West Belconnen Odour Impact Investigations of Emissions from Vent Stacks of the Ginninderra Sewer Tunnel Preliminary Assessment Report

Sewerage Network Planning

Version 6

Effective date: 27 May 2014

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CERTIFICATE OF APPROVAL FOR ISSUE OF DOCUMENTS

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Title: **Odour Impact Investigation of Emissions from Vent Stacks at Shaft 3 (4GIN) and 4 (5GIN) on the GST**

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Other Review by:	Ian Wallis (CEE), Leigh Crocker (EDD)

Document Revision Control

Version	Description of Revision	Person Making Issue	Date	Approval
01	First draft for review	Teck Foo	4 April 2014	Peter Szlapinski
02	Reviewed by Peter Szlapinski	Teck Foo	7 April 2014	Peter Szlapinski
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06	Final Review with Leigh Crocker's (EDD) comments incorporated	Glen Alanne	27 May 2014	

Disclaimer

Executive Summary

The ACT government has been undertaking planning for the land development in West Belconnen that is bounded by West Macgregor, the Murrumbidgee River and Ginninderra Creek, with the partnership of the Riverview Group. The proposed 1000 hectare land development will extend north and westwards in stages to the ACT/NSW border and eventually across the border to NSW. There will be a river corridor, which ranges from 500 metres to 1 kilometre and about 550 hectares set aside to provide a buffer to the river and recreation purposes.

The Ginninderra Sewer Tunnel (GST) is a major ACTEW sewerage asset within this area. There are two 10 metre tall vents stacks along the GST which ventilate the sewer assets to minimise corrosion and control gas build up in the sewers.

The purpose of this report is to carry out a preliminary assessment of the potential odour impacts from the existing Ginninderra Sewer Tunnel vent stacks on the proposed land development at West Belconnen using field data.

Field monitoring and analysis in this report include the following:

- Detailed H_2S emission monitoring and odour concentration sampling undertaken during summer months after the installation of sampling ports at both vents.
- Odour strength measured by dynamic olfactometric analysis (odour units) in March 2014.
- Confirmation of air exit volumes from stacks and recalculation of emission load.
- Sewage grab samples taken from shaft 4 for laboratory analysis
- Review of AUSPLUME models.

The AUSPLUME modelling results suggest that the odour emission from the existing two existing vents and an overflow structure within the proposed development area should not cause widespread odour impact to the future residents of West Belconnen. There is

only minor odour impact surrounding vent 5GIN and will unlikely to cause adverse odour nuisance to the nearby residents of the proposed land development.

Although preliminary assessment suggests a minor odour impact to the proposed land development, further work is required to verify the parameters used in the model and to take into consideration the impacts of the inversion layers in this area. Consideration also needs to be given to the siting of odour scrubbers should they be required in the future.

Based on this, it is recommended that a more detailed technical and planning study of the potential odour impacts at West Belconnen be carried out.

The detailed study should include:

1. Monitor to quantify the levels of natural inversion layers in this area, best performed during autumn to winter period.
2. Additional dispersion modeling using the most appropriate model as determined by best industry guidance and compliance with South Australia Air Quality Impact Assessment Guidelines (Reference 8).
3. Consideration of the effect of inversion height and strength in the area on odour impact.
4. Siting of any potential future infrastructure and housing including planning provision for access and buffer zones.
5. Two further H_2S measurement periods at the two vents and two further sewage sampling rounds (DO, ORP, dissolved sulphide) to verify the parameters used in this preliminary modeling. These measurements are recommended to be done during summer season.

Table of Contents

1. Purpose

The purpose of this report is to carry out a preliminary assessment of the potential odour impacts from the existing Ginninderra Sewer Tunnel vent stacks on the proposed land development at West Belconnen using field data.

2. Scope

This report only looks at the potential odour impacts from the two existing GST vent stacks within the boundary of the proposed West Belconnen land development area.

Odour impacts from Lower Molonglo Water Quality Control Centre (LMWQCC) or any other proposed new sewer infrastructure in the new development have not been included in this preliminary odour impact assessment. Separate studies will be conducted.

3. Background

The ACT government, in partnership with the Riverview Group, has proposed to develop land near the West Belconnen in the ACT up to the NSW border. There is a plan to build about 11 500 houses in a number of stages over the next 30 years, where 6500 of these will be in the ACT. There are two 10 metre tall (approximately 1 metre diameter) sewer vent stacks located adjacent to the boundary of the proposed West Belconnen land development area (Figure 1) which have the potential to cause odour nuisance to the future residents.

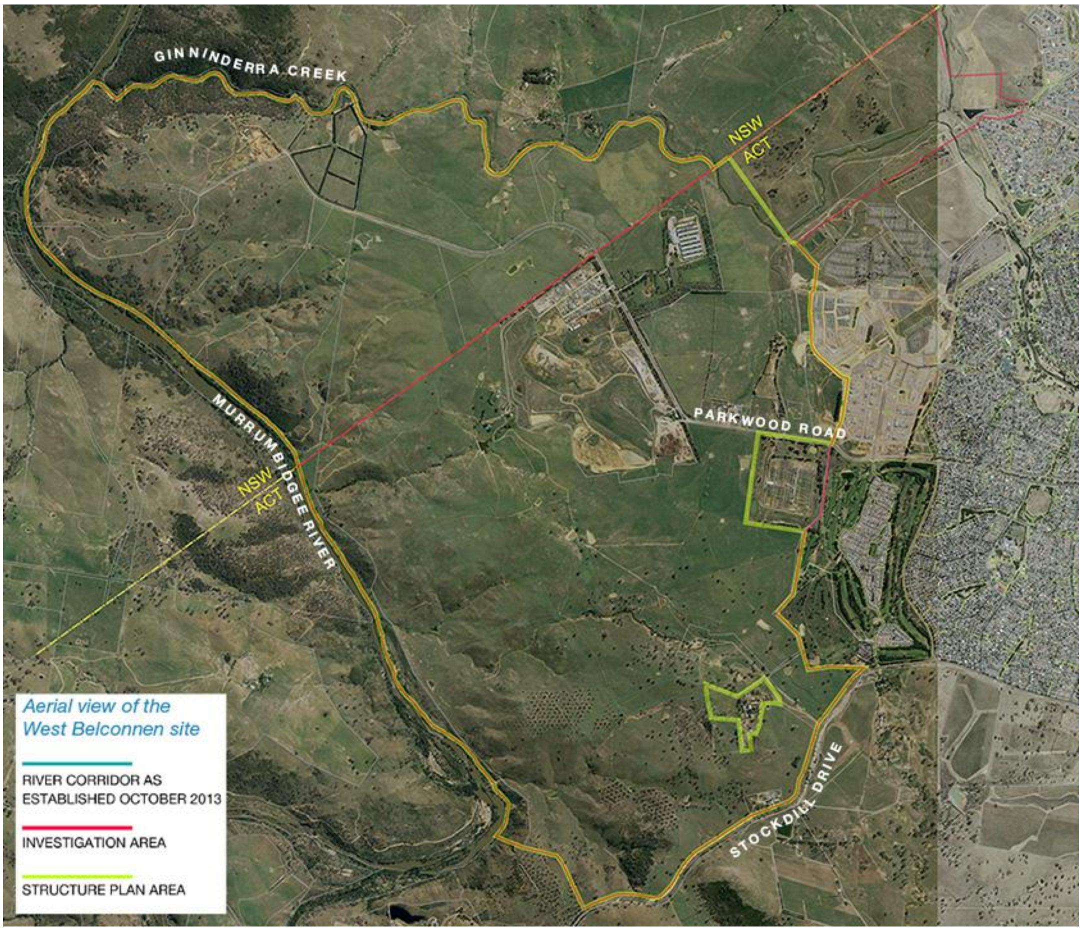


Figure 1. Proposed land development (Source: http://talkwestbelconnen.com.au/)

4. Description of GST Ventilation System and Mode of Operation

The Ginninderra Sewer Tunnel is ACT's second largest sewer, 2.13 meter in diameter. It collects sewage generated from approximately 30 % of the serviced ACT population.
All shafts on the GST are provided with ventilation structures. Recently major scrubbers have been fitted to vents at Shaft 1 and Shaft 2 by the developers of West McGregor.

There are 2 vent stacks located within the boundary of the proposed land development (Figure 2).

The first vent stack Facility Code (FC) 806381 which is connected to GST Shaft 3, also known as Vent 4GIN is located in block 1607. The second vent stack Facility Code 3735707 which is connected to GST Shaft 4, also known as vent 5GIN is located in block 1605. Also located near vent 5GIN is a 1.8 m wide overflow structure from the Ginninderra Sewer Tunnel (GST).

