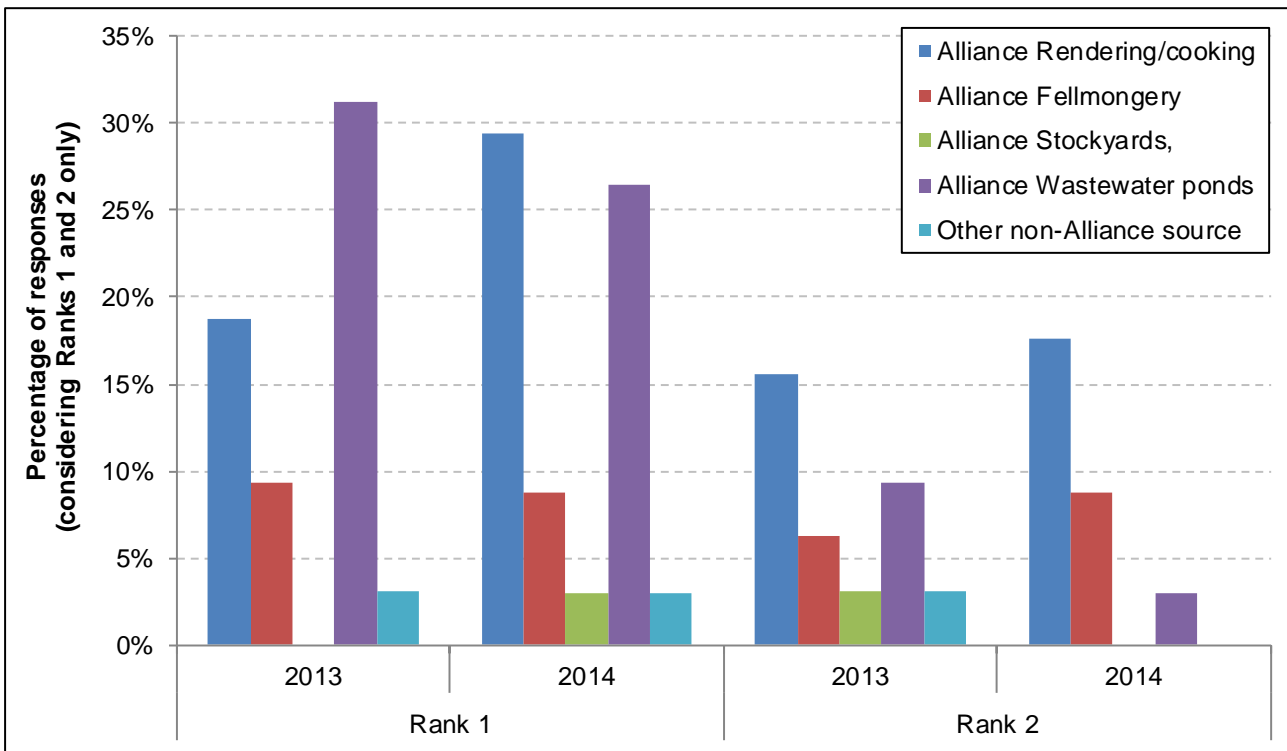


Figure 12: Most frequent (Ranks 1 and 2) sources of odours identified by respondents.

Figure 13 compares the number of years respondents have been living in the area when the 2013 and 2104 surveys were undertaken (Question 9 of survey). The residents interviewed in 2013 were split between people who had lived in the area less than 5 years and longer, whereas the residents surveyed in 2014 had predominantly (~ 70 % of total) lived in the area over 5 years and often for 20 years or longer. This change is most likely due to the difference in people being interviewed, not to a trend in the same people being interviewed.

Figure 14 compares the typical time that each respondent stays at home during the week when the 2013 and 2104 survey was undertaken (Question 10 of survey). This was based on the reported regular hours away from the house which, as explained in Section 4.2.3, were accounted for in the calculation of odour hours for each respondent.

An evaluation of the summary data presented in this section by neighbourhood group is discussed further in Section 7.0 along with other measures of odour exposure such as acute and chronic odour effects.

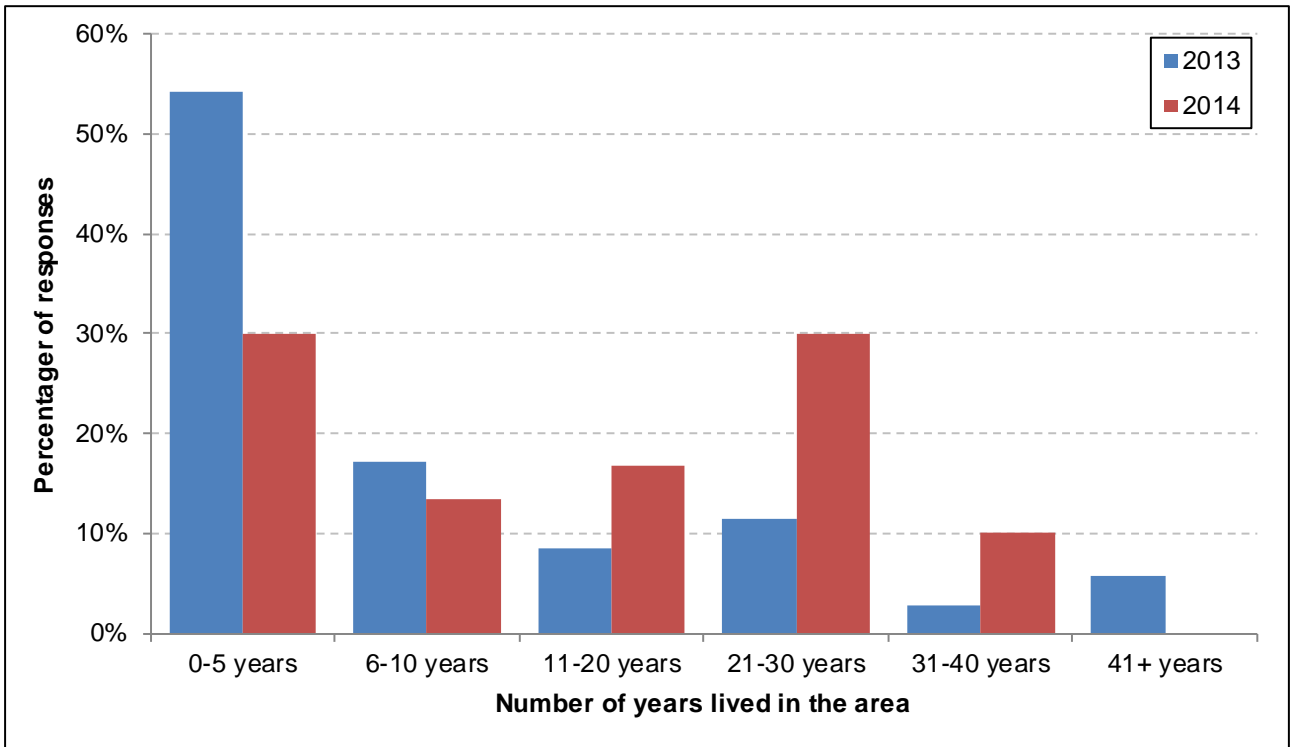


Figure 13: Number of years lived in the area.

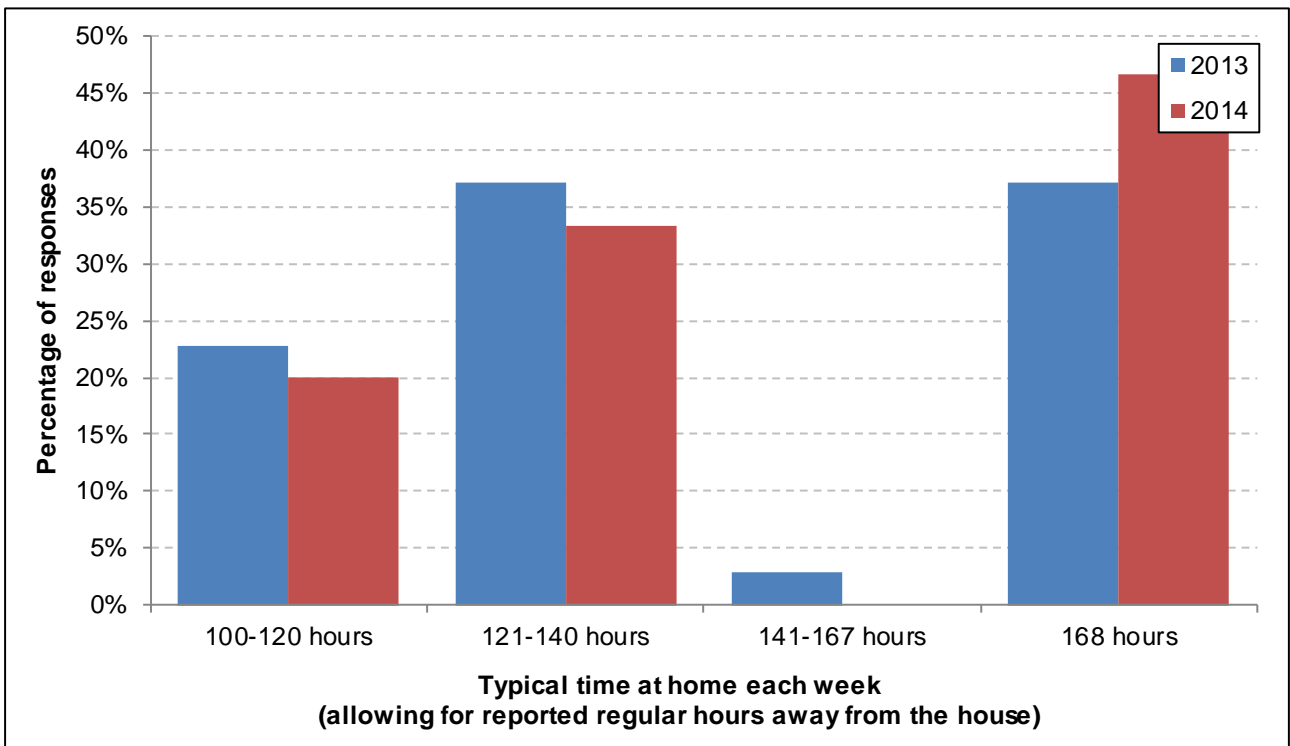


Figure 14: Typical time at home (allowing for reported regular hours away from the house (Note: 168 hours is 1 week).



