Appendix 3.7

Odour Survey for Chicken Farm at Hung Shui Kiu

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For AECOM ASIA COMPANY LIMITED

Odour Survey for Chicken Farm at Hung Shui Kiu

September 2015

By Odour Research Centre

Faculty of Science and Technology
Technological and Higher Education Institute of Hong Kong

(*Member of VTC Group*)

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1. Background

An odour assessment service was required by AECOM ASIA COMPANY LIMITED to conduct odour patrol, on-site odour sampling in the chicken farm at Hung Shui Kiu and olfactometry measurement at THEi.

2. Scope of the Work

- To conduct odour sampling and olfactometry analysis to determine odour emission rates at the odorous source locations of the existing chicken farm, and ambient odour concentration within the chicken farm and its boundary as specified by AECOM Asia Co. Ltd. (The Consultant);
- In conjunction with the ambient air sampling, to record the in-situ meteorological conditions in order to determine the wind flux across openings of the chicken houses;
- To conduct odour patrol at the spot-check points (the locations of the nearest representative air sensitive receivers (ASRs) to determine the odour intensity and odour concentration using nasal range field olfactometer in order to identify the odour impact induced from existing operation of chicken farm to the nearby ASRs; and
- Preparation and submission of Odour Analysis Report to the Consultant.

3. Sampling Locations and Frequency

The odour sampling works/odour measurement shall be conducted on a maximum of three non-rainy days with daytime's temperature measuring greater than 30 degree Celsius during the sampling at site. Owing to the fact that excrements and premises will be washed and cleansed after 2:00 pm, it is required that all the samples shall be collected before 2:00pm.

Odour sampling shall be carried out at the odour source locations within the chicken farm and its boundary. The respective locations are listed in Table 1 and as shown in Appendix A1 and A2:

Table 1 Odour Sampling Locations

Sample ID	Location	Number of Sample	Purpose
Set 1			
Collected odour samples using flux hood (from less strength to high strength avoiding cross contamination)			
S1	Small-sized Chicken House	1	Determination of Odour Emission Strength
S2	Small-sized Chicken House	1	Determination of Odour Emission Strength
S11	Excretion Collection channels in small-to-medium-sized chicken house	1	Determination of Odour Emission Strength
S13	Excretion Collection channels in small-to-medium-sized chicken house	1	Determination of Odour Emission Strength
Collected odour samples using direct air bags (Ambient Air Sampling)			
A1-1', A5-1, A5-1', A7-1', A8-1', A8-2, A8-2', A8-4, A8-4'[1]	Small-sized Chicken House	1 per each location	Determination of Odour Concentration and associate dilution factor
Sample ID	Location	Number of Sample	Purpose
AM-1 [1]	Outside the Farm Entrance Gate	1 per each location	Determination of Odour Concentration
AM-2 [1]	Access road to the Farm	1 per each location	Determination of Odour Concentration
Set 2			
Collected odour samples using flux hood (from less strength to high strength)			
S4	Garbage Collection Area	1	Determination of Odour Emission Strength
S5	Excretion Collection channels in large-sized chicken house	1	Determination of Odour Emission Strength
S6	Excretion Collection channels in large-sized chicken house	1	Determination of Odour Emission Strength
S7	Excretion Collection channels in large-sized chicken house	1	Determination of Odour Emission Strength
Collected odour samples using direct air bags (Ambient Air Sampling)			
A4-1', A4-2', A4-3'[1]	Medium-sized chicken house	1 per each location	Determination of Odour Concentration and associate dilution factor
AM-4'[1]	Area as shown outside the large-sized chicken house	1 per each location	Determination of Odour Concentration
Set 3			
Collected odour samples using flux hood (from less strength to high strength)			
S8	Excretion Collection channels in medium-sized chicken house	1	Determination of Odour Emission Strength
S9	Excretion Collection channels in medium-sized chicken house	1	Determination of Odour Emission Strength
S10	Excretion Collection channels in medium-sized chicken house	1	Determination of Odour Emission Strength
ST	Septic Tank	1	Determination of Odour Emission Strength
Collected odour samples using direct air bags (Ambient Air Sampling)			
A3-1', A3-2', A3-3'[1]	Large-sized chicken house	1 per each location	Determination of Odour Concentration and associate dilution factor
A6-1'[1]	Fully enclosed and mechanically-ventilated chicken house	1 per each location	Determination of Odour Concentration and associate dilution factor
AM-3 [1]	Area near the dead chicken body collection area	1 per each location	Determination of Odour Concentration

Note:
[1] All outdoor ambient odour samples shall be taken under downwind condition from farm. Actual sampling location for these samples will be determined on site subject to wind condition.
[2] Since ambient odour sample AM-1, AM-2, AM-3 & AM-4 shall be taken under downwind condition from farm, actual collection day for these 4 samples will be determined on site subject to wind condition.