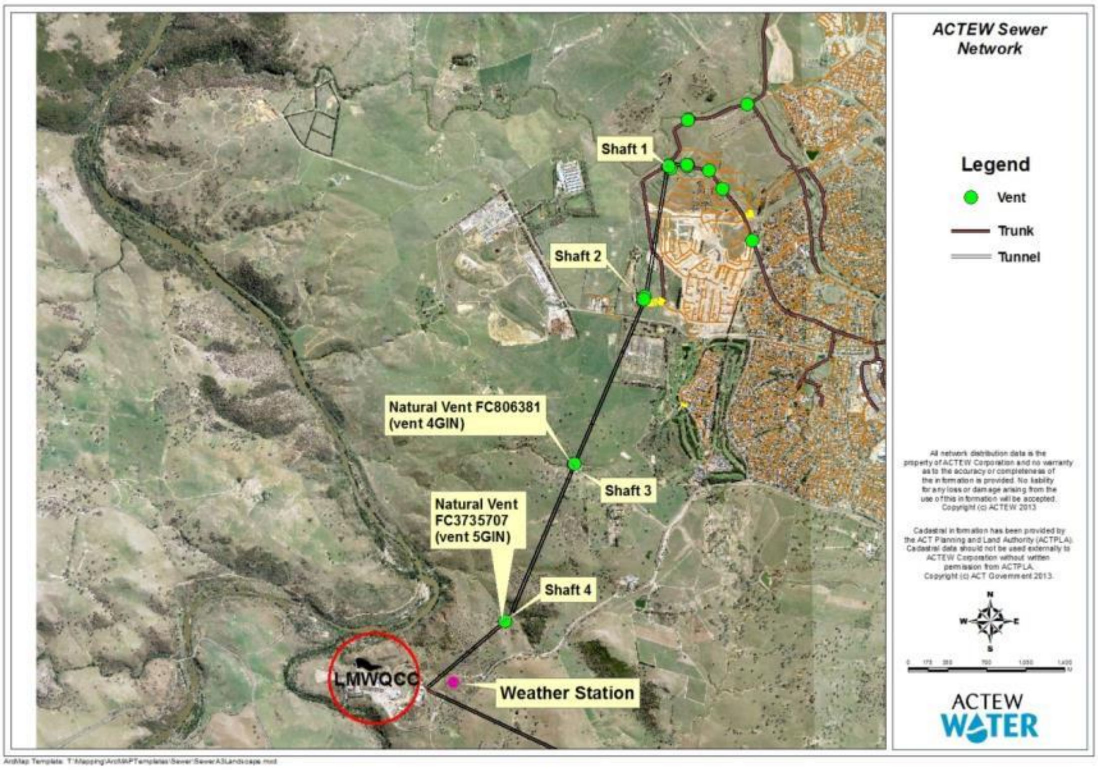


Figure 2. Location of vent stacks and access shafts on GST within the proposed West Belconnen land development area

The GST is 2130 mm in diameter, 5.5 km long, and laid at a grade of 1:600. The length of the GST from LMWQCC to first overflow level is 0.92 km and the length of backwater effect is 2.98 km. The design capacity of the GST is 9,000 L/s (Reference 4).

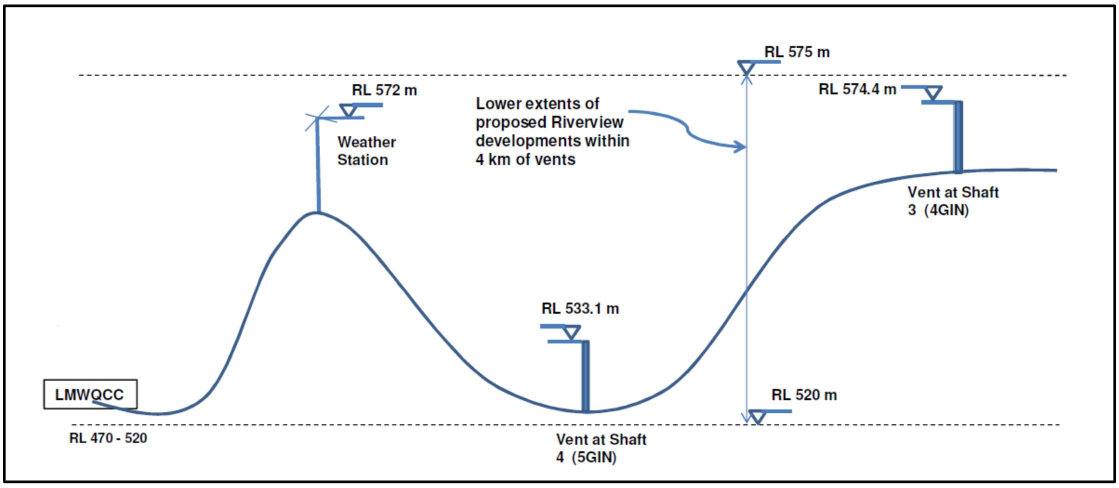
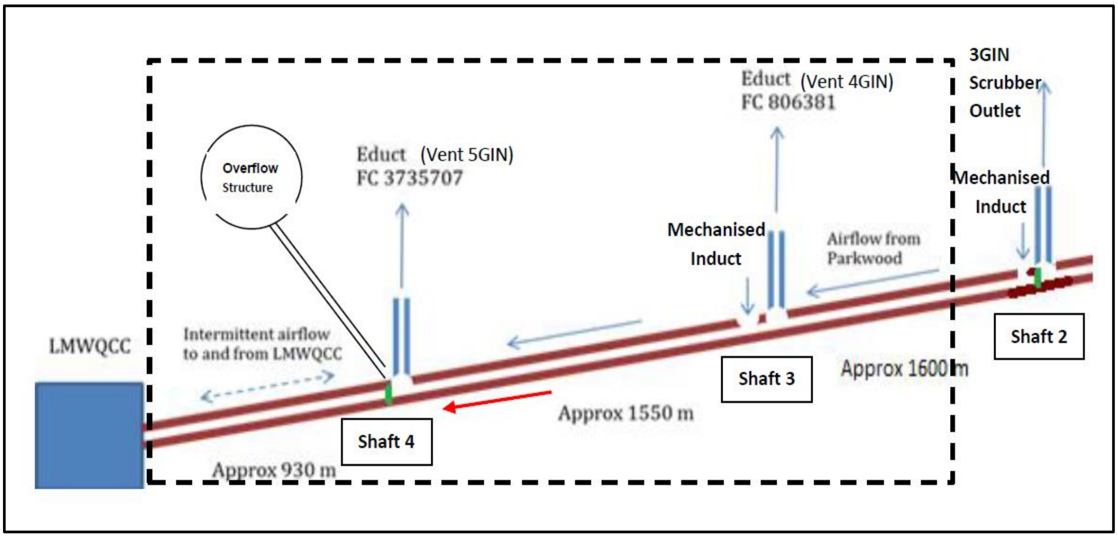


Figure 3. Elevation of weather station, vent 4GIN and vent 5GIN (Note: diagram not drawn according to scale)

Figure 3 shows the location of the nearest weather station in relation to the vent stacks. The weather data from this site has been assumed to be representative of the area and has been used for modelling purposes. Further investigation of the effects of terrain and inversion layers on vent 5GIN is required.

The GST pipeline operates under positive air pressure created by mechanised induct vents. This means that designs intending to connect lateral sewers to the GST will need to prevent gas migration to the lateral connections. The educt vents along the GST are designed to provide emission points for the GST airspace. The schematic airflow in this tunnel is shown in Figure 4.



Air Curtain

Preliminary assessment field monitoring investigation boundary area

Sewage Flow Direction

Air Flow Direction

Figure 4. Schematic of airflow in the GST (see Drawings in Attachment 2 for details of shaft 2, 3 and 4)

The air flow in the section of the GST between shaft 2 and shaft 3 is controlled by the fresh air from a mechanised induct fan located at shaft 2 to provide ventilation to this section of the tunnel. The foul air in this section of the tunnel is then being ventilated to the atmosphere via vent 4GIN at shaft 3. There is another mechanised induct fan located at shaft 3 to provide fresh air to ventilate the sewer tunnel section between shaft 3 and shaft 4. The air flow direction from these mechanical fans has been confirmed. No mechanical induct fan at Shaft 4 that provides fresh air into GST downstream to LMWQCC. There are air curtains at shaft 2 and shaft 4 to separate the air flow in different sections of GST tunnel.

Most of the ventilation structures along GST were constructed in days when odour impact management was not a fully quantified or regulated science. The primary purpose of the ventilation systems was to protect the sewer assets from corrosion. The second purpose was to discharge and disperse sewer gases at many points to avoid gas accumulation in conduits beneath urban areas. In the past ventilation assets did not receive operational priority and operational facts about many of these structures might not be known.

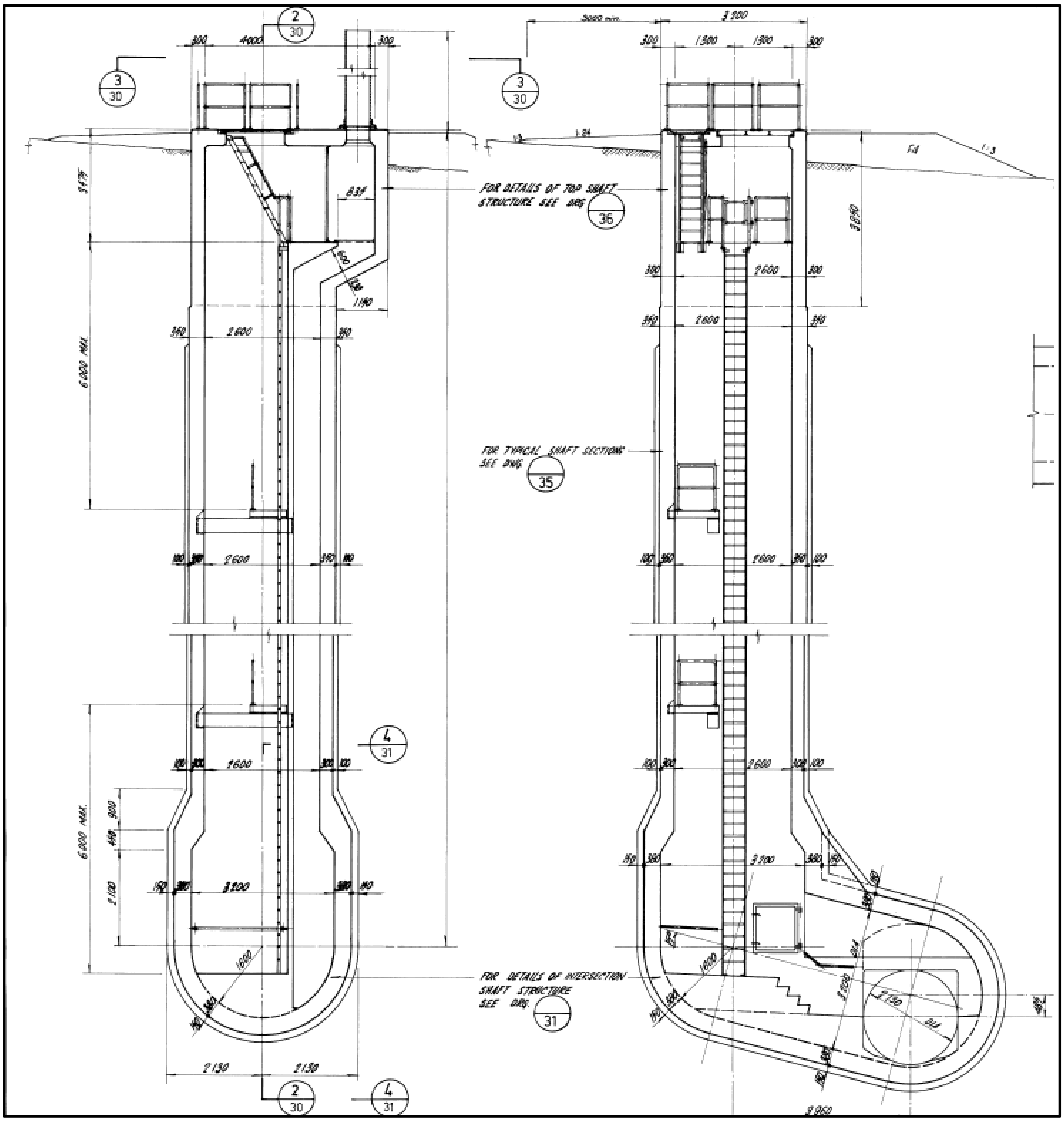


Figure. 5. Schematic of sewerage structures at Shaft 2 and Shaft 3. (Refer to Attachment 2, Drawing No. CD75/500/1)