6.0 COMPLAINT RECORDS

Odour complaint records have been obtained from Alliance and Environment Southland. Environment Southland has provided records of complaints attributed to Alliance and all complaints within 4 km of the plant since 2008. A summary of Environment Southland complaints to July 2014 is shown in Figure 15. With the exception of 2013, most complaints within 4 km of the site are not related to Alliance’s operations, with burning / smoke / ash and farming type odours being the most frequent air related complaints reported to Environment Southland. Environment Southland’s records show that there has been a significant decline in the overall level of complaints in the area since 2008.

Alliance has received more complaints directly about their operation than recorded by Environment Southland, and a summary of Alliance’s complaint records (to July 2014) is shown in Figure 16. Typically there have been less than 10 complaints per year reported to Alliance with the majority of complaints relating to WWTP odour. There was an increase in the number of complaints in 2013, which had the most complaints reported in any year since Alliance’s records began. As discussed in Section 2.0, during 2013 Alliance had difficulty with the commissioning of the new rendering system that also put pressure on the WWTP. There were also minor changes to the Fellmongery process that may have contributed to the increase level of complaints. The majority of complaints to Environment Southland and to Alliance about Alliance’s odour in 2013 were from a single neighbour on Leonard Road. Note that of the seven complaints received in 2012, three of them were during the 2012 / 13 processing season (i.e., December 2012). Compared to the first half of 2013, there has been a decrease from 11 to 8 complaints in the first semester of 2014.

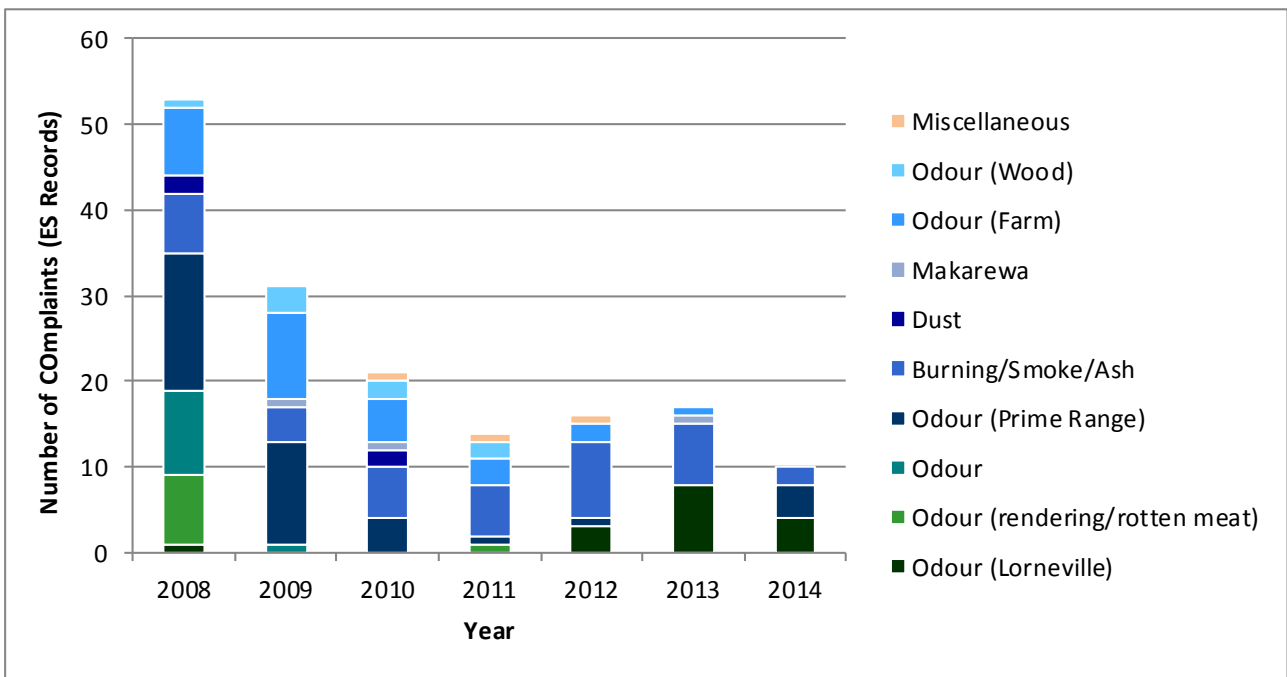


Figure 15: Environment Southland Complaint Records. All air related complaints within 4 km of Alliance Lorneville.

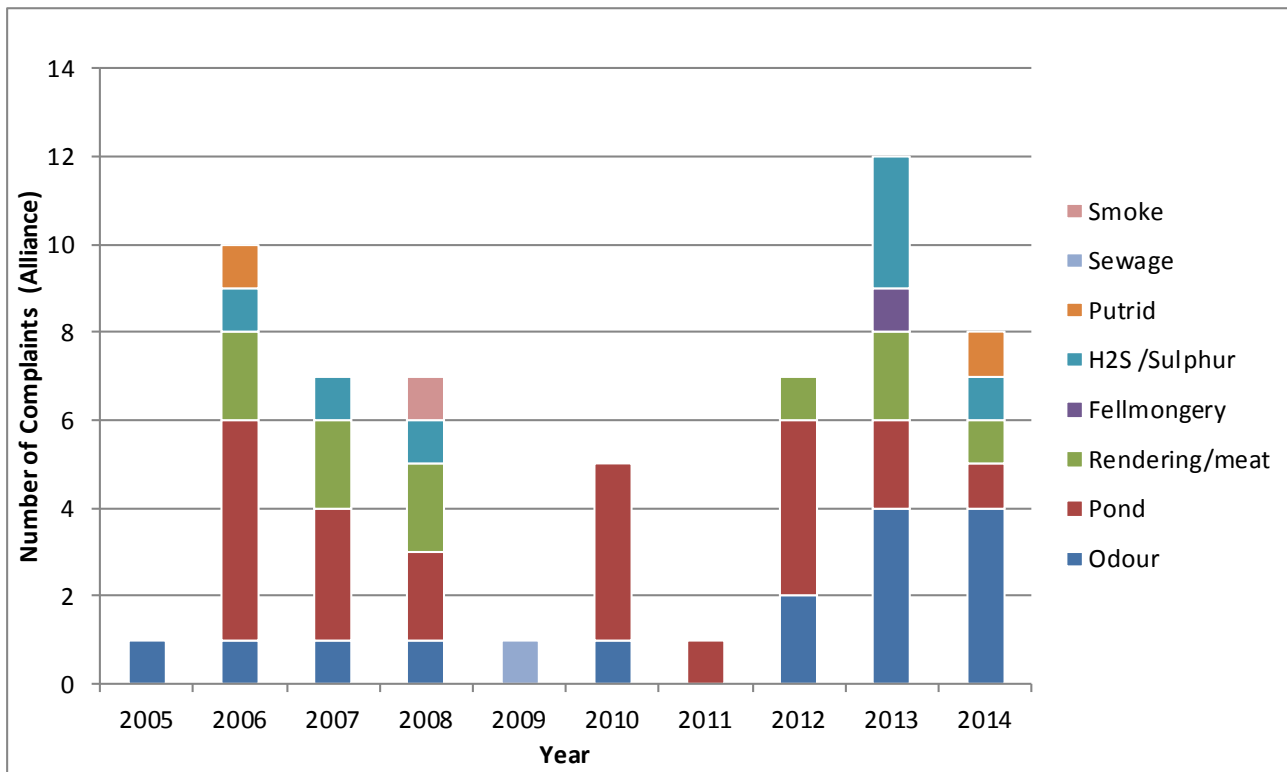


Figure 16: Alliance Complaint Records.

7.0 ODOUR EXPOSURE ASSESSMENT

7.1 Overview

This section presents the estimated odour exposure time for different groups of neighbours surrounding the Alliance site, based on an assessment of individual survey results. Odour exposure is presented as 'percentage of odour hours', as defined in Section 4.2.3. This section also presents an assessment of chronic and acute odour effects for each group based on the odour exposure and other FIDOL factors. As explained in Section 4.2.1, chronic odour effects are due to a high frequency of repeated recognisable odour over time, while acute odour effects are due to infrequent, high intensity exposures of unpleasant odour.