4. Methodology

4.1. Odour Sampling

4.1.1 Odour gas sample at each survey location is collected by a Sampling Device Standard consists of a vacuum container, which is evacuated by a vacuum pump. The sampling point and the standard sampler are connected by a probe.

4.1.2 Due to the evacuation in the sampling device, the sample bag, inside the device, sucks in sample air via the probe. During this process, none of its components come into contact with the sample air due to the construction of the sampling device.

4.1.3 The only materials, which the odorous air should contact, are stainless steel, borosilicate glass or one of polytetrafluoroethylenes (PTFE). The sample bags are to be manufactured from PTFE, Tedlar if the bags to be reused or from nalophane NATM if the sample bags are to be discarded after use.

Odour Sampling System

4.1.4 In order to determine a specific odour emission rate from an area source such as water surface, air sampling can use a “hood” method, whereby a Flux Hood is placed on the odour emission surface of selected locations and a stream of odour-free nitrogen gas from a certified gas cylinder is supplied into the Flux Hood to simulate a sweep wind blowing on the main section of sampling hood. The flow rate of odour-free nitrogen gas is 5 (L/min). The emission rate is then determined by the air flow through the hood and the odour concentration of the exit air. Air samples shall be collected using the above Sampling Device Standard and odour bags. The Flux Hood system is shown below.

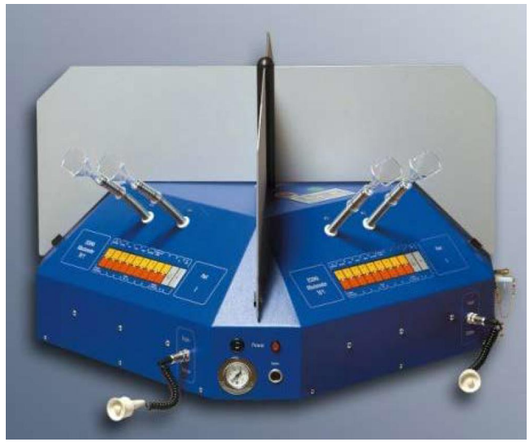
Flux Hood Systems

4.2. Odour Measurement by Olfactometry

4.2.1 The collected air sample in sample bag should be deliveried to Odour Research Centre of THEi and the odour concentration is determined by a Dynamic Olfactometer (TO9) in accordance with the European Standard Method (EN13725).

4.2.2 This European Standard specifies a method for the objective determination of the odour concentration of a gaseous sample using dynamic olfactometry with human assessors and the emission rate of odours emanating from point sources, area sources with outward flow and area sources without outward flow. The primary application is to provide a common basis for evaluation of odour emissions in the member states of the European Union.

4.2.3 This European Standard is applicable to the measurement of odour concentration of pure substances, defined mixtures and undefined mixtures of gaseous odorants in air or nitrogen, using dynamic olfactometry with a panel of human assessors being the sensor. The unit of measurement is the European odour unit per cubic metre: OU_E/m^3. The odour concentration is measured by determining the dilution factor required to reach the detection threshold. The odour concentration at the detection threshold is by definition 1 OU_E/m^3. The odour concentration is then expressed in terms of multiples of the detection threshold. The range of measurement is typically from 2^2 OU_E/m^3 to 2^{17} OU_E/m^3 (excluding pre-dilution).



Olfactometer TO9

4.3. Determination of Specific Odour Emission Rate

A dynamic flux hood system was employed in this sampling work to collect odour samples from water surface, in which an odour-free gas from a nitrogen gas cylinder was supplied to generate a known air inflow at a fixed flow rate of 5 L/min inside the hood. The specific odour emission rates (SOER) at the area source can be calculated by the following equation:

$$\text{SOER } (ou/m^2/s) = \frac{\text{Odour concentration } (ou/m^3) \text{ x Air flow rate inside hood } (m^3/s)}{\text{Covered surface area } (m^2)}$$

4.4. Quality Control (QA/QC)

During each odour sampling day, one blank sample by purging odour-free nitrogen gas from the certified gas cylinder shall be prepared for a purpose of QA/QC.

4.5. Quality Assurance

The odour laboratory shall be ventilated to maintain an odour-free environment and to provide fresh air to the panel members.