Photo 1

Photo 2

Photo 3

Photo 4

Photo1: Vent 4GIN

Photo 2: Vent 5GIN

Photo 3: Overflow structure adjacent to vent 5GIN

Photo 4: Air curtain at upstream end of shaft 4

5. Field Data Collection

5.1 Summary of Testing and Monitoring

Field data was collected in summer period of 2013/14 to provide input for dispersion modelling. A summary of the field data collection is shown in Table 1 below:

Table 1. Summary Table of Monitoring/Testing for Preliminary Asssesment

Test/ Monitoring	Monitoring/Test Period
H_2S	Monitoring Period 1: 28 Nov to 4 Dec 2013, Monitoring Period 2: 12 Feb to 20 Feb 2014, Monitoring Period 3: 28 Feb to 7 March 2014
Vent exit air velocity	28 Feb to 1 Mar 2014
Dynamic olfactometry analysis	25 to 26 March 2014
Sewage samples laboratory testing	25 to 26 March 2014

5.2 Findings

5.2.1 Continuous Hydrogen Sulphide Monitoring

Hydrogen sulphide (H_2S) gas logging instruments were deployed at the sampling ports which were installed in November 2013 for gas sampling and monitoring purposes. H_2S data was collected for a week from late November to early December 2013 (28 November to 4 December 2013). The H_2S data was also measured from February to early March (12 to 21 Feb 2014, 28 February to 7 March 2014) to confirm validity and accuracy of the data. The H_2S data collected between these periods showed consistent diurnal patterns. From the monitoring, up to 0.7 ppm H_2S has been detected from the two vents at GST.

The following table summarises the H_2S monitoring results for each of the three monitoring period:

Table 2. H_2S monitoring results

Monitoring Period	Vent 4GIN H_2S (ppm)		Vent 5GIN H_2S (ppm)	
	(75th Percentile)	(99th Percentile)	(75th Percentile)	(99th Percentile)
28 Nov to 4 Dec 2013	0.1	0.4	0.2	0.4
12 Feb to 20 Feb 2014	0.1	0.35	0.1	0.45
28 Feb to 7 March 2014	0.1	0.2	0.2	0.5

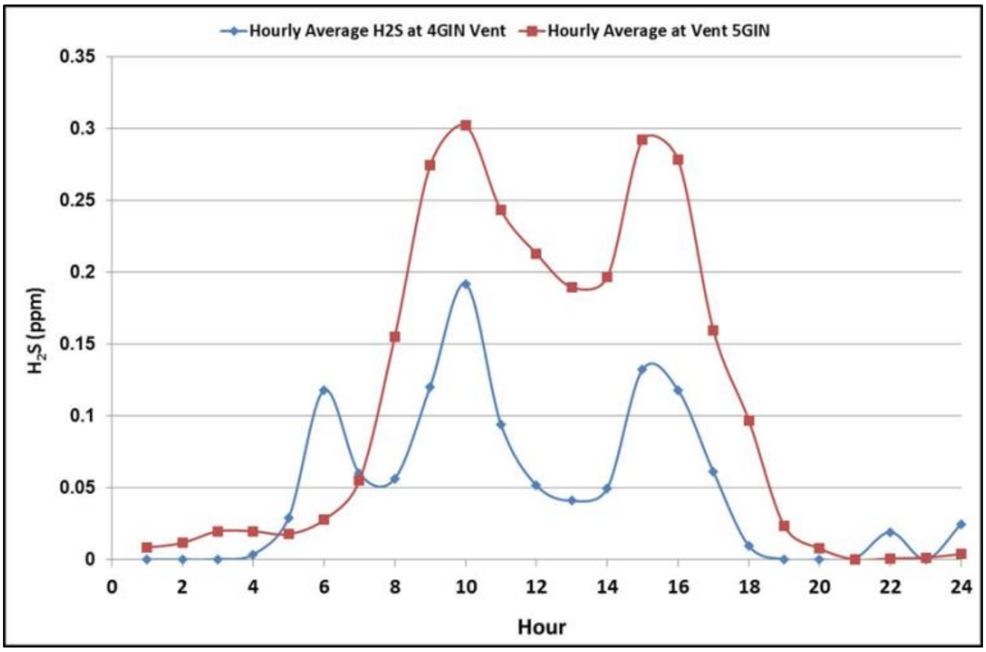


Figure 6. Hourly average H_2S data from 28 Nov to 4 December 2013

As can be seen in Figure 7, the peak H_2S measured at vent 5GIN is higher than the peak H_2S measured at vent 4GIN, which is located upstream of vent 5GIN.

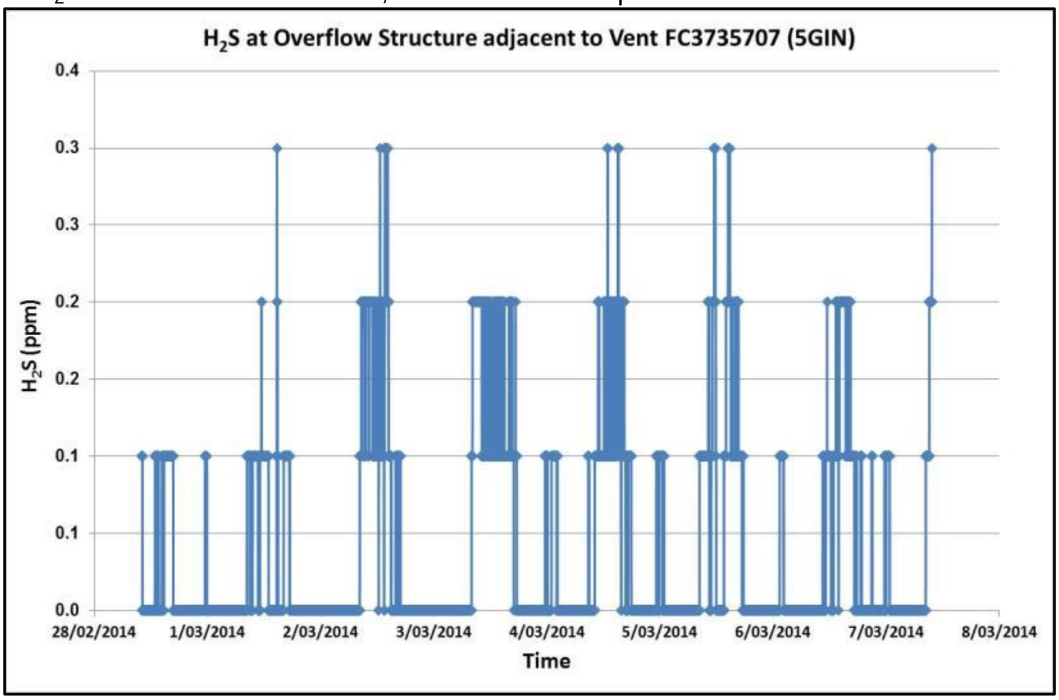


Figure 7. H_2S Measured at Overflow Structure from 28 February to 7 March 2014

The overflow structure H_2S was monitored from 28 February to 7 March 2014. The diurnal pattern of the H_2S measured at the overflow structure coincides with the peaks of sewer flow in GST in ADWF, confirming the sewer gas inside GST near the overflow structure is being displaced from the tunnel to the overflow structure during high flow period (11 am to 1 pm). Due to the large opening of the overflow structure (approximately 1.8 metre diameter), the H_2S measured inside the overflow structure may have been diluted by fresh air being drawn into the overflow structure. However, given the low level of H_2S measured at the overflow structure and its location in a valley, it should cause very little odour impact to the nearby land development.