7.2 Neighbour Groups

When analysing the data from the 2013 survey, the respondents to the survey were grouped according to their geographic proximity to the Alliance site. Groups A to G were used in the 2013 survey. With the exception of groups A and G, all these groups were re-surveyed in 2014 and including two new groups, H and I. Groups H and I were added as part of the 2014 survey to include data with a greater emphasis on neighbours to the northeast and east of the site (closer to the rendering plant and Fellmongery). The groupings locations are shown in Figure 17 and described in Table 1. Residents to the west and to the southwest of the site were not surveyed because there are only a few residential dwellings located in these directions from the site and which are set back at a greater distance than Group F (see Figure 17). Group F residences have a greater cluster of houses and are expected to be more significantly impacted by wastewater odours. Respondent 22 of the 2013 survey chose not to provide address information and therefore has not been included in the groupings or on Figure 17.

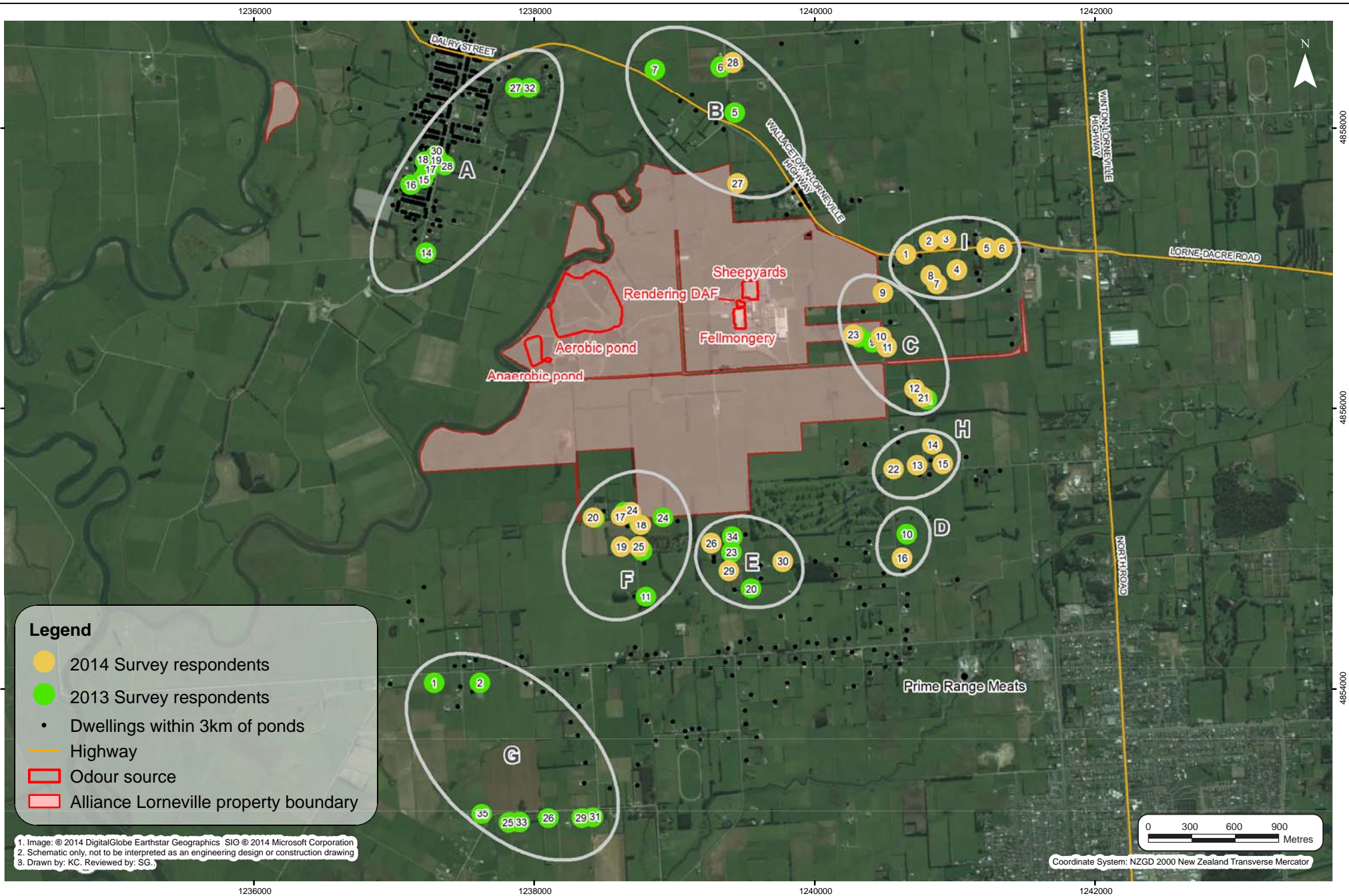




Table 1: Locations of 2013 and 2014 odour survey groupings.

Group	Location	2013 Survey	2014 Survey
A	Wallacetown	✓	
B	North of Alliance	✓	✓
C	Opposite Alliance eastern boundary	✓	✓
D	Southeast of Alliance	✓	✓
E	Wills Road - south of plant	✓	✓
F	Leonard Road - south of WWTP	✓	✓
G	West Plains Road	✓	
H	Southeast of processing plant		✓
I	Northeast of processing plant		✓

7.3 Results

7.3.1 Summary

As explained in Section 4.2.3, the percentage of odour hours was estimated based on survey responses. The results for odour hour estimations are shown in Figure 18 for the 2013 survey and in Figure 19 for the 2014 survey. These are discussed further for Groups A to I in Sections 7.3.2 to 7.3.10 respectively.

The frequency that each resident is downwind of the various potential sources of odour has been calculated using local meteorological data recorded near Wallacetown. The results are provided in Appendix D and these are discussed further in the following sections.

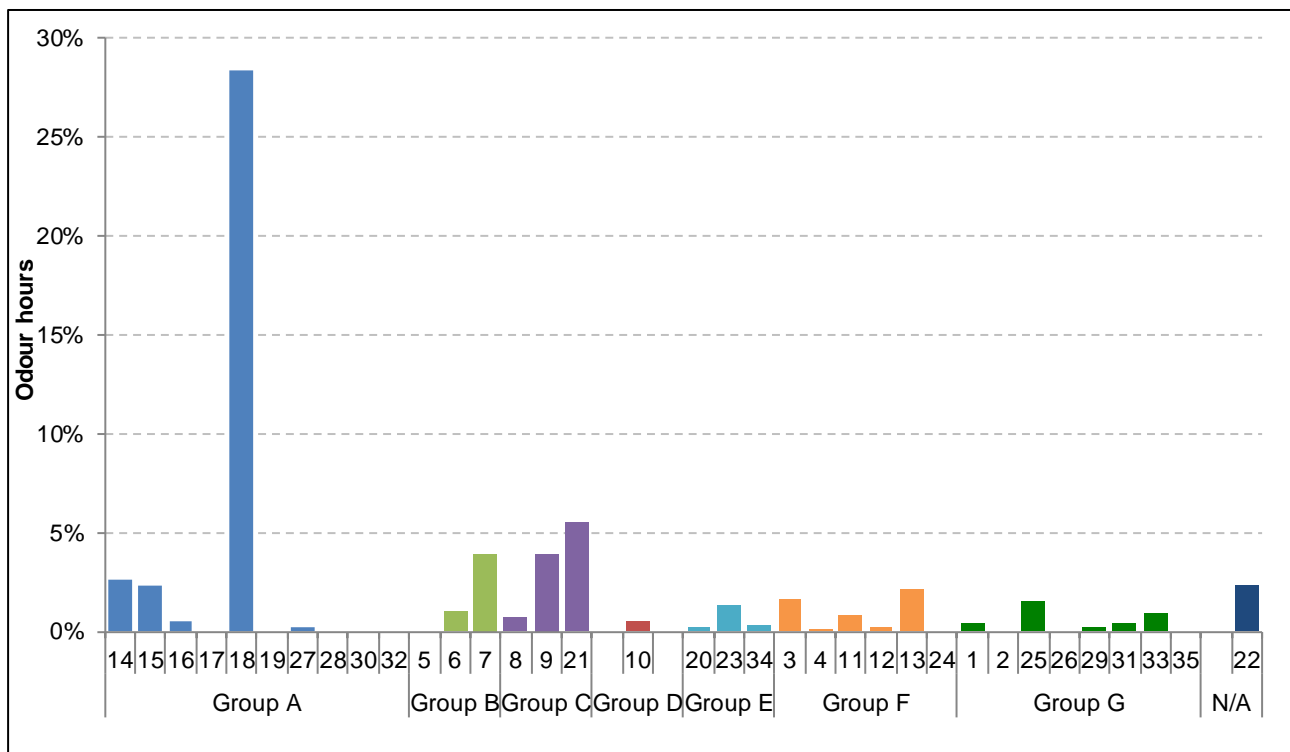


Figure 18: Percentage of Odour Hours by respondent number and location groups of 2013 survey.