Each odour testing session shall comprise of at lease four qualified panellists. All of the panellists shall be screened beforehand by using a certified n-butanol standard gas. The qualified panellists should have their individual thresholds of n-butanol in the range of 20-80 ppb/v to comply with the requirement of EN13725.

Panel members must not eat or smoke for one hour prior to the testing session. Panel members should not use perfumes, shave lotions or any other fragment essences before the session. Panel member should not attend a session if he/she has a cold, influenza or any other health problems which will affect his/her nose.

Eating, drinking or smoking is not permitted while a session is in progress. The exception is during the mid-session break when water can be taken. If a lunch break is taken, food can also

be eaten at one hour before the session. Smoking is not permitted during any breaks.

Each odour testing session should not last for more than 4 hours, in which at lease two breaks (ten minutes each) for olfactometry test shall be taken.

Exposure to direct sunlight shall be avoided for the samples. If any condensate is observed on the inner surface of the air bag, the sample should be discarded. After sampling, the odour samples should be delivered to an odour laboratory as soon as possible and the odour samples shall be analysed within 24 hours.

Regular calibrations of the olfactometer should be performed to check the accuracy and repeatability of its dilution settings and to establish its calibration history. The calibration should be regularly performed using sulfur hexafluoride as a tracer gas and a sulfur hexafluoride monitor.

4.6. Odour Patrol/Spot-check Survey

Odour patrol survey means a simple judgment by observers patrolling and sniffing around to detect any odour at different hours.

Three qualified odour panel members from the Odour Research Centre of THEi conduct the odour patrol, who have their individual n-butanol thresholds in the range of 20 to 80 ppb/v as required by the European Standard Method for Olfactometry (EN13725). They are free from any respiratory diseases and are not normally working or living in the chicken farm at Hung Shiu Kiu.

During the odour survey, the panelists shall conduct the odour patrol/spot-check at the four proposed odour spot-check points as shown in Appendix C at four different directions. They shall use their olfactory senses to detect the presence of any odours and also bring along a logbook to record the findings, including the locations where odour was spotted, the possible sources of the odour, the perceived intensity of the odour, and the characteristics of the odour detected.

The perceived odour intensity is divided into 5 levels which are ranked in a descending order as follows:

Rank	Description	Remarks
0	Not	No odour perceived or the odour was so weak that it cannot be easily detected, characterized or described
1	Slight	Identifiable odour, slight
2	Moderate	Identifiable odour, moderate
3	Strong	Identifiable odour, strong
4	Extreme	Severe odour

The patrol shall be conducted in 4 sessions, during early morning (6am), afternoon (10am-2pm), evening (6pm) and night (8pm) to catch different wind conditions. During each session, odour intensity and concentration shall be checked at 4 spot-check points by the 3 qualified panellists. Samples shall be taken at 1.5m above local ground.

The odour concentration (5 second averaged) will be determined at the odour patrol/spot-check points by using a field olfactometer (Nasal Ranger) as shown below.

For each spot-check location (at each session in each spot-check day), 5 samples in both intensity and concentration shall be recorded (each sample separated by 1 min interval). During the patrol/spot-check, wind direction needs to be recorded by recognizing the local geographical setting and orientation of the site by the odour panelists, relevant weather conditions such as ambient temperature, relative humidity, and wind speed will be measured using a portable environment anemometer (Lutron LM-8000) on the site. The panellists shall also record the any odour sources other than from operation of the chicken farm.

5. Odour Sampling, Olfactometry Measurement and Odour Patrol/Spot-check Survey

5.1. Sampling Activities

5.1.1 Three sampling sets were conducted at identified odour source and representative air sensitive receiver of thirty two locations respectively on 18, 19 and 24 August 2015 of a maximum of three non-rainy days with daytime's temperature measures greater than 30^{o}C (during sampling period) at site. The sampling locations are shown in Table 1 and Appendix A1 and A2.

5.1.2 On the emission surface of the different area source at twelve locations, the odour sample was taken from the surface using the Flux Hood, where a stream of odour-free nitrogen gas from a certified gas cylinder is supplied into the Flux Hood to simulate parallel winds blowing on the main section of sampling hood at a fixed flow rate of 5 L/min and the outlet gas from the Flux Hood was taken as odour samples.

5.1.3 At the twenty odour source locations and the nearest representative air sensitive receivers, the ambient air was collected as odour samples.

5.1.4 During the odour sampling, relevant weather conditions including ambient temperature, relative humidity, wind speed, and wind direction were recorded on the sites for references. The data are shown in Table 2.

5.1.5 In every sampling day, one blank sample by purging odour-free nitrogen gas from the certified gas cylinder was also prepared for a purpose of QA/QC.