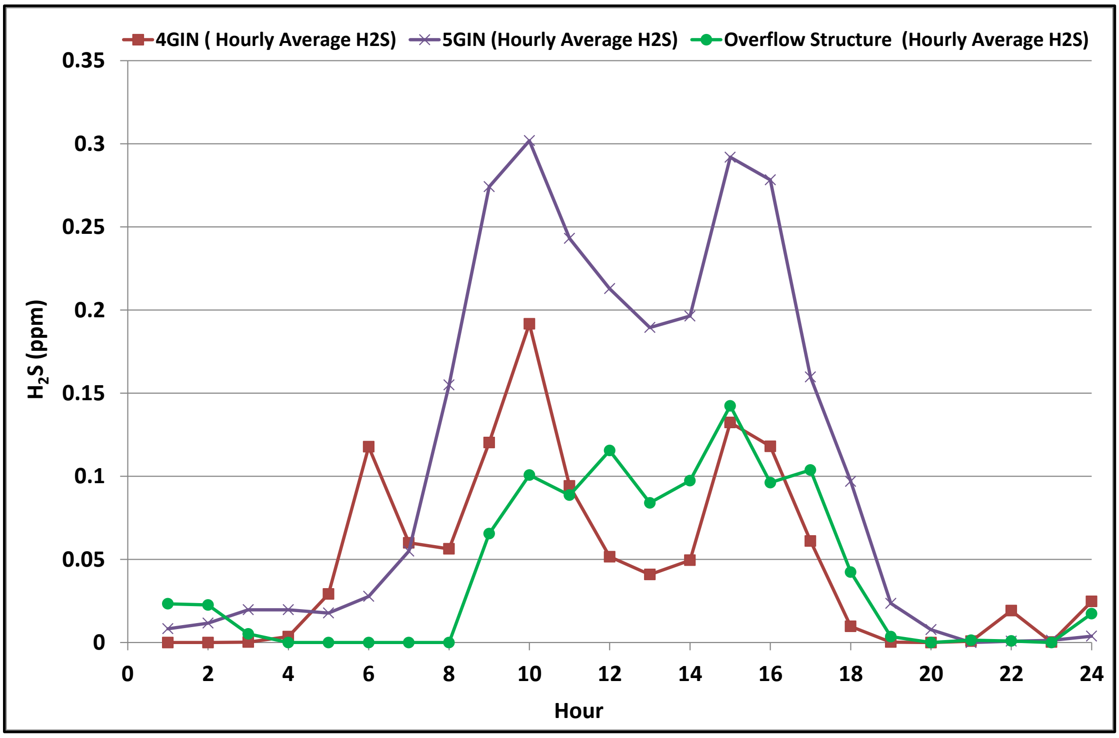


Figure 8. Hourly average H_2S comparison between overflow structure and vents 4GIN and 5GIN

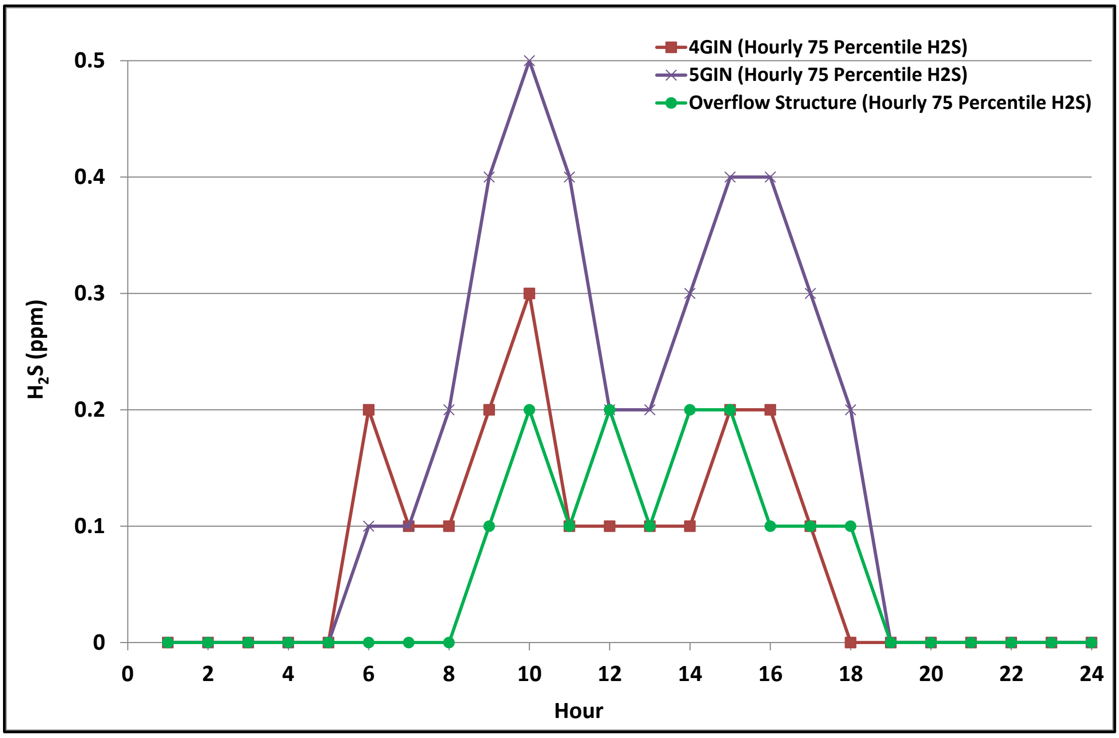


Figure 9. 75th Percentile H_2S comparison between overflow structure and vents 4GIN and 5GIN

5.2.2 Sewer Flow Velocity (Derived from sewer gauging data)

In sewers generally, air flow is predominantly affected by the drag of wastewater. The wastewater drag on the air is usually estimated as a fraction of the sewage speed based on what percentage full the pipe is. In average dry weather conditions, over a day the level in the 2.13 m (nominal) diameter GST tunnel varies between 10% and 24% full (based on cross sections, Reference 6).

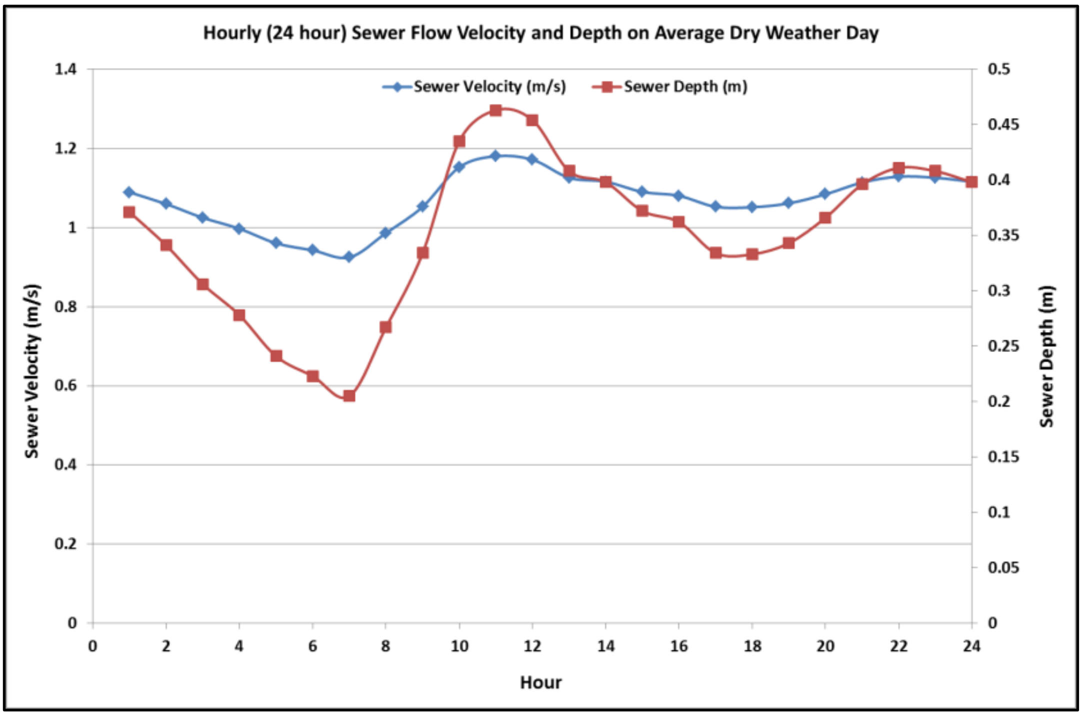


Figure 10. The hourly maximum (24 hour) sewer flow depth and velocity of GST on ADWF based on sewer gauging data of GST in April 2012

From Figure 10 above, the calculated average sewer flow velocity in GST is 1.1 m/s. The sewage level is between 0.2 to 0.48 m depth in GST. The minimum sewer flow normally occurs around 6:00 am and the maximum flow occurs around 10:30 am on average dry weather flow conditions. The hourly maximum sewer flow data plotted in Figure 9 above is obtained from the data collected in April 2012 by a sewer gauging station installed at GST which has since been decommissioned.

5.2.3 Vent Exit Air Flow Measurement

Air flow measurement instruments (pitot tubes with logging instrument) were deployed at the sampling ports of both vents 4GIN and 5GIN on 28 February 2014. The monitoring result is shown in Figure 11.

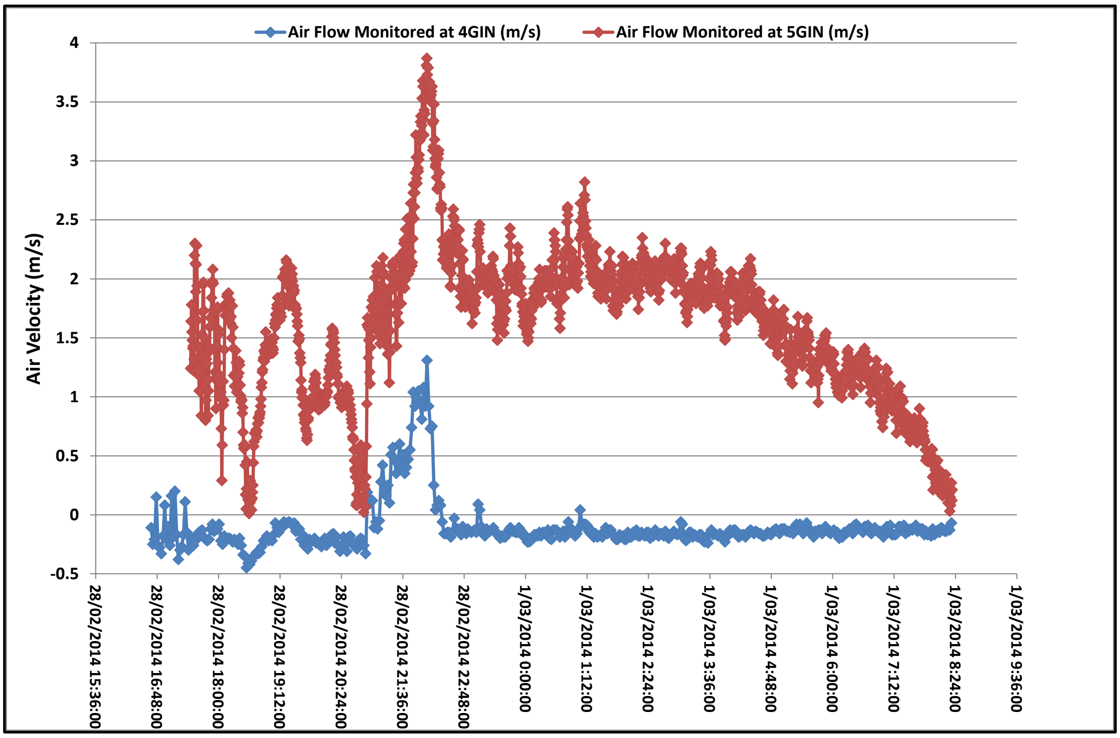


Figure 11. Air velocity Measurement Results at 4GIN and 5GIN vents.