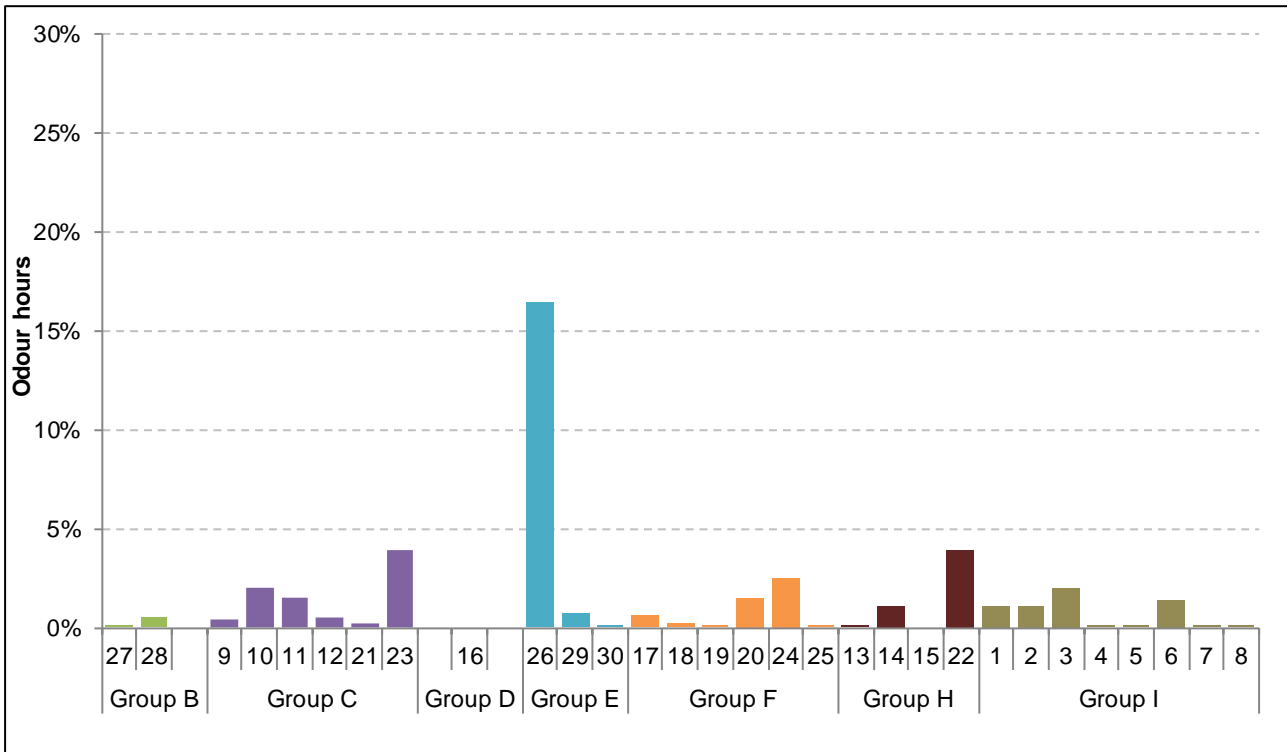


Figure 19: Percentage of Odour Hours by respondent number and location groups of 2014 survey

7.3.2 Wallacetown (Group A)

Overview

Group A includes residents of Wallacetown who were only surveyed in 2013. These residents are 1,000 to 1,800 m to the northwest from the WWTP and approximately 2,400 m northwest from the Processing plant. The majority of the respondents to the survey are downwind of the WWTP 6 % to 10 % of the time and are downwind of the processing plant on average 8 % of the time. A review of complaint records up to July 2014 (from both ES and Alliance) show only one to two complaints regarding odours from Alliance in the last 10 years from this area. Out of the 10 survey responses in this area, five reported to smell odour less than once or twice per year from Alliance.

Estimated Odour Exposure

People typically noticed odour, and the typical frequency (F) of odour events is weekly to monthly, with an intensity (I) distinct to strong. The duration (D) of odour events is typically reported as 2 – 3 hours to half a day. This indicates an average percentage of odour hours of to 0.4 % to 2 %. The average value of 0.7 % is calculated from individual results for Wallacetown, which is below the criteria of 3 %. This value excluded the one outlier of 28 % odour hours. This is far in excess of the frequency that Wallacetown is downwind of Alliance’s WWTP.

Descriptions

The odour descriptions in 2013 ranged from cooked meat, rotten meat to Rotorua type (H₂S type odours), and the WWTP was typically identified as the source of the odour with rendering and the fellmongery also ranked in the top two sources. This indicates odour impacts from the newly commissioned rendering plant in 2013 that would have been mitigated by Alliance in 2014.



Assessment of Odour Effects

Based on the low percentage of odour hours, it is considered that, as from 2014 process season, residents at Wallacetown would receive a low to moderate level of chronic odour exposure due to the wastewater ponds and processing plant that is unlikely to be objectionable.

During relatively infrequent occasions (< 0.5 % of time) would wind from the southeast be sufficiently light (i.e., > 0 > and < 3.6 m/s) to transport clearly recognisable to strong anaerobic pond odours to Wallacetown. These events are expected to occur for several hours or less. Therefore, it is concluded that there is a low level of acute odour exposure at Wallacetown from the wastewater ponds that is unlikely to be objectionable or offensive.

7.3.3 North of Alliance (Group B)

Overview

Group B residents are located north of the site at 2,000 m from the WWTP and approximately 1,500 m from the processing plant. The majority of the respondents to the survey are downwind of the WWTP on average 17 % of the time and are downwind of the processing plant on average 6 % of the time. A review of complaint records (from both ES and Alliance) shows only three to four complaints about Alliance in the last 10 years from this area. It is noted that there have been several complaints about a neighbour's dairy effluent pond.

Estimated Odour Exposure

Respondents of this group often noticed odours from Alliance. In 2013 the occurrence of odour was typically weekly to monthly events, while in 2014 this decreased to once or twice to several times a year. In both years the intensity (I) of odour varied from weak to strong and the duration (D) of odour events was reported as half a day. Calculated percentage of odour hours varied from 1 % to 4 % of the time in 2013, with an average of 2 %. This decreased in 2014, varying from 0.1 % to 0.5 % and with an average of 0.33 % of the time – This is well below the criteria of 3 %.

Descriptions

The odour was described as “dead things” or WWTP odour. The general feedback indicates that some of the respondents often recognise odour when wind blows from the Alliance site towards north. Some of these respondents reported a strong odour intensity.

Assessment of Odour Effects

Group B residents are frequently downwind of the WWTP, which is typically associated with moderate (i.e., > 3.6 and < 8.8 m/s) to strong (i.e., > 8.8 m/s) wind conditions, which effectively dilute odour intensity as with distance from the WWTP.

Based on the estimated percentage of odour hours, Group B is assessed to have a low to moderate chronic odour exposure level due to the Alliance site that is not likely to be objectionable.

On infrequent occasions (< 0.5 % of time) the wind conditions from the south are light (i.e., > 0 and < 3.6 m/s) and more likely to cause recognisable to strong WWTP odours. Therefore, it is concluded that there is a low acute odour exposure level due to the Alliance site and WWTP that is unlikely to be objectionable or offensive to Group B residents.

7.3.4 Opposite Alliance Eastern Boundary (Group C)

Overview

Group C residents are 2,300 m to the east of the Alliance WWTP and are mostly located adjacent to the eastern boundary of the Alliance owned property. These residences are not sensitive to the WWTP pond odours because of the separation distance and because the prevalent winds from that direction (west) are moderate to strong. However, Group C residences are relatively close to Alliance's onsite process odour sources (typically 800 to just over 1000 m away) and downwind for up to 2 % of the time when light wind



conditions prevail (i.e., > 0 and < 3.6 m/s). These sources include the rendering plant, wastewater dissolved air flotation tank, the fellmongery, soup stock and the stockyards.

The Group C residents are not downwind of the site processes during calm conditions and drainage air flows. They are more typically downwind during moderate (i.e., > 3.6 and < 8.8 m/s) to strong (i.e., > 8.8 m/s) wind conditions, which occur for approximately 6 % of the time. These wind conditions dilute odour discharges rapidly as they travel from their source. Therefore, while Group C residents are very close to Alliance's eastern property boundary, they are very rarely downwind during worst case conditions for odour dispersion. There appears to be no complaints of odour that is attributed to Alliance from the Group C area.

Estimated Odour Exposure

In 2013 only three residents were surveyed in the Group C area - two living close to the Alliance site boundary and the third much further away to the south east. The calculated percentage of odour hours (based on reported duration and frequency information), ranged from 1 % to 6 % of the time and for odour which was described as cooking meat or septic tank odour. The source of the odour was in two out of three cases identified as the rendering plant. This indicates chronic odour exposures that were objectionable or offensive could have occurred during the 2013 processing season.

The 2014 survey obtained double the number of respondents in Group C, which reported the frequency (F) of odour events ranging from weekly to several times per year. The reported intensity (I) was distinct to strong. The responses regarding duration (D) of odour events typically varied from "less than 15 minutes" to 2 - 3 hours. One response reported "half a day", which is considered an outlier. This indicates a percentage of odour hours in the range of 0.3 % to 2 %, which is below the criteria of 3 %.