5.1.6 A total of thirty-five gas samples on 18, 19 and 24 August 2015 were collected and immediately transported to the Odour Research Centre of THEi after the sampling.

5.2. Olfactometry Analysis

Olfactometry analysis was conducted within 24 hours after the sampling work using a dynamic olfactometer in accordance with the European Standard Method (EN13725). Four qualified panellists participated in the odour testing session, who were previously selected through a set of screening tests using a certified n-butanol gas (60 ppm/v) as a standard reference.

5.3. Determination of Specific Odour Emission Rate

From the odour concentrations determined by olfactometry, the specific odour emission rates (SOER) at twelve sampling locations were calculated by the following equation and the final results are shown in Table 1:

$$\text{SOER } (\text{ou/m}^2\text{/s}) = \frac{\text{Odour concentration (ou/m}^3\text{) x Air flow rate inside hood (m}^3\text{/s)}}{\text{Covered surface area (m}^2\text{)}}$$

Where air flow rate inside hood = 5.0 (L/min) x 10^{-3} / 60 = 8.33 x 10^{-5} (m^3/s), and covered surface area = 0.2 (m) x 0.2 (m) x 3.14 = 0.126 m^2.

5.4. Odour sampling results

Summary of sampling condition and results for odour sampling and olfactometry measurement are shown in Table 2.

Table 2. Summary of sampling condition and results for odour survey

Sample ID	Sampling Location	Date	Time	Sampling Method	Ambient Temp. ^{0}C	Humidity %	Wind Direction	Wind Speed m/s	OC OU_E/m^3	SOER $OU_E/m^2.s$
Set 1										
S1	Small-sized Chicken House	18-8-2015	11:36	FH	35.7	67.3	W-SW	0.2	569	0.376
S2	Small-sized Chicken House	18-8-2015	11:52	FH	35.8	67.1	W-SW	0.2	609	0.403
S11	Excretion Collection channels in small-to-medium-sized chicken house	18-8-2015	12:36	FH	36.1	66.8	W-SW	0.2	1024	0.677
S13	Excretion Collection channels in small-to-medium-sized chicken house	18-8-2015	12:51	FH	36.2	66.7	W-SW	0.4	287	0.190
A1-1'	Small-sized Chicken House	18-8-2015	12:20	A	35.8	67.0	W-SW	0.5	25	
A5-1	Small-sized Chicken House	18-8-2015	10:35	A	34.0	70.1	W-SW	0.3	90	
A5-1'	Small-sized Chicken House	18-8-2015	10:30	A	35.1	66.9	W-SW	0.3	19	
A7-1'	Small-sized Chicken House	18-8-2015	13:25	A	36.5	66.3	W-SW	0.3	45	
A8-1'	Small-sized Chicken House	18-8-2015	10:40	A	35.0	67.1	W-SW	0.1	26	
A8-2	Small-sized Chicken House	18-8-2015	10:45	A	34.5	69.2	W-SW	0.6	107	
A8-2'	Small-sized Chicken House	18-8-2015	10:50	A	35.6	67.7	W-SW	0.5	31	
A8-4	Small-sized Chicken House	18-8-2015	11:00	A	35.6	67.6	W-SW	0.0	114	
A8-4'	Small-sized Chicken House	18-8-2015	11:05	A	35.7	67.4	W-SW	0.1	45	
AM-1	Outside the Farm Entrance Gate	18-8-2015	10:25	A	33.6	70.0	W-SW	0.7	18	
AM-2	Access road to the Farm	18-8-2015	10:22	A	34.2	68.5	W-SW	0.3	16	
QA/QC-1		18-8-2015	13:15						< 4	
Set 2										
S4	Garbage Collection Area	19-8-2015	10:10	FH	35.6	60.3	W	0.4	724	0.479
S5	Excretion Collection channels in large-sized chicken house	19-8-2015	11:22	FH	34.0	65.4	W-SW	1.0	30573	20.2
S6	Excretion Collection channels in large-sized chicken house	19-8-2015	10:42	FH	32.3	73.7	W-SW	0.7	32767	21.7
S7	Excretion Collection channels in large-sized chicken house	19-8-2015	11:55	FH	32.9	73.0	W-SW	0.7	8191	5.41
A4-1'	Large-sized chicken house	19-8-2015	12:26	A	34.8	64.1	W-SW	0.6	38	
A4-2'	Large-sized chicken house	19-8-2015	12:15	A	36.2	56.5	W-SW	3.3	64	
A4-3'	Large-sized chicken house	19-8-2015	11:10	A	35.5	65.6	W-SW	0.8	38	
AM-4	Area as shown outside the large-sized chicken house	19-8-2015	11:15	A	35.3	66.6	W-SW	0.4	17	
QA/QC-2		19-8-2015	12:12						< 4	
Set 3										
S8	Excretion Collection channels in medium-sized chicken house	24-8-2015	11:00	FH	33.9	59.2	W	0.3	1722	1.14
S9	Excretion Collection channels in medium-sized chicken house	24-8-2015	10:33	FH	32.8	66.5	NW	0.4	3821	2.53
S10	Excretion Collection channels in medium-sized chicken house	24-8-2015	10:16	FH	32.9	63.1	N-NW	0.4	4390	2.90
ST	Septic Tank	24-8-2015	11:50	FH	35.0	59.2	N-NW	0.4	6888	4.55
A3-1'	Medium-sized chicken house	24-8-2015	11:30	A	36.0	54.3	W-NW	0.9	11	
A3-2'	Medium-sized chicken house	24-8-2015	11:20	A	34.3	60.7	W-NW	1.1	31	
A3-3'	Medium-sized chicken house	24-8-2015	11:35	A	34.6	54.1	NW	1.1	8	
A6-1'	Fully enclosed and mechanically-ventilated chicken house	24-8-2015	10:05	A	32.8	61.1	N-NW	2.2	22	
AM-3	Area near the dead chicken body collection area	24-8-2015	12:36	A	37.3	48.2	W-NW	0.1	< 4	
QA/QC-3		24-8-2015	12:49						< 4	