From Figure 11 above, both 4GIN and 5GIN vents show similar air velocity diurnal variation. The negative instrument readings measured at vent 4GIN indicate a possibility of ambient air inducting into the vent stack due to venturi effect. The direction of flow through a natural educt can change throughout the day as the ambient conditions change. However, the magnitude of the negative value readings does not represent the actual amount of air inducting into the vent. The instrument can indicate direction of air flow but only measures velocity in one direction.

5.2.4 Odour Sampling

Eight gas samples were collected from both vent 4GIN and 5GIN on 25th and 26th March 2014 for dynamic olfactometric analysis. The test results show very low OU concentrations (<0.01 ppm).

5.2.5 Sewage Grab Sampling

Sewage samples were taken at shaft 4 (maintenance hole adjacent to vent 5GIN) and sent to a commercial laboratory in Canberra to test for various parameters such as dissolved oxygen (DO), dissolved sulphide, pH, ORP and other parameters. A sample could not be collected from shaft 3 (maintenance hole adjacent to vent 4GIN) due to the lack of safe access from ground level for sampling. However, the sewage characteristics from the shaft 3 is expected to be very similar to shaft 4 due to no side connections and relatively short sewage flow travel distance. The gas and liquid test results are included in attachment 3. Key parameters are presented in Table 3 below:

Table 3. Selected sewage parameters tested from samples taken at shaft 4 of GST

Date and Time	Dissolved Oxygen (mg/L)	Dissolved sulphide (mg/L S)	pH	Sulphide (mg/L S)	Redox (µS/cm)
25 Mar 2014 6:15 am	1.3	0.07	7.8	0.10	-26
25 Mar 2014 7:05 am	1.6	0.05	7.8	0.09	25
25 Mar 2014 8:55 am	3.4	0.04	7.9	0.08	47
26 Mar 2014 10:15 am	<0.1	0.14	7.8	0.17	-82
25 Mar 2014 11:05 am	0.2	0.18	7.8	0.18	-160
26 Mar 2014 1:25 pm	0.1	0.34	7.7	0.41	-262
26 Mar 2014 2:00 pm	<0.1	0.26	7.5	0.32	-255
26 Mar 2014 4:45 pm	0.1	0.12	7.5	0.18	-247

From Table 3, it can be seen that the low dissolved sulphide levels correspond well with low measured H_2S levels in GST.

6. Dispersion Modelling

Dispersion modeling was carried out using AUSPLUME version 6 and ACTEW Odour Assessment Guidelines (Attachment 1). Three scenarios were modeled:

- Odour impact from existing sewer structures
- Odour impact from 23m tall vent stacks at 4GIN and 5GIN
- Predicted future sewage flow odour impact modelled with existing vents

6.1 Modelling Assumptions and Inputs

The following assumptions have been made in the initial modelling and assessment:

1. The West Belconnen land development map in Figure 1 is based on the latest proposal provided by the website www.talkwestbelconnen.com.au.
2. Hydrogen sulphide gas, H_2S, is considered the predominant odorous gas in sewers and is used as a surrogate. H_2S gas can be measured accurately.
3. Odour strength loading in Odour Units (OU) has been derived from 1 ppm H_2S (g) = 5000 OU. This relationship has been established from sewer ventilation study of similar size sewer pipes in ACT.
4. The 75th percentile H_2S, based on site-specific measurements throughout the monitoring period are used.
5. The odour plume dispersion results are plotted for ground level impacts.
6. The meteorology throughout the West Belconnen land development area is distinctly different from the nearest Bureau of Meteorology (BOM) weather stations at the Canberra Airport. Therefore, validated weather data collected from weather station installed at LMWQCC (year 2010), has been used for this modelling.
7. The default Pasquill Gifford curve is used for vertical dispersion and Sigma theta curve for horizontal dispersion. Both curves are for sources less than 100 m in height.

8. The site-specific topography (terrain files) used for the modelling constitute 4 km x 4 km to cover the area of the proposed future land development.
9. Odour decay coefficient of 0.0005 has been used. Surface roughness and other factors adjusted to match local conditions.

Wind File

The wind file input is created from the weather data collected for the whole calendar year 2010 at a weather station near LMWQCC (location of weather station shown in Figure 2).

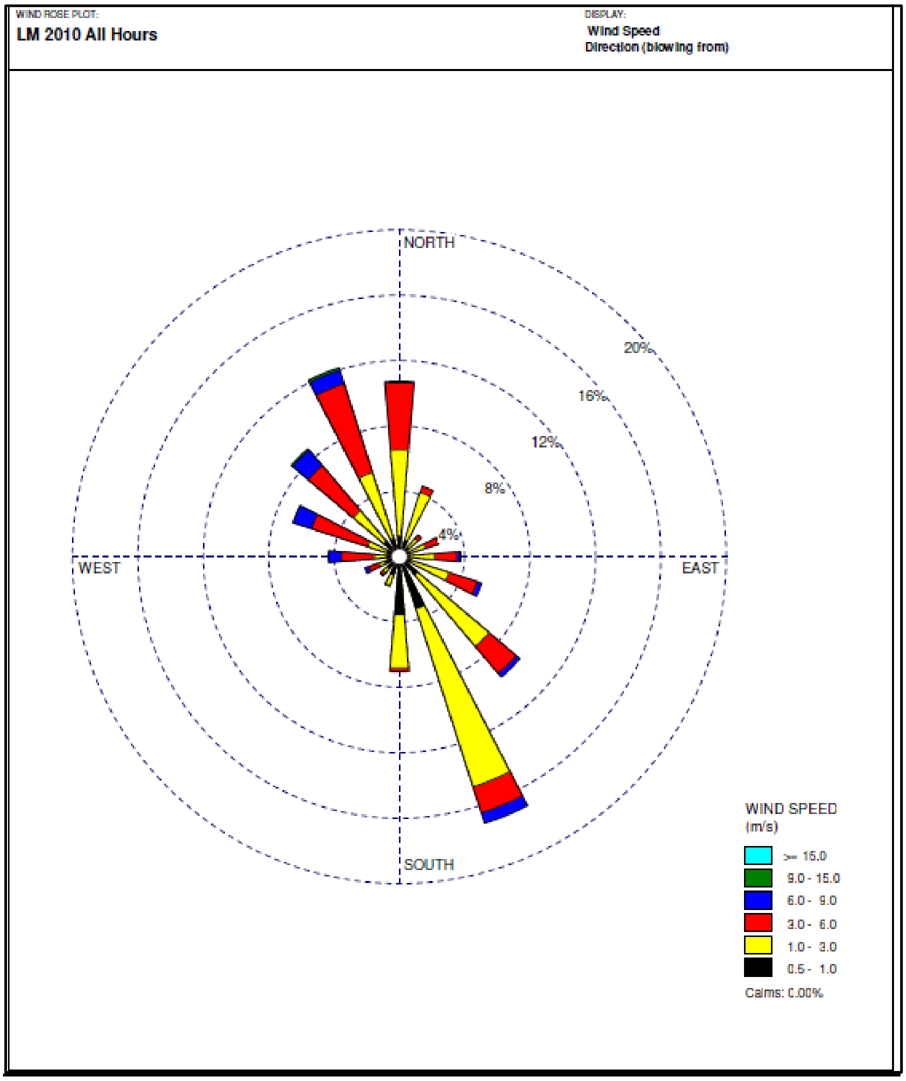


Figure 12. Wind Rose of weather data collected at weather station near LMWQCC in 2010.