Half of the 2014 survey respondents in Group C commented that odour from Alliance was not an issue or did not bother them. One of the respondents also commented that odour from Alliance has been better since the commissioning of the new rendering plant, which aligns with the experience of Alliance and reports from survey respondents in Group F.

With regard to the acceptability of the existing odour impacts, the 2014 survey identified that most residents living in Group C seem to be tolerant of odour impacts from Alliance's site processes and half of them considered that odour from Prime Range Meats was more noticeable. Only one resident appears to find the level of odour from Alliance to be a significant issue.

Finally, it was interesting that none of Group C residents mentioned the strong burnt wool / manure odour that was observed by Golder when undertaking the 2014 survey. This was observed near properties that are closest to Alliance when the wind direction was coming from the southeast and downwind of the wool processing facility that is off Steel Road.

Descriptions

Typical odour descriptions are listed below. The first four descriptions indicate relatively neutral odour character and raises the prospect that soup stock odours might be observed by the neighbours as opposed to rendering odours – although this is considered to be unlikely. The dead sheep and rotten eggs could be associated with the Fellmongery operation which discharges sulphide type odours from the process and the wastewater reticulation system.

- Corn beef cooking
- Hot meat smell
- Fat cooking
- Meat cooking
- Dead sheep
- Rotten eggs



Assessment of Odour Effects

Golder concludes that the rendering odours being produced from the new line during commissioning in 2013 were likely to be causing frequent rendering process odours that could have been causing chronic odour exposure exposures that were objectionable for Group C. However, this situation appears to be resolved based on 2014 survey feedback.

Subsequent to the above, it is concluded that long term chronic odour exposures due to Alliance's odour emissions are not of sufficient frequency (i.e., < 3.0 % time) to cause objectionable effects.

Regarding acute odour impacts, the dead sheep or rotten egg type odour have the potential to cause objectionable effects. The odour character descriptions from some Group C residents indicate relatively unpleasant odour characters (i.e., a similar hedonic tone rating to WWTP pond odour).

The frequency of unpleasant odours occurring within Group C is estimated to be in the order of 0.5 % time (44 hours / year) or less. The most common odour descriptions are associated with more neutral cooked meat processes for which the total chronic odour exposure time is estimated to be < 2 % time.

Given the above, it is concluded that the actual percentage of time for acute odour impacts within Group C is likely to be below the threshold for causing an objectionable or offensive odour. An exception to the above conclusion could result from the discharge of sulphide based odour emissions from the fellmongery on Monday mornings (due to multiple liming drums being dumped to drain) and these coinciding with light wind conditions blowing towards Group C. However, given the downwind frequency of light winds being < 2 % of the time and this discharge occurring up to once a week several hours, then exposures to strong unpleasant odour from the fellmongery would be rare (i.e., < 0.05% time). However, on those rare occasions when levels of sulphide emission occur from the fellmongery combined with light westerly wind, then an acute odour exposure could be objectionable and/or offensive to some Group C residents

7.3.5 Southeast of Alliance (Group D)

Overview

Two people were surveyed in the area to the southeast of the plant, with one interviewed in 2013 and another in 2014. They are 2,000 m from the processing plant and 2,800 m from the WWTP, and are downwind of both of those odour sources about 10 % of the time. A review of complaint records (from both ES and Alliance) does not clearly identify any complaints about Alliance from this area although there are a significant number about Prime Range Meats.

Estimated Odour Exposure

The frequency (F) of odour events reported in 2013 was several times per year, while in 2014 it was never. The 2013 respondent identified the intensity (I) as distinct and the duration (D) of odour events as half a day. The calculated percentage of odour hours for the 2013 respondent is 0.5 % of the time, while for the 2014 respondent it is 0 % - indicating negligible odour impacts from Alliance.

Descriptions

The 2013 respondent description of odour from Alliance indicated rendering to be the source. Both years' respondents reported to experience odours from Prime Range Meat more often and their feedback indicated they do not consider odours from Alliance an issue.

Assessment of Odour Effects

When considering the two resident's feedback, it is not considered that this area has an acute or chronic odour exposure from Alliance that are sufficient to cause objectionable or offensive effects. Furthermore, odours effects in this area appear to be dominated by Prime Range Meats.

7.3.6 Wills Road - South of Plant (Group E)

Overview

Group E residents are on average 2,000 m from the WWTP and approximately 1,800 m south of the processing plant. The general area is downwind of the WWTP (i.e., the anaerobic pond and first section of



the aerated pond) and of the processing plant for approximately 5 % of the time when calm to light wind conditions prevail (i.e., > 0 and < 3.6 m/s).

A review of complaint records (from both ES and Alliance) shows no complaints of odour that is attributed to Alliance from the Group E area.

Estimated Odour Exposure

The odour frequency (F) was typically reported as monthly in 2013, while in 2014 it ranged from several times per week (during last March) to several times per year. In both years the odour intensity (I) was typically identified as distinct and the reported duration (D) of odour events varied from “approximately 1 hour” to “half a day”. This indicated a percentage of odour hours from 0.2 % to 1.3 % and an average of 0.6 % of the time in 2013 – this well below the 3 % criterion for chronic odour effects.

For 2014, with the exception of one outlier value of 16.5 % of the time, the calculated percentages of odour hours varied from 0.2 % to 0.7 % and were on average 0.4 % of the time.

The respondent whose survey information indicated a 16.5 % exposure time had lived in the area for the last 5-6 months and indicated this occurred during light to still conditions. This frequency of odour is not consistent with the percentage of time (approximately 5 %) that the location is downwind of the Alliance’s odour sources during calm to light wind conditions. Subsequently, this data was not included in the calculation of 2014 percentage of odour hours for Group E. It is noted that, while people living in an area exposed to odours for longer periods may become more tolerant of the odour impacts, their ability to observe ambient odours is not diminished by this factor. In other words, people who are new to an area do not necessarily have a greater ability to observe odours and report more reliable FIDO information as a result.

Two respondents commented that odour from Alliance is not an issue. One resident from this area reported a high frequency of odour events; however as noted above this information is not supported by wind frequency information. This resident is new in the area (5-6 months) and appears to be far more sensitive to environmental odours compared to other respondents in the area.

Descriptions

In 2013 the odour was typically described as septic tank or foul cooking, and the WWTP and rendering plant were equally identified as the top two sources.

In 2014 descriptions of odour included offal / meaty smell, hydrogen sulphide and rotten eggs, and rendering and Fellmongery were identified as the top two sources. The hydrogen sulphide and rotten eggs descriptions could be associated with the Fellmongery operation, which discharges sulphide type odours from the process and the wastewater reticulation system.

As for Group C, the offal / meaty smell description also raises the prospect that soup stock odours are being smelt by the neighbours as opposed to rendering odours.

Assessment of Odour Effects

Group E is more frequently downwind of the processing plant compared to other groups and the Fellmongery and soup stock operations appear to be the main sources of the odours currently experienced by this group.

During near still conditions, some emissions from the plant can drift towards this area, although the air movement is expected to move more towards the south west under cool drainage flow periods.

Based on the percentage of odour hours and the low complaint levels, it is considered that Group E are now exposed to a low level of chronic odour that are unlikely to cause objectionable effects. This conclusion may not have been valid during the 2013 processing season when rendering and WWTP odour emissions were more elevated.

The frequency and duration of odour events reported by most respondents in Group E indicate the occurrence of acute odour events in the order of about 0.5 % time (44 hours / year) or less. Furthermore,



the typical odour strength was reported as distinct, as opposed to strong. Therefore the exposure to acute odour impacts within Group E is not expected to be causing objectionable or offensive effects.

7.3.7 Leonard Road - South of WWTP (Group F)

Overview

Group F residential dwellings are 1,200 to 2,000 m south-southwest of the WWTP and approximately 1,800 m south-southwest of the Alliance processing site. The residential dwellings are downwind of the main odorous areas of the WWTP (i.e., the anaerobic pond and first section of the aerated pond) for approximately 5 % of the time when calm to light wind conditions prevail (i.e., > 0 and < 3.6 m/s). As such, the most northern located residential dwellings in this group are assessed as being the most impacted by odour emissions from the Alliance WWTP (specifically the anaerobic pond and the first section of the first aerated pond).

The vast majority of complaints regarding odour from Alliance have been lodged from residents living at one of these most northern located residential dwellings in Group F. Their survey results and those from a neighbour both indicated the occurrence of strong WWTP pond odour exposures during still conditions (associated with cold air drainage flows) on some evenings – predominantly in Autumn.

Estimated Odour Exposure

For those individuals surveyed in 2013 and 2014 that noticed odour, there is a wide range of frequency (F) reported, going from weekly during the season to once or twice per year. There was also a wide range of reported odour intensities (I) from weak to very strong for both years. The reported duration (D) of odour events ranged from “less than 15 minutes” through to half day.

The estimated percentage of odour hours varies from 0.2 % to 2 % (2013) and 0.03 % to 2.5 % (2014), with an average of 1 % of the time. This indicates a low level of chronic odour exposure compared to the 3 % criterion. However, the two nearest neighbours during the 2014 survey commented that odour from the WWTP causes strong anaerobic pond type odour for a number of hours during still evenings in the autumn. Both respondents considered the odour to be very strong and unpleasant in character, however, their tolerance of this was different. One neighbour considered this odour unacceptable whilst the other showed a high level of tolerance – although still indicated that on occasion the odour was unpleasant and strong.