Remark: A: Ambient sampling; FH: Flux hood method; OC: Odour concentration; SOER: Specific odour emission rate;

5.5. Sampling photos

During the sampling, relevant photos were taken at the all sampling locations and are shown below:

S1

S2

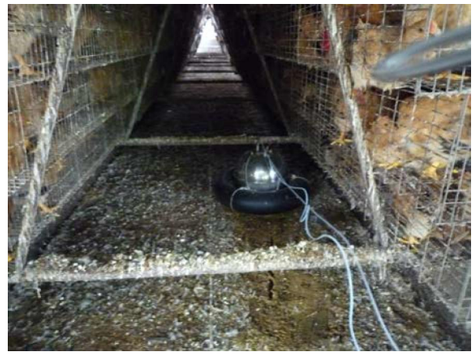
S4

S5

S6

S7

S8



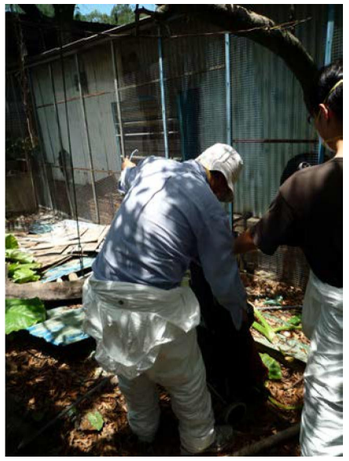
S9

S10

S11

S13

ST



A1-1'

A3-1'

A4-3'

A5-1

A3-2'

A3-3'

A5-1'

A6-1'

A4-1'

A4-2'

A7-1'

A8-1'

A8-2

A8-2'

A8-4

A8-4'

AM-1

AM-2

AM-3

AM-4

5.6. Odour Patrol/Spot-check Survey

5.6.1 The odour patrol/spot-check at the four proposed odour spot-check points as shown in Appendix B at four different directions was conducted by 3 qualified odour panel members (see their certificates in Appendix C) from THEi. Preliminary observations of odour natures at each location are summarized in the Table 3.

5.6.2 The odour patrol/spot-check in 4 sessions were be conducted on 18, 19 and 24 August 2015, during early morning (6am), afternoon (10am-2pm), evening (6pm) and night (8pm) to catch different wind conditions. During each session, odour intensity and concentration shall be checked at 4 spot-check points by the 3 qualified panellists. Samples shall be taken at 1.5m above local ground.

5.6.3 The odour concentration (5 second averaged) was be determined at the odour patrol/spot-check points by using a field olfactometer (Nasal Ranger) as shown the Table 3.

5.6.4 For each spot-check location (at each session in each spot-check day), 5 samples in both intensity and concentration were be recorded (each sample separated by 1 min interval). The relevant weather conditions were also be recorded on site during the measurement, including wind speed, wind direction, temperature and humidity, and any odour sources other than from operation of the chicken farm.