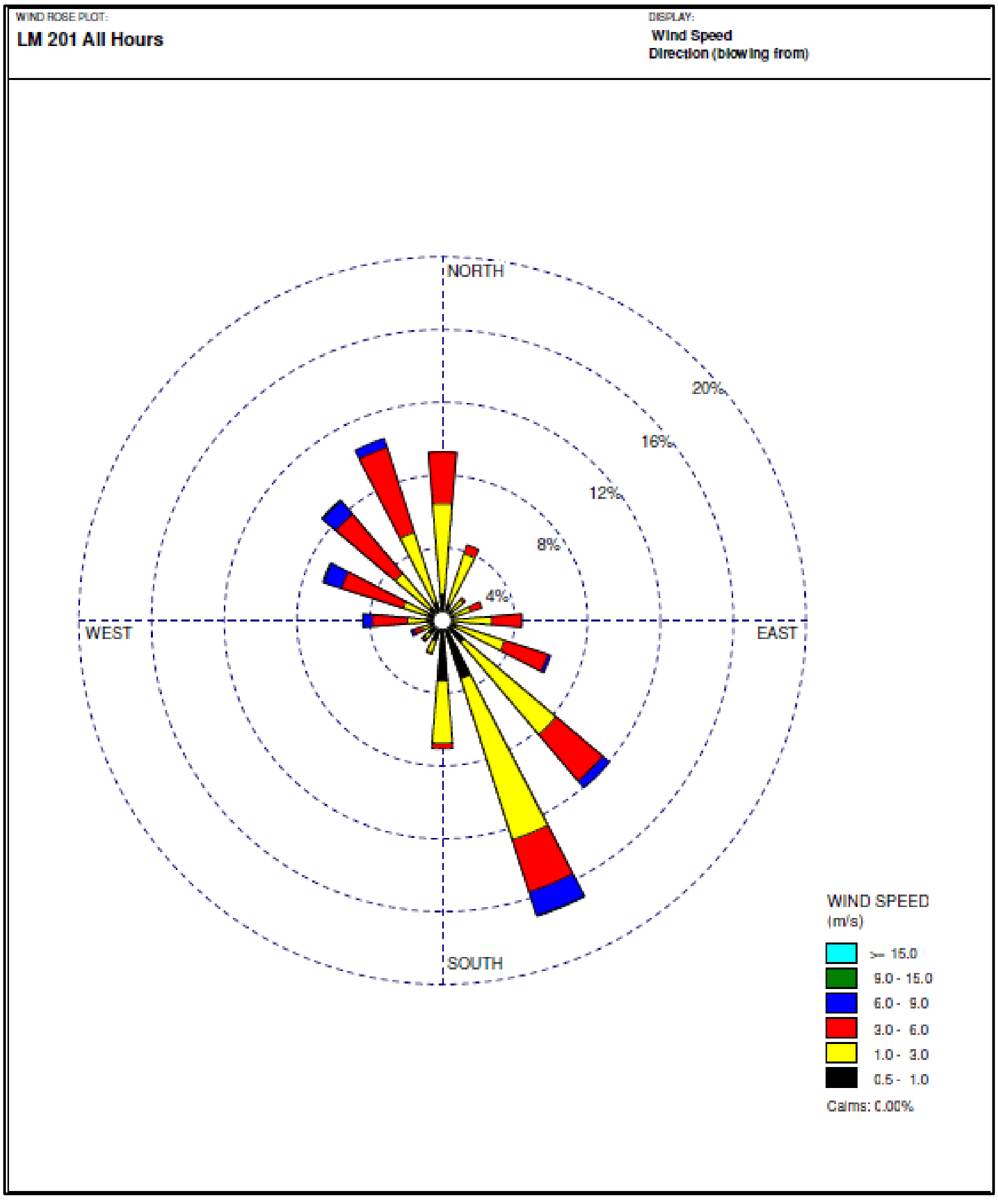


Figure 13. Wind Rose of weather data collected at weather station near LMWQCC in 2011.

From the wind roses above it can be seen that the wind pattern near the LMWQCC is quite similar in the year 2010 and 2011. The wind direction near LMWQCC is mainly blowing from South and South East direction. The wind speed in the area is generally quite low (< 3 m/s at 70% frequency), with long period of calm winds which is less than 0.5 m/s.

Vent Velocity Input

Optimum Ventilation Design Criteria

In practice, the air flow rate must be set to achieve the optimum outcomes based on the following three design criteria (Reference 7):

1. Sufficient air flow to maintain pipe/ tunnel dry walls
2. Negative pressure in appropriate range
3. Keeping air velocity close to sewage flow velocity.

In order to achieve the optimum design criteria above, the following design criteria are considered:

- Shear velocity between sewage and air flow
- Air changes per hour

The GST air extraction rates should be adjusted to achieve an air flow rate of 100 % to 130% of the average sewage velocity in order to minimise air stripping from the sewage (Reference 7). H_2S and other odourous gases might be stripped from the sewage if the extraction rate is substantially higher (more than 130%) than the average sewage velocity. The 110 % of the average sewage velocity is chosen as the ideal GST air extraction rate. This is due to the surface sewage velocity is approximately110 % of the average sewage velocity in ADWF.

The Molonglo Valley Interceptor Sewer (MVIS) ventilation and corrosion report prepared by an industry expert recommends 2 air changes per hour (ACPH) to ventilate a 2.59 m diameter sewer concrete pipeline, which is of similar size to the GST tunnel (Reference 7). The main objectives of maintaining 2 air changes per hour in the sewer tunnel of similar sizes are to manage the moisture and also hydrogen sulphide gas accumulation in the tunnel. The ideal air flow rate based on recommended 2 ACPH is used as the model input.

The following formula is used to calculate the ideal (theoretical) air flow in the sections of GST based on the recommended number of air changes per hour (ACPH):

Air Flow (m^3/hour) = ACPH ($hour^{-1}$) x sewer tunnel air space cross-sectional area (m^2) x section length of sewer tunnel to be ventilated (m)

Based on the ideal air flow the GST air extraction rate can be calculated and summarised in Table 4 and Figure 14:

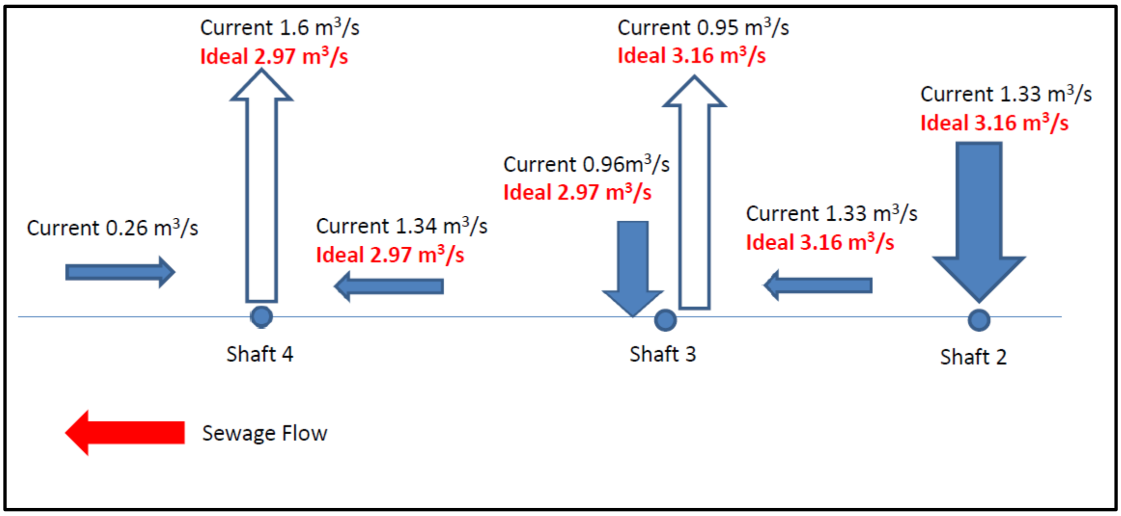


Figure 14. Air Flow Schematics of GST (Current and Ideal)

Table 4. Theoretical (Ideal) air flow in the sections of GST tunnel and actual vent air exit velocity from vent 4GIN and 5GIN

	Length of sewer tunnel to be ventilated (m)	Diameter of tunnel (m)	Current Air extraction rate (m^3/s)	Ideal GST sewer air extraction rate (m^3/s)		Ideal matching GST sewer air velocity (m/s)	
				Based on 110 % Sewage velocity (ADWF)	Based on 2 ACPH	Based on 110 % Sewage velocity (ADWF)	Based on 2 ACPH
Sewer tunnel section Shaft 2 to Shaft 3	1600	2.13	1.33	3.45	3.16	1.01	0.88
Sewer tunnel section Shaft 3 to Shaft 4	1500	2.13	1.34	3.45	2.97	1.01	0.97

The optimisation of the ventilation rate in GST has led to the following ideal vent air flow rates shown in Table 5 below:

Table 5. Vent Exit velocity (measured and ideal)

Vent	Continuous 1 day field measured velocity (m/s)	Instantaneous field measured velocity (m/s)	Ideal vent air exit velocity based on recommended 2 ACPH, m/s (model input)	Ideal vent air exit velocity based on 110 % sewage velocity (ADWF)
4GIN	1.3 (90^{th} percentile)	0.70	4.32	4.72
5GIN	2.2 (90^{th} percentile)	1.64	4.06	4.72

While there is a satisfactory rate of air exchange with the existing fans providing about 1 air changes per hour. The existing ventilation system is satisfactory with a low sulphide concentration in the sewage and a reasonably low rate of corrosion of the GST tunnel

(Reference 3). However, the current air extraction rate in GST is slightly below the expected optimum/ideal level. Due to the proximity of the approaching development, odour and ventilation improvements by air flow optimisation may be required.
The modelling results using the ideal air flow rate as model input is rather conservative. The odour dispersion modelled using the current air flow rate as input will have less odour impact compared to the ideal air flow rate input.

Assessment Criteria

Odour impact is assessed according to the criteria in the *ACTEW Odour Assessment Guidelines*.

These stipulate that 99.9% of the hours in a year in a certain type of development should not be impacted by odour of a particular strength or higher.
This criterion is summarised in Table 6 (Reference 2).

Table 6. Odour Performance Criteria (ACTEW Odour Assessment Guidelines)

Number of people	Odour Units (3 minute at 99.9%)
High density development	2
300 or more	3
50 or more	5
10 or more	6
Less than 10	7

The West Belconnen land development is considered high density development and the odour criteria that applies is 2 OU. While levels as high as 7 OU may be tolerable in industrial or rural environments, levels of 5 OU or higher are likely to result in ongoing complaints in residential areas. Levels of less than 2 OU are recommended for sensitive receptors such as residence, shops, offices, restaurants that are expected in the proposed West Belconnen development area.

Both South Australia Odour Assessment Guidelines and ACTEW Odour Assessment Guidelines apply that the predicted odour level (three minute) must not exceed 2 OU for 99.9 % of the time for sensitive receptors.