Descriptions

For both surveys the odour was typically described as rotten eggs / hydrogen sulphide and the WWTP was mostly identified as the main source of the odour.

General Comments

Most residents living in Group F are tolerant of odour impacts from Alliance’s WWTP ponds and there is a general consensus among these residents that the odours attributed to Alliance have improved significantly over the last ten years. Several residents commented in 2013 that odours increased in the 2012 / 2013 process season, which aligns with the commissioning of the new rendering plant at Alliance that resulted in increased rendering process odours and organic loadings to the WWTP. This situation appeared to have been resolved during the season as Alliance overcame issues related to rendering very fresh material with high moisture levels.

With regard to the acceptability of the existing odour impacts, the 2014 survey identified most residents to either have no concern, or were otherwise accepting of the situation. Two respondents indicated they did not accept the odours that still occur and clearly desire further reductions and containment of odours within Alliance’s site boundary.

Assessment of Odour Effects

Alliance’s process related odours appear to cause only minor adverse effects (due to either chronic or acute odour exposures) within the Group F area. With regards to the WWTP’s pond odour emissions, the percentage of odour hours is relatively low and therefore indicates a low potential for adverse effects due to chronic odour exposure. However, this source appears to be causing infrequent, high intensity exposures of unpleasant odour (acute odour impacts), during mainly still to calm atmospheric conditions. While most residents within the Group F area are tolerant of these events, several residents are not.



For Group F, the high intensity odour events described by several property owners indicates a percentage time in the order of 0.5 % (44 hours / year) and involving durations in the order of 4 to 6 hours per event. From the above descriptions it is considered that acute odour exposures due to WWTP pond emissions are probably objectionable or offensive on some isolated occasions. The occurrence of these events mainly in autumn months is probably due to the anaerobic ponds still being biologically active (producing odour) from the previous season, during a time when more extreme calm atmospheric conditions establish. As winter approaches and the pond activity and associated emissions decrease, odour impact intensity will also decrease significantly.

7.3.8 West Plains Road (Group G)

Overview

Group G includes the respondents to the further south of the Alliance site who were only interviewed in 2013. They are typically 3,200 m from the WWTP and on average 3,800 m from the processing plant. The respondents to the survey are downwind of the WWTP 16 % of the time on average and are downwind of the processing plant on average 14 % of the time. A review of complaint records (from both ES and Alliance) identifies approximately 5 complaints on or around West Plains Road regarding Alliance and a similar number attributed to Prime Range Meats in the last 10 years. The details on the complaint records don't allow exact locations to be determined. Three of the survey respondents reported to never observe odour from Alliance.

Estimated Odour Exposure

The dominant frequency (F) of odour events was monthly to several times per year, with an intensity (I) of distinct to strong. The duration (D) of odour events was mostly reported as 2 - 3 hours to half a day. Calculated percentage of odour hours varies from 0 % to 1.5 % of the time, with an average of 0.5 %. This is below the criterion of 3.0 % odour hours.

Descriptions

The odour was described as rotting or sewage type odour with ammonia also mentioned. All of the respondents identified odour events to typically occur in the early morning, and the source of the odour was split between the WWTP, rendering and Fellmongery plants. Other comments from this group included that the Alliance odour has reduced in recent years, and that Prime Range Meats was also a source of odour noticed by them.

Assessment of Odour Effects

While there are some respondents that report a strong odour, overall, Golder concludes there is unlikely to be either significant chronic or acute odour effects occurring at this location due to Alliance. This group is the furthest distance from the WWTP and the processing plant and while odours are still observed in this area, the feedback indicates that only a minor potential for objectionable or offensive odour effects in this area.

7.3.9 Southeast of Processing Plant (Group H)

Overview

This new group was interviewed in 2014 with the objective of better assessing the impacts of odour from the processing plant on the area around Group C, but more to the southeast of the plant. Group H residents are on average 1,800 m from the processing plant and 2,600 m from the WWTP. They are downwind of the plant and the WWTP about 10 % of the time.

Estimated Odour Exposure

For the respondents that noticed odour from Alliance (three out of four), the reported frequency (F) varied from weekly to once or twice a year. The intensity (I) was reported as either distinct or strong, and duration (D) of odour events varied from "less than 15 minutes" to "half a day". Calculated percentage of odour hours varies from 0.03 % to 4 %, with an average of 1.7 % of the time, which is below the criteria of 3.0 % odour hours.



Descriptions

Descriptions of odour experienced by Group H included rendering / cooking meat, stock and septic tank, and the rendering plant was identified as the main source of odour. One respondent from this group never smelled odour from Alliance in 2014, but commented that they had smelled it in the past and that they still smell odour from Prime Range Meats. Two out of the three respondents who noticed odour from Alliance commented that it was not an issue for them.

Assessment of Odour Effects

Although there are some respondents that report a strong odour, overall, there is unlikely to be a significant chronic or acute odour effect occurring at this location due to Alliance. This group is further from the processing plant than Group C, and located about halfway between the Alliance and Prime Range Meats sites. While odours are still observed in this area, the feedback indicates that only a low adverse acute effect is likely to be occurring for this group.

7.3.10 Northeast of Processing Plant (Group I)

Overview

This new group was interviewed in 2014 with the objective of better assessing the impacts of odour in an area that is near Group C, and northeast of the processing plant. Group I residents are on average 1,400 m from the processing plant and 2,700 m from the WWTP. They are downwind of the plant and the WWTP about 17 % of the time.

Estimated Odour Exposure

The reported frequency (F) of odour varied from weekly to once or twice a year, with more than half the respondents identifying it as monthly or less frequent. The intensity (I) was mostly identified as either distinct or strong, and other responses include weak and very weak. The reported duration (D) of odour events varied from "less than 15 minutes" through to "half a day", with half the respondents identifying it as 1 hour or less. Calculated percentage of odour hours varies from 0.03 % to 2 %, with an average of 0.75 % of the time, which is below the criteria of 3.0 % (see Section 4.2.3).

Descriptions

Descriptions of odour included rendering / cooking meat, septic tank and ammonia. Fellingmongery and rendering were the most commonly identified sources. A neighbour's dairy effluent pond was also mentioned as a main source of odour for some individuals in this group.

Assessment of Odour Effects

Similarly to Group H, some respondents in Group I reported to notice strong odour on occasions. However, overall, there is unlikely to be a significant chronic or acute odour effect occurring at this location due to Alliance. This group is also further from the processing plant compared to Group C, and exposed to a lower frequency of light (i.e., > 0 and < 3.6 m/s) to calm winds from the Alliance site (< 0.5 % of time). Therefore, it is concluded that the level of both chronic and acute odour exposures from the Alliance site are unlikely to cause objectionable or offensive effects.

8.0 DISCUSSION AND CONCLUSIONS

8.1 General

This report provides a baseline level of odour exposure characteristics (frequency, intensity duration, and offensiveness) for key locations surrounding the Alliance Lorneville site and include community feedback information of existing odour effects. A survey of odour exposure experiences was undertaken in 2013 and repeated in 2014 of people living around the Alliance Lorneville site. The information from these neighbours has been grouped into nine different groups based on their general location. This was necessary to provide



an assessment of potential effects for people living in different directions and distances from the Alliance site and associated WWTP.

The survey information has been used to establish a baseline level of odour exposure due to emissions from the Alliance Lorneville site. An assessment of the significance of the odour exposure has been provided for each group of neighbours (Groups A to I).

8.2 Assessment Criterion

The criteria used in this report to assess the potential of either chronic or acute odour exposures to cause objectionable or offensive effects are not nationally accepted guidelines or standards. They are based on values that Golder has established over many years of undertaking odour diaries and odour surveys within New Zealand and that have been documented in the DSL Environmental Handbook (DSL, 2009) and presented at Clean Air Society odour workshops. In our view, these are the only criteria currently available in New Zealand for providing an objective basis for assessing the likelihood of odour impacts being either objectionable and/or offensive to the average reasonable person. For some individuals who are relatively intolerant of environmental odours, it is likely that meeting the acute and chronic odour criteria specified in this report will not necessarily equate to them accepting that odour exposures due to Alliance are neither objectionable nor offensive. The subjective nature of odour impact assessments will always create such anomalies irrespective of how low criterion is set for odour exposure unless effectively set to a zero level.

8.3 Conclusions

For all residential areas surrounding Alliance's Lorneville property (except for Group F) it is concluded that odour impacts from Alliance's process plant and WWTP sites are not of sufficient frequency, duration and intensity (either on a long term basis, or specific events), to be deemed objectionable or offensive.

It is also concluded, that for several residents who live closest to the southern property boundary of Alliance (off Leonard Road), there are some relatively infrequent occasions when the odour discharges from the WWTP's anaerobic pond are likely to be cause objectionable and / or offensive effects. This generally occurs in the autumn period when the anaerobic pond is still relatively active, and when more still atmospheric conditions are establishing.

With respect to the Alliance Fellmongery operation, it is concluded that a rare combination of light wind conditions and elevated releases of sulphide odours (predominantly on Monday mornings) has the potential to cause an objectionable or offensive odour beyond the site boundary.