Table 3: Summary of Odour Survey Findings at Different Points

Location		Point 1											
Date		18/8/2015	18/8/2015	18/8/2015	18/8/2015	19/8/2015	19/8/2015	19/8/2015	19/8/2015	24/8/2015	24/8/2015	24/8/2015	24/8/2015
Time		6:53	9:50	18:35	19:53	6:48	9:42	18:30	19:50	6:55	9:43	18:40	19:55
Temperature (°C)		29.2	33.8	31.7	28.6	29.5	31.5	31.0	30.6	29.9	31.3	31.6	30.3
Relative Humidity (%)		75.4	69.2	72.1	74.2	81.7	75.7	74.3	75.2	80.1	67.5	58.8	67.5
Wind Direction		S-SW	S-SW	S-SE	S-SE	S	W	SW	SE	E	N-NW	SW	SE
Wind Speed (m/s)		0.3	0.7	0.0	0.5	0.0	0.6	0.4	0.3	0.0	0.1	0.0	0.1
Weather		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Nature / Type of Odour		Fecal						Fecal		Fecal			
Origin / Source(s)		Chicken Farm						Chicken Farm		Chicken Farm			
Odour Intensity	Panel 1	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 2	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 3	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Mean	0.067	0	0	0	0	0	0.033	0	0.033	0	0	0
Offensiveness		Mild						Mild		Mild			
Duration		Intermittent						Intermittent		Intermittent			
Nasal Ranger Number	Panel 1	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Panel 2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Panel 3	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Mean	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Location		Point 2											
Date		18/8/2015	18/8/2015	18/8/2015	18/8/2015	19/8/2015	19/8/2015	19/8/2015	19/8/2015	24/8/2015	24/8/2015	24/8/2015	24/8/2015
Time		6:43	9:58	18:25	20:02	6:38	9:52	18:20	20:00	6:48	9:53	18:30	20:05
Temperature (°C)		29.0	34.7	32.0	27.5	28.8	33.2	32.3	29.8	29.5	31.7	31.3	30.0
Relative Humidity (%)		78.3	66.3	68.8	74.2	82.2	70.0	72.6	75.7	78.8	63.2	57.5	63.5
Wind Direction		S-SW	S-SW	S-SE	S-SE	S	W	SW	SE	E	N-NW	SW	SE
Wind Speed (m/s)		0.5	0.8	0.1	1.3	0.0	0.4	0.5	0.4	0.0	1.0	0.0	0.0
Weather		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Nature / Type of Odour				Fecal	Fecal				Mild				
Origin / Source(s)				Chicken Farm	Chicken Farm				Intermittent				
Odour Intensity	Panel 1	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0~1, 0~1, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 2	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 3	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0~1, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Mean	0	0	0.1	0.13	0		0	0.067	0	0	0	0
Offensiveness				Mild	Mild				Mild				
Duration				Intermittent	Intermittent				Intermittent				

Nasal Ranger Number	Panel 1	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Panel 2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Panel 3	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Mean	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Location		Point 3											
Date		18/8/2015	18/8/2015	18/8/2015	18/8/2015	19/8/2015	19/8/2015	19/8/2015	19/8/2015	24/8/2015	24/8/2015	24/8/2015	24/8/2015
Time		6:35	10:07	18:15	20:12	6:30	10.02	18:02	20.08	6:30	10.12	18:12	20:13
Temperature (°C)		30.2	33.6	31.9	27.2	28.7	32.2	31.7	29.0	29.3	32.4	30.4	29.5
Relative Humidity (%)		79.5	68.0	66.5	76.0	81.3	66.2	73.5	76.2	78.0	63.5	60.2	68.2
Wind Direction		S-SW	S-SW	S-SE	S-SE	S	W	SW	SE	E	N-NW	SW	SE
Wind Speed (m/s)		0.5	2.6	1.6	0.5	0.4	2.1	0.3	0.3	0.0	0.5	0.1	0.0
Weather		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Nature / Type of Odour													
Origin / Source(s)													
Odour Intensity	Panel 1	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 2	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 3	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Mean	0	0	0	0	0	0	0	0	0	0	0	0
Offensiveness													
Duration													
Nasal Ranger Number	Panel 1	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Panel 2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Panel 3	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2	< 2, <2, <2, <2, <2
	Mean	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Location		Point 4											
Date		18/8/2015	18/8/2015	18/8/2015	18/8/2015	19/8/2015	19/8/2015	19/8/2015	19/8/2015	24/8/2015	24/8/2015	24/8/2015	24/8/2015
Time		6:25	10:15	18:05	20:22	6:20	10.12	18:12	20.18	6:40	10.03	18:22	20:23
Temperature (°C)		29.9	34.4	31.3	26.9	28.0	34.0	31.9	28.7	29.8	32.5	30.2	29.2
Relative Humidity (%)		80.5	66.6	65.5	77.4	81.6	62.5	73.2	76.8	77.5	61.4	60.7	69.4
Wind Direction		S-SW	S-SW	S-SE	S-SE	S	W	SW	SE	E	N-NW	SW	SE
Wind Speed (m/s)		0.3	0.6	0.8	0.3	0.5	0.7	0.2	0.4	0.0	0.4	0.2	0.1
Weather		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Nature / Type of Odour													
Origin / Source(s)													
Odour Intensity	Panel 1	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 2	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0
	Panel 3	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0	0, 0, 0, 0, 0