Table 7 below summarises the hourly odour emission rates (OER) entered into AUSPLUME for each vent modelled. The assessment below used the following general formula:

Odour emission rates (OER) = odour concentration (OU) x vent air velocity x vent cross-sectional area (unit: OU.m^3/s)

Table 7. The OER for each vent and overflow structure

Hour	Vent 4GIN (current model)	Vent 5GIN (current model)	Overflow Structure (current model)
1	0	0	135
2	0	0	135
3	0	0	135
4	0	0	0
5	0	0	0
6	3159	0	0
7	1580	0	0
8	1580	1485	0
9	3160	4454	270
10	4739	4454	405
11	1580	4454	270
12	1580	2969	405
13	1580	4454	405
14	1580	4454	405
15	3160	2969	405
16	3160	2969	405
17	1580	2969	270
18	0	2969	270
19	0	1485	135
20	0	0	0
21	0	0	135
22	0	0	135
23	0	0	0
24	0	0	135

6.2 Scenario 1: Odour Impact from Existing Sewer Structures

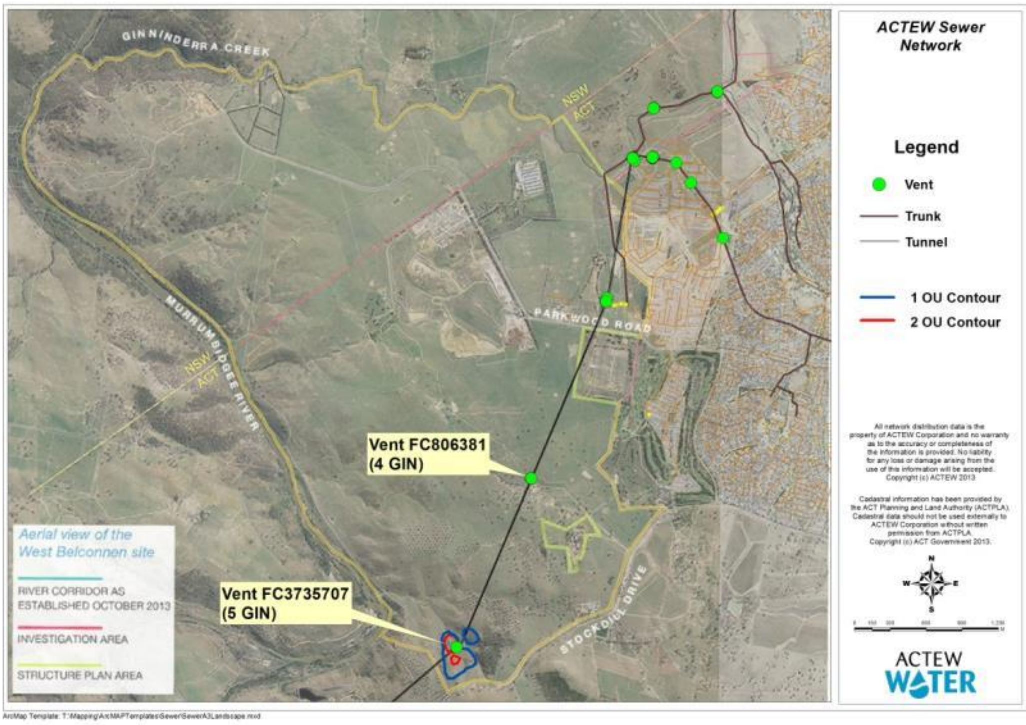


Figure 15. Ground Level odour impact on the proposed West Belconnen land development **(contours are 99.9th percentile at 3 minute averaging time, decay coefficient of 0.0005)**

The odour emission impact from Figure 15 above is based on the H_2S field data collected between late November 2013 and early March 2014 during the summer period. Hourly emission rates for all vents are derived from data collected during this period for input into AUSPLUME model. The emissions from the overflow structure adjacent to vent 5 GIN are also based on the field data collected during summer period. The 2 OU odour contour is from vent 5GIN. The odour impact from vent 4GIN is below 1 OU threshold and hence not shown in the modeling result. A separate odour dispersion model is run with a few discrete receptors located at 10 metre above ground level (about 3 storey height) and the model predicts low odour levels which meet the 2 OU limit as per the ACTEW Odour Assessment Guidelines.

6.3 Scenario 2: Odour Impact from 23 m vent stacks at 4GIN and 5GIN

The two key issues for the future are to maintain or improve the ventilation at GST and to limit the odour emitted from the ventilation structures to protect the future residents of West Belconnen from adverse odour impacts. Therefore in this study the future increase of sewage flows to the sewerage system from the future residents of West Belconnen of up to 12 000 houses is considered. This will significantly increase the H_2S loading in the sewer in addition to the increased sewer flow due to growth of the ACT's population in the next 10 to 15 years. In order to minimise the odour impact to the future residents of West Belconnen due to the increased sewage flow, one of the approaches is to replace the two current 10 metre vent stacks of 4GIN and 5GIN with two 23 m tall vent stacks. However, the effectiveness of installing tall stacks to minimise the odour impact is dependent on the analysis outcomes of the effect of inversion height and strength of the proposed residential area. This scenario is modelled and presented in Figure 16 below:

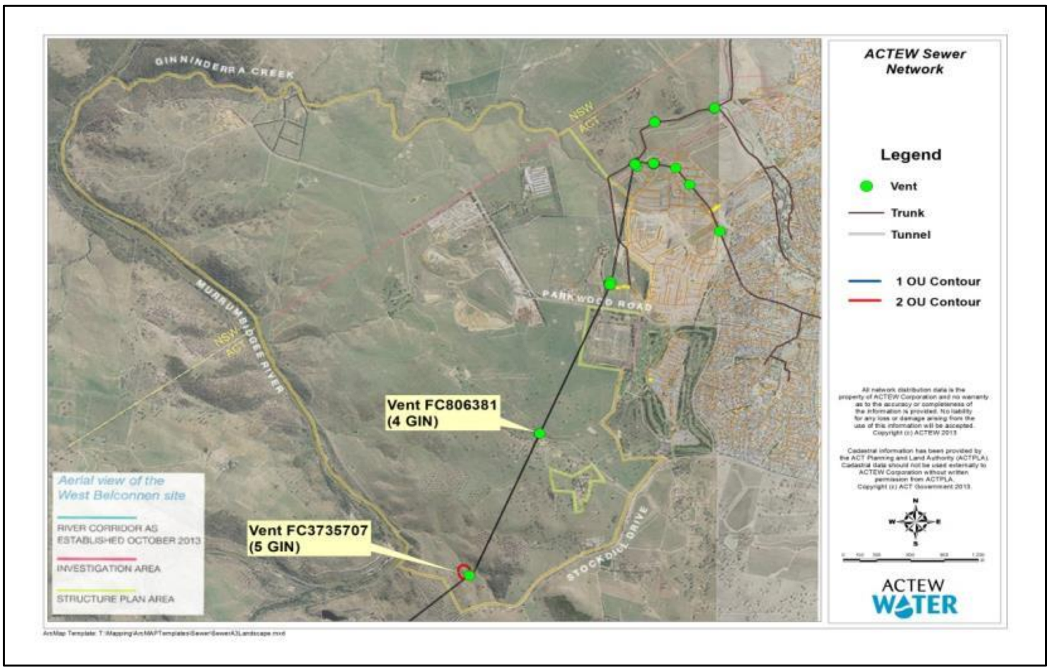


Figure 16. Odour impact with 23 metre vent stacks **(contours are 99.9th percentile at 3 minute averaging time, decay coefficient of 0.0005)**

6.4 Scenario 3: Future Sewage Flow Prediction Odour Impact

The sewage composition will become stronger in the future as the connected population from the same sewer network catchment increases while the sewage flow remains constant due to reduction in consumption per capita. For this study, it is assumed that the concentration of sewage constituents such as BOD will increase on average by about 30 percent. If BOD increases in the future by 30 percent, then it may be expected that sulphide concentrations will increase by about 30 percent. This will also increase the hydrogen sulphide gas released from the sewer. This scenario has been modelled with the existing sewer ventilation structures of GST and the result presented in Figure 17.

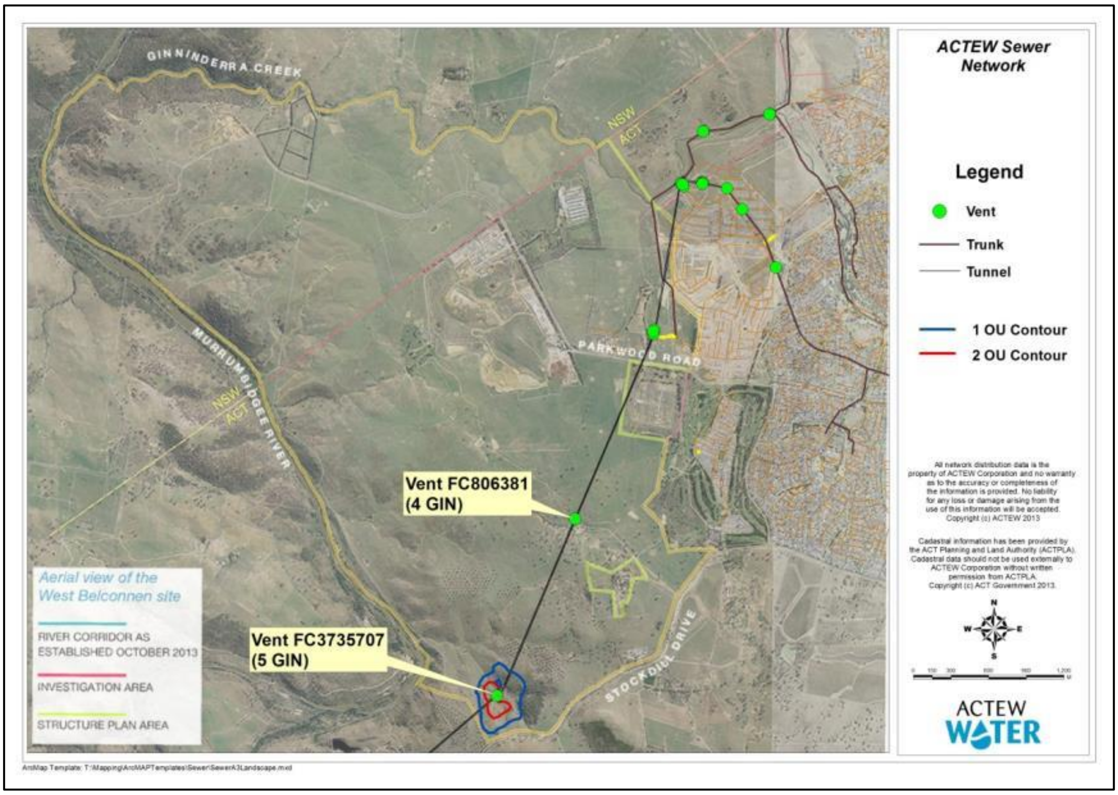


Figure 17. Odour impact modelled with future sewage flow scenario on the proposed West Belconnen land development **(contours are 99.9th percentile at 3 minute averaging time, decay coefficient of 0.0005)**