Given residual level of odour effects from the WWTP, it is recommended that the best practicable option (BPO) is implemented to minimise odour emission from this plant. It is considered that future upgrades to the WWTP system that are designed to improve the quality of the treated wastewater discharge will also provide a good opportunity to further reduce odour emissions from the WWTP's anaerobic pond and the Fellmongery wastewater discharge.

Finally, it is also concluded that the improved control of rendering plant in 2014 has resulted in a lower potential for odours from both the Alliance processing site and the Alliance WWTP ponds.



9.0 REFERENCES

Golder 2013. Alliance Lorneville – Baseline Odour Survey. Report number 1378104044_002_R_Rev1_030. Prepared for Alliance Group by Golder Associates (NZ) Limited. September 2013.

Golder 2014. Alliance Lorneville – Background ambient air quality. Report number 1378104044-040-R-Rev2-009. Prepared for Alliance Group by Golder Associates (NZ) Limited. July 2014.

VDI 3940 Part 2, 2006. Determination of odorants in ambient air by field inspections.

VDI 3788 Part I, 2000. Environmental Meteorology: Dispersion of odorants in the atmosphere – Fundamentals.

DSL 2009. DSL Environmental Handbook. Chapter 16: Environmental Odours.

10.0 REPORT LIMITATIONS

Your attention is drawn to the document, “Report Limitations”, as attached in Appendix A. The statements presented in that document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks to which this report relates which are associated with this project. The document is not intended to exclude or otherwise limit the obligations necessarily imposed by law on Golder Associates (NZ) Limited, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.



APPENDIX A

Report Limitations



Report Limitations

This Report / Document has been provided by Golder Associates (NZ) Limited (“Golder”) subject to the following limitations:

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- iv) The passage of time affects the information and assessment provided in this Report / Document. Golder’s opinions are based upon information that existed at the time of the production of the Report / Document. The Services provided allowed Golder to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality of the site, or its surroundings, or any laws or regulations.
- v) Any assessments, designs and advice made in this Report / Document are based on the conditions indicated from published sources and the investigation described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this Report / Document.
- vi) Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Golder for incomplete or inaccurate data supplied by others.
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APPENDIX B

Odour Survey Questionnaire

QUESTIONNAIRE FOR ENVIRONMENTAL SURVEY

Alliance Lorneville wishes to establish the extent, to which you may notice odour from their processing site or the wastewater treatment pond particularly during the last twelve months. We would be very grateful if you could assist us by filling out this questionnaire and sending back to Golder Associates (our consultant)

1. How often do you notice any odours from Alliance in or around your home? - *Please circle one of the following:*

1. Daily
2. Weekly
3. Monthly
4. Several times per year
5. Once or twice a year
6. Never (if never then please go to Q9)

The following questions relate to a typical odour **event** and in particular how long the odour event typically lasts for and varies with time when it occurs.

2. For the overall odour event, what was the typical length of the time the event lasted? - *Please tick one of the following:*

- | | |
|---|--------------------------------------|
| <input type="checkbox"/> Less than 15 Minutes | <input type="checkbox"/> 2 – 3 hours |
| <input type="checkbox"/> 15-45 minutes | <input type="checkbox"/> Half a day |
| <input type="checkbox"/> Approximately 1 hour | <input type="checkbox"/> Other _____ |

3. For a typical odour event, how did the presence of the odour vary with time? *Please tick one of the following:*

- Present continuously
- Present for most of the time
- Present less than 50% of the time
- Infrequent

4. For odour events, what times of day do they typically occur? - *Please tick all that apply :*

- | | |
|--|---|
| <input type="checkbox"/> Early morning | <input type="checkbox"/> Late afternoon |
| <input type="checkbox"/> Mid-morning | <input type="checkbox"/> Early evening |
| <input type="checkbox"/> Midday | <input type="checkbox"/> Late evening |
| <input type="checkbox"/> Early afternoon | <input type="checkbox"/> At night |

5. On those days you that notice odours mentioned above, are there typical atmospheric conditions that were present ?- *Please tick all that apply :*

- | | |
|--|--|
| <input type="checkbox"/> Cold and calm | <input type="checkbox"/> Clear sky and sunny |
| <input type="checkbox"/> Warm and light winds | <input type="checkbox"/> Windy |
| <input type="checkbox"/> Overcast and still | <input type="checkbox"/> Other (please specify)_____ |
| <input type="checkbox"/> Light cloud with breeze | |

6. During an odour event, what is the typical strength when odour is present?

1. Very Weak
2. Weak
3. Distinct
4. Strong
5. Very Strong
6. Extremely Strong

7. Can you describe the odour most commonly experienced during the typical odour events?

8. Out of all the odours you experience at your house, can you rank (1 = most frequently noticed odour) to 5 (least noticed odour) out of the following sources?

- _____ Alliance Rendering/cooking
- _____ Alliance Fellmongery
- _____ Alliance Stockyards,
- _____ Alliance Wastewater ponds
- _____ Other non-Alliance source (please specify)_____

Please note that these final few questions provide assist us in determining how often you are at home and your location relative to Alliance. However we fully respect your right to not provide answers to these should that be your decision.

9. How long have you lived in the area for? _____

10. How often are you home during day time hours? _____

11. Address: _____

12. Any Other Comments?



APPENDIX C

Odour Hour Calculation



APPENDIX C

Odour Hour Calculation

An odour hour is defined as an hour during which there is a clear odour perception for at least 10 % of that hour¹. Odour hours are usually determined during a period of field observations around the subject site. During each observation, the intensity of any odours observed is recorded every 10 seconds for 10 minutes in each hour, and the fraction of perceived odours is then assumed to be representative of that hour. Any field observation that has more than 10 % of observations with a detectable odour is classified as an odour hour. Over a number of field observations carried out under strict criteria to ensure a representative sample of meteorological conditions and times of day (including night-time), the percentage of time that odour hours are observed is calculated. For all locations that odour hours are calculated, the percentage odour hours is compared to exposure criteria.

For evaluating the odour exposure in the area surrounding Alliance Lorneville, it was considered that a community survey was the most appropriate to determine the level of effect on the nearest neighbours, and the results of the survey have been used to calculate the percentage of odour hours. The results of the odour survey are discussed in the main report.

The odour survey had two key questions for determining the amount of time a resident is exposed to odour at their home, namely:

Q1. How often do you notice any odours from Alliance in or around your home?

Q2. For the overall odour event, what was the typical length of the time the event lasted?

Odour exposure at the survey respondent's home is calculated using the duration of the odour event multiplied by the number of events experienced in a year, as shown in Equation (1) below. If the duration of the event was less than 1 hour, this was rounded up to be 1 hour.

(1)

$$\text{Odour exposure (hours per year)} = \text{duration (hours)} \times \text{number of odour events per year}$$

The amount of odour received by a respondent living in the area surrounding Alliance Lorneville is dependent on the amount of time they are at their place of residence. If they worked away from the home, their potential for odour exposure is lessened. Likewise, if the respondent stays at home for the majority of the day, then their odour exposure will be higher. Assuming that the occurrence of odours is just as likely at any time of day or night, the exposure to odours is dependent on both the amount of odour received and the amount of time the respondent is at home.

To determine the amount of time a resident could potentially be exposed to odour, the survey contained the following question:

Q10. How often are you home during day time hours?

This was converted into the number of hours per week that a resident was at home, based on several assumptions. It was assumed that residents are at home all weekend and for at least 12 hours each day. If a respondent was 'at home all the time', it was assumed that they are away from the house for 10 % of the time. Therefore the minimum amount of time someone was assumed to be at home is 108 hours per week and the most is 151 hours per week,

The calculated number of odour hours is adjusted to take this into account, where:

(2)

$$\text{Estimated odour hours per year} = \text{odour exposure (hours per year)} \times (\text{total hours} / \text{hours at home})$$

Thus Equation (2) gives an estimate of the potential odour hours experienced at that location (the respondent's home) in a year, based on the respondent's actual experience of odours, scaled up to account for the respondent's absence from home.

¹ VDI 3788 Part 1, 2000. Environmental Meteorology: Dispersion of odorants in the atmosphere – Fundamentals. Standard by Verband Deutscher Ingenieure / Association of German Engineers, 07/01/2000.



APPENDIX D

Downwind Frequency of Survey Locations



APPENDIX D

Downwind Frequency and Distance of Survey Locations to Plant and WWTP

This Appendix shows the results of calculations to determine the amount of time each odour survey location was downwind of several identified sources of odour. It also shows the results of calculations to determine the distance between these potential sources of odour and the odour survey location.

Five main odour sources were identified on the Alliance Lorneville site, namely:

- Aerobic pond
- Anaerobic pond
- Fellmongery
- Rendering
- Sheep yards.

The minimum and maximum angle between the on-site odour sources and each of the survey locations was calculated using GIS. From these values and the 2012 Wallacetown meteorological data, the amount of time that each survey location is downwind of an odorous source can be calculated. These values are shown in Table 1 and Table 2. To allow for short-term wind variation (within each hour), the angles between the site and survey locations was increased by 15 ° in each direction.

The distances between each of the sources and survey locations was also determined using GIS. These distances are summarised in Table 3 and Table 4.