	Mean	0	0	0	0	0	0	0	0	0	0
Offensiveness											
Duration											
Nasal Ranger Number	Panel 1	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2
	Panel 2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2
	Panel 3	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2	< 2, <2, <2, <2, <2, <2
	Mean	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2

5.7. Odour patrol/spot-check photos

During the odour patrol/spot-check at the four proposed odour spot-check points, relevant photos were taken at the four locations and are shown below:

Point 1

Point 2

Point 3

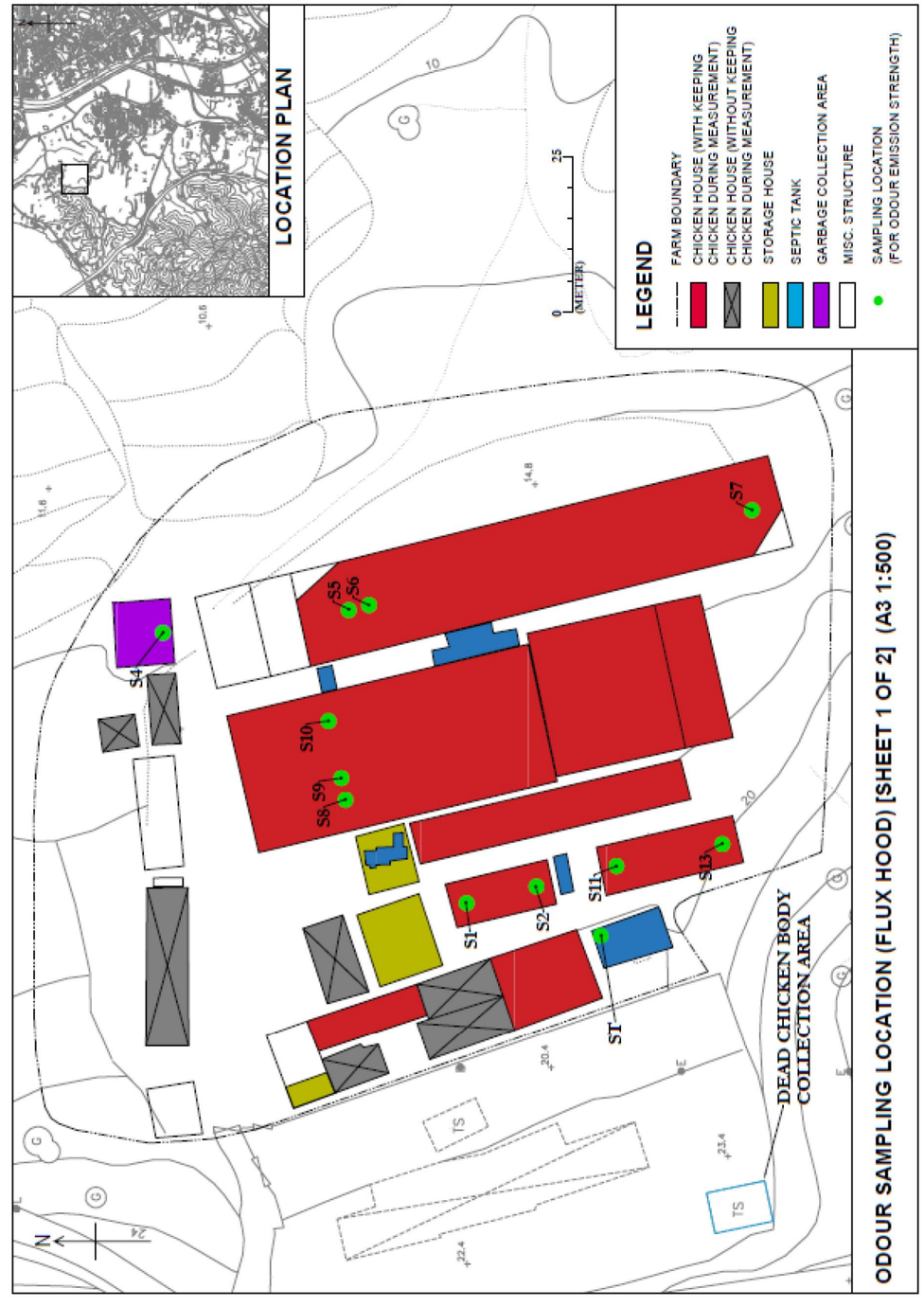
Point 4

Prepared by:

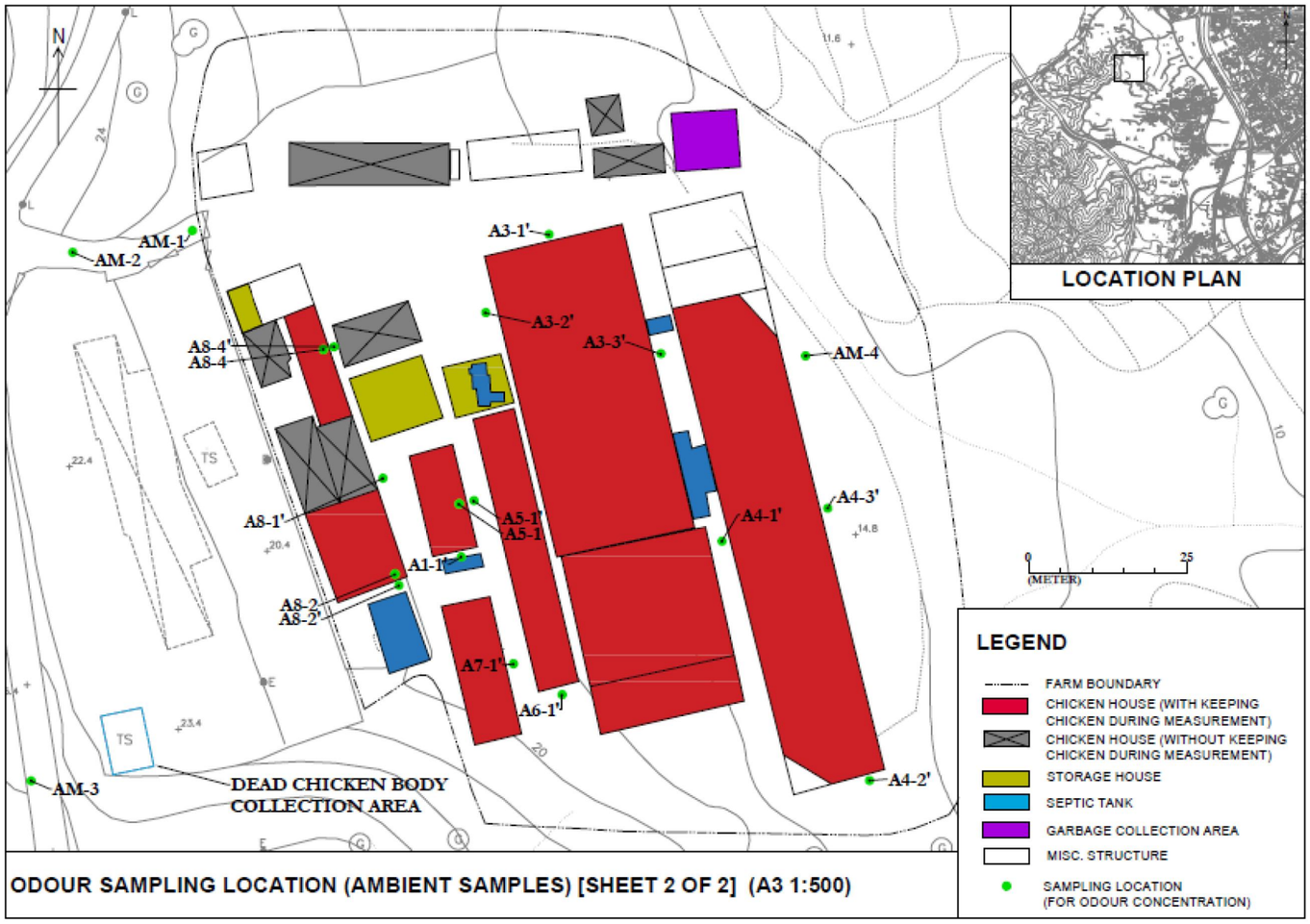
KH NG Signed:

Odour Research Centre at THEi