6.5 Comparison of Current Modelling Result with Initial Modelling Result

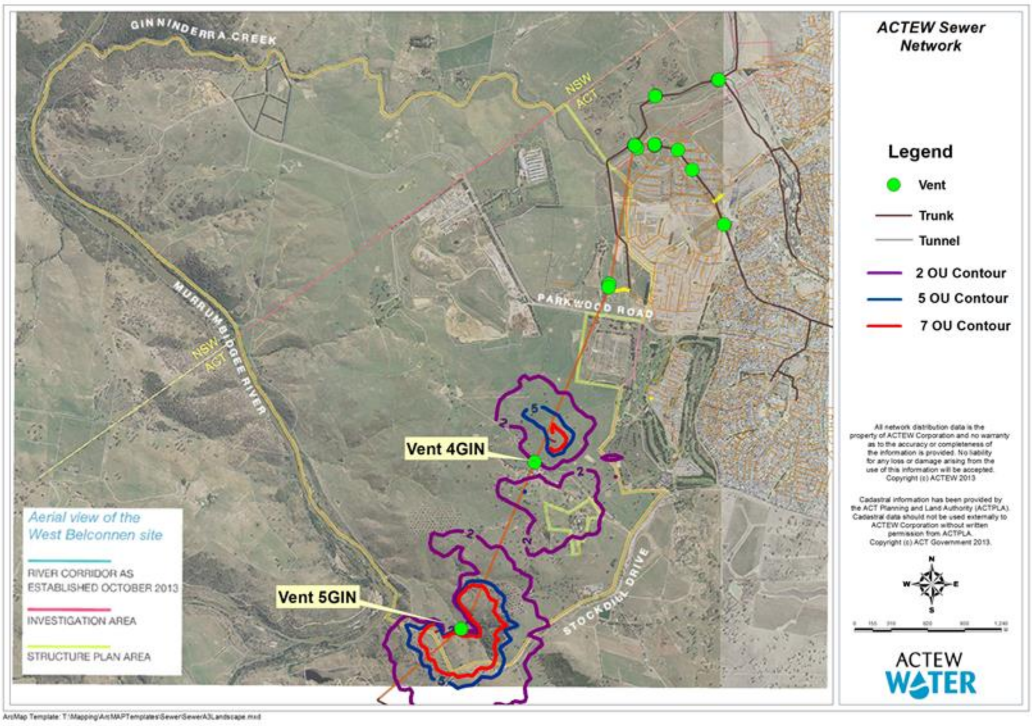


Figure 18. Initial odour impact modelled on the West Belconnen Development in September 2013 **(contours are 99.9th percentile at 3 minute averaging time, decay coefficient of 0.0005)**

Figure 18 shows the predicted odour impact from the initial modelling conducted in September 2013 using H_2S data from the manhole adjacent to 5GIN and assumed air exit velocities. Modelling using actual field data as shown in Figure 15 shows the predicted odour impact is much less than that previously modelled.

Table 8. The comparison of hourly OER inputs between current and initial model

Hour	Vent 4GIN (current model)	Vent 5GIN (current model)	Overflow Structure (current model)	4GIN and 5GIN (Initial model)
1	0	0	135	5599
2	0	0	135	6999
3	0	0	135	6999
4	0	0	0	5599
5	0	0	0	6999
6	3159	0	0	6999
7	1580	0	0	5599
8	1580	1485	0	6999
9	3160	4454	270	8399
10	4739	4454	405	8399
11	1580	4454	270	8399
12	1580	2969	405	6999
13	1580	4454	405	6999
14	1580	4454	405	5599
15	3160	2969	405	5599
16	3160	2969	405	5599
17	1580	2969	270	4200
18	0	2969	270	4200
19	0	1485	135	5599
20	0	0	0	5599
21	0	0	135	5599
22	0	0	135	6999
23	0	0	0	5599
24	0	0	135	6999

6.6 Model and Data Limitations

The dispersion modeling carried out as part of this preliminary assessment was based on a limited amount of field data. Further sewage sampling and H_2S monitoring is required as part of a more detailed assessment to verify the findings of this preliminary assessment.

Vent stack FC 3735707 is located in a sharply incised creek valley. AUSPLUME modeling may not accurately represent the actual dispersion pattern. Vent 5GIN is located in an incised valley which is about 80 m lower than the ground level of the nearby Stockdill Drive as shown in Figure 19 below. Therefore it is necessary to consider the implications of strong inversion layers in the valley especially during night time. This may have an influence on the odour impact to the proposed urban areas. This has not been taken into account in this study and therefore needs to be investigated further.

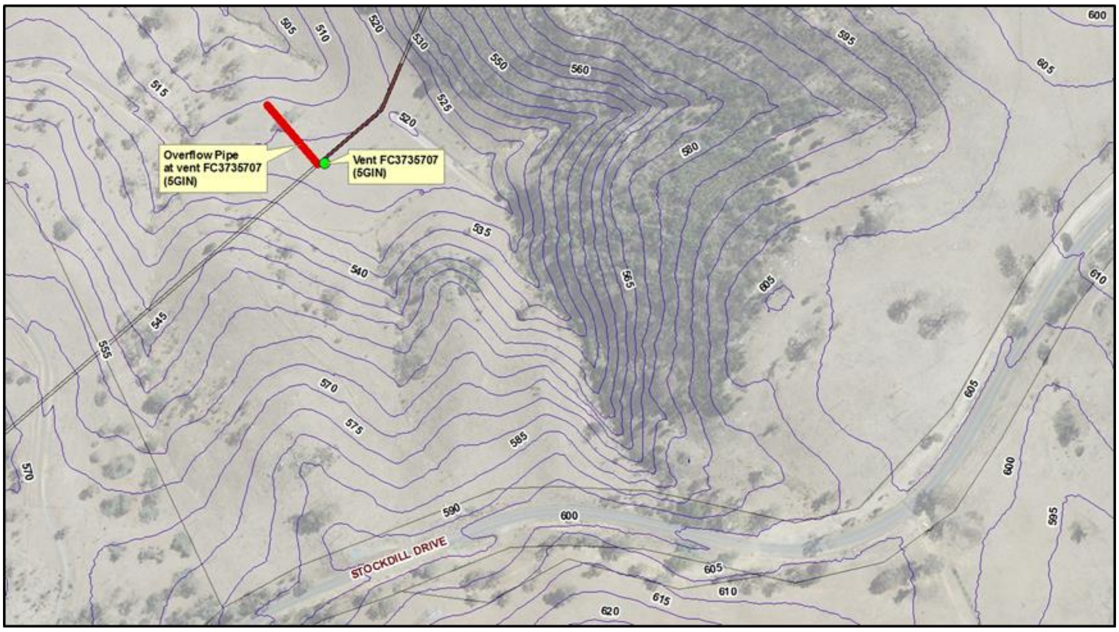


Figure 19. Topography surrounding Vent 5GIN (FC3735707)

7. Siting of Future Odour Scrubbers

Although preliminary assessment suggests a minor odour impact to the proposed land development, consideration should be given to the siting of odour scrubbers should they be required in the future. Issues that need to be considered include identification of a suitable site, land availability, land use compatibility and buffer zone requirements.

8. Conclusion

The AUSPLUME odour dispersion modeling results indicate that the odour impact from existing vents is low and within the threshold of 2 OU as set in the ACTEW Odour Assessment Guidelines for most of the proposed residential area. The existing GST ventilation system seems to be satisfactory with relatively low sulphide concentration in the sewage and hence low H_2S gas produced from the sewage. Nevertheless, approximately 130 m surrounding the vent 5GIN is likely to be impacted by the 2 OU odour contour.

Further detailed assessment is required to verify the findings of this preliminary assessment and to investigate in more detail issues relating to inversion layers, growth, land use compatibility and the future siting of odour scrubbers.

9. Recommendations

Based on the findings of this preliminary assessment and peer review it is recommended that a more detailed technical planning study of the potential odour impacts at West Belconnen be carried out.

The detailed study should include:

6. Monitor to quantify the levels of natural inversion layers in this area, best performed during autumn to winter period.
7. Additional dispersion modeling using the most appropriate model as determined by best industry guidance and compliance with South Australia Air Quality Impact Assessment Guidelines (Reference 8).
8. Consideration of the effect of inversion height and strength in the area on odour impact.
9. Siting of any potential future infrastructure and housing including planning provision for access and buffer zones.
10. Two further H_2S measurement periods at the two vents and two further sewage sampling rounds (DO, ORP, dissolved sulphide) to verify the parameters used in this preliminary modeling. These measurements are recommended to be done during summer season.

10. References

1. Talk West Belconnen website (www.talkwestbelconnen.com.au) by Riverview Group
   http://talkwestbelconnen.com.au/about-west-belconnen/location/
2. Methodology for Impact Assessment of Nuisance Odours in ACT, 2007 (ACTEW Odour Assessment Guidelines)
3. Ginninderra Trunk Main and Tunnel Inspection Report, ActewAGL, May 2010.
4. Improved Management Plan for Flushing of Ginninderra Sewer Tunnel and Pine Ridge Tunnel, ActewAGL, June 2010.
5. Pescod, M.B.; Price, A.C. 1982, Major Factors in Sewer Ventilation, J. Water Pollution. Control Federation, 54(4), 385–397.
6. Inflow Regulation Project – Combined MVIS and GST Flow Detail Design Report, ActewAGL, February 1995.
7. Molonglo Valley Interceptor Sewer Ventilation and Corrosion Report, Consulting Environmental Engineers (CEE), December 2012.
8. EPA Guidelines, Air Quality Impact Assessment Using Design Ground Level Pollutant Concentrations (DGLCs), EPA South Australia, January 2006.

Attachments

Attachment 1. Methodology for Impact Assessment of Nuisance Odours in ACT, 2007

Attachment 2. Details of GST

Attachment 3. Gas and Sewerage (Liquid) Grab Sample Laboratory Test Results

Attachment 4. Initial Odour Dispersion Modelling of Vent Stacks on the GST near Riverview Land Development Report