APPENDIX D

Downwind Frequency and Distance of Survey Locations to Plant and WWTP

Table 1: Percentage of time the 2013 survey locations are downwind of the various odorous sources at the processing plant and wastewater treatment plant (WWTP). Based on the meteorological data from the Wallacetown station for 2012. Calms accounted for 2.1 % of the data.

Survey location	Sections of processing plant and WWTP				
	Aerobic pond	Anaerobic pond	Fellmongery	Rendering	Sheep yards
1	17.1%	15.2%	14.6%	14.2%	14.9%
2	18.6%	16.7%	14.8%	13.9%	14.7%
3	7.6%	14.3%	15.2%	14.3%	15.5%
4	18.5%	11.5%	14.6%	13.8%	15.0%
5	19.5%	16.1%	5.3%	5.1%	5.4%
6	14.3%	12.8%	5.0%	4.9%	5.2%
7	9.2%	8.8%	5.5%	5.3%	5.8%
8	13.4%	14.2%	11.4%	8.6%	9.7%
9	12.9%	13.7%	10.7%	8.5%	9.5%
10	10.3%	8.4%	9.9%	9.6%	10.7%
11	17.8%	11.7%	14.6%	14.2%	14.9%
12	19.0%	11.1%	14.6%	14.2%	15.0%
13	19.7%	11.8%	15.2%	13.9%	15.1%
14	12.1%	8.2%	8.2%	8.0%	8.4%
15	9.8%	6.6%	7.8%	7.3%	7.7%
16	9.9%	7.0%	7.9%	7.3%	7.9%
17	9.7%	6.4%	7.8%	7.5%	7.9%
18	9.3%	6.2%	7.6%	7.3%	7.7%
19	9.3%	6.2%	7.8%	7.5%	7.9%
20	12.8%	9.5%	15.7%	15.4%	13.9%
21	10.4%	10.2%	9.1%	8.0%	9.0%
23	13.6%	9.6%	16.3%	15.6%	16.4%
24	18.1%	10.6%	15.1%	14.0%	14.7%
25	18.2%	16.0%	13.8%	13.1%	13.8%
26	17.7%	13.9%	13.9%	13.5%	13.9%
27	6.7%	5.4%	7.2%	7.0%	7.3%
28	9.4%	6.0%	7.6%	7.3%	7.9%
29	12.2%	15.5%	13.9%	13.9%	14.2%
30	9.1%	6.1%	7.7%	7.4%	7.9%
31	12.2%	15.3%	14.1%	14.1%	14.4%
32	6.8%	5.4%	7.0%	6.9%	7.4%
33	18.2%	16.0%	13.8%	13.1%	13.8%
34	13.1%	9.4%	16.3%	15.6%	16.4%
35	17.7%	16.4%	13.9%	13.5%	13.9%



APPENDIX D

Downwind Frequency and Distance of Survey Locations to Plant and WWTP

Table 2: Percentage of time the 2014 survey locations are downwind of the various odorous sources at the processing plant and wastewater treatment plant (WWTP). Based on the meteorological data from the Wallacetown station for 2012. Calms accounted for 2.1 % of the data.

Survey location	Sections of processing plant and WWTP				
	Aerobic pond	Anaerobic pond	Fellmongery	Rendering	Sheep yards
1	17.9%	18.0%	21.0%	17.3%	18.0%
2	18.9%	18.4%	22.5%	19.2%	19.6%
3	18.7%	17.7%	20.1%	17.6%	18.1%
4	15.2%	15.7%	16.6%	12.8%	12.5%
5	17.9%	17.7%	19.7%	17.3%	17.6%
6	17.1%	16.8%	18.1%	16.2%	16.4%
7	16.4%	16.8%	18.3%	14.3%	14.0%
8	15.9%	16.2%	17.4%	13.8%	13.5%
9	15.0%	15.9%	17.5%	12.1%	12.0%
10	12.5%	13.1%	10.7%	9.1%	9.7%
11	12.1%	12.7%	10.2%	8.7%	9.5%
12	10.6%	10.0%	9.3%	8.5%	9.4%
13	10.4%	8.9%	9.7%	9.5%	10.2%
14	10.5%	9.3%	9.4%	9.0%	9.8%
15	9.9%	9.0%	9.4%	9.2%	9.8%
16	11.0%	9.1%	11.5%	11.5%	12.5%
17	20.7%	13.0%	15.9%	15.0%	15.8%
18	19.5%	12.6%	15.1%	14.3%	15.4%
19	19.6%	13.4%	15.1%	14.3%	15.1%
20	21.4%	14.6%	15.7%	14.8%	16.0%
21	10.6%	10.0%	9.3%	8.5%	9.4%
22	10.7%	8.9%	10.1%	9.5%	10.6%
23	14.4%	15.5%	15.2%	10.3%	10.7%
24	20.7%	13.0%	15.9%	15.0%	15.8%
25	19.2%	12.8%	15.0%	14.6%	15.3%
26	16.2%	10.6%	16.3%	16.0%	16.6%
27	28.5%	22.8%	5.7%	5.5%	5.8%
28	18.5%	16.3%	5.6%	5.4%	5.5%
29	14.9%	10.5%	16.4%	16.1%	16.8%
30	12.6%	9.8%	15.7%	15.2%	15.8%



APPENDIX D

Downwind Frequency and Distance of Survey Locations to Plant and WWTP

Table 3: Minimum distance from each of the 2013 survey locations to the various odorous sources at the processing plant and wastewater treatment plant (WWTP).

2013 Survey location	Sections of processing plant and WWTP				
	Aerobic pond	Anaerobic pond	Fellmongery	Rendering	Sheep yards
1	2,800	2,500	3,400	3,500	3,600
2	2,700	2,400	3,200	3,300	3,400
3	1,400	1,200	1,700	1,900	2,000
4	1,700	1,500	1,700	1,900	2,000
5	1,700	2,200	1,400	1,300	1,200
6	1,800	2,400	1,700	1,700	1,500
7	1,600	2,100	1,800	1,800	1,700
8	1,900	2,300	840	880	830
9	2,000	2,400	950	990	940
10	2,800	2,900	1,900	2,000	2,100
11	2,000	1,800	2,000	2,200	2,300
12	1,500	1,400	1,600	1,700	1,800
13	1,400	1,200	1,600	1,700	1,800
14	1,100	1,000	2,300	2,200	2,300
15	1,400	1,400	2,500	2,400	2,400
16	1,500	1,400	2,500	2,500	2,500
17	1,500	1,400	2,500	2,400	2,400
18	1,500	1,500	2,500	2,400	2,500
19	1,500	1,500	2,400	2,400	2,400
20	2,200	2,200	1,900	2,000	2,100
21	2,500	2,800	1,500	1,500	1,500
23	2,000	1,900	1,600	1,800	1,800
24	1,500	1,400	1,500	1,600	1,700
25	3,700	3,300	3,900	4,100	4,100
26	3,600	3,300	3,800	3,900	4,000
27	1,500	1,800	2,300	2,200	2,200
28	1,400	1,400	2,400	2,300	2,300
29	3,500	3,300	3,700	3,800	3,900
30	1,500	1,500	2,400	2,400	2,400
31	3,500	3,300	3,700	3,800	3,900
32	1,600	1,800	2,200	2,100	2,100
33	3,700	3,300	3,900	4,100	4,100
34	1,900	1,900	1,500	1,700	1,700
35	3,600	3,300	3,900	4,100	4,200



APPENDIX D

Downwind Frequency and Distance of Survey Locations to Plant and WWTP

Table 4: Minimum distance from each of the 2014 survey locations to the various odorous sources at the processing plant and wastewater treatment plant (WWTP).

2014 Survey location	Sections of processing plant and WWTP				
	Aerobic pond	Anaerobic pond	Fellmongery	Rendering	Sheep yards
1	2,300	2,700	1,200	1,200	1,100
2	2,400	2,800	1,300	1,300	1,200
3	2,700	3,000	1,600	1,600	1,500
4	2,700	3,000	1,600	1,600	1,500
5	2,800	3,200	1,800	1,800	1,600
6	2,900	3,300	1,900	1,900	1,700
7	2,400	2,800	1,350	1,350	1,250
8	2,400	2,800	1,350	1,350	1,250
9	2,100	2,500	1,000	1,000	950
10	2,000	2,400	950	1,000	950
11	2,100	2,500	1,050	1,100	1,050
12	2,450	2,750	1,400	1,450	1,400
13	2,550	2,800	1,600	1,700	1,650
14	2,500	2,800	1,500	1,550	1,550
15	2,700	3,000	1,750	1,850	1,800
16	2,800	2,900	2,100	2,250	2,250
17	1,450	1,250	1,600	1,750	1,800
18	1,600	1,450	1,650	1,750	1,850
19	1,700	1,500	1,800	1,900	2,000
20	1,450	1,250	1,650	1,800	1,850
21	2,350	2,700	1,300	1,350	1,350
22	2,450	2,650	2,500	2,600	2,600
23	1,950	2,350	850	900	800
24	1,450	1,250	1,600	1,750	1,800
25	1,700	1,550	1,750	1,850	1,950
26	2,000	2,000	1,650	1,800	1,850
27	1,400	1,800	950	900	750
28	2,000	2,450	1,800	1,700	1,600
29	2,100	2,050	1,750	1,900	1,950
30	2,250	2,300	1,700	1,850	1,900

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

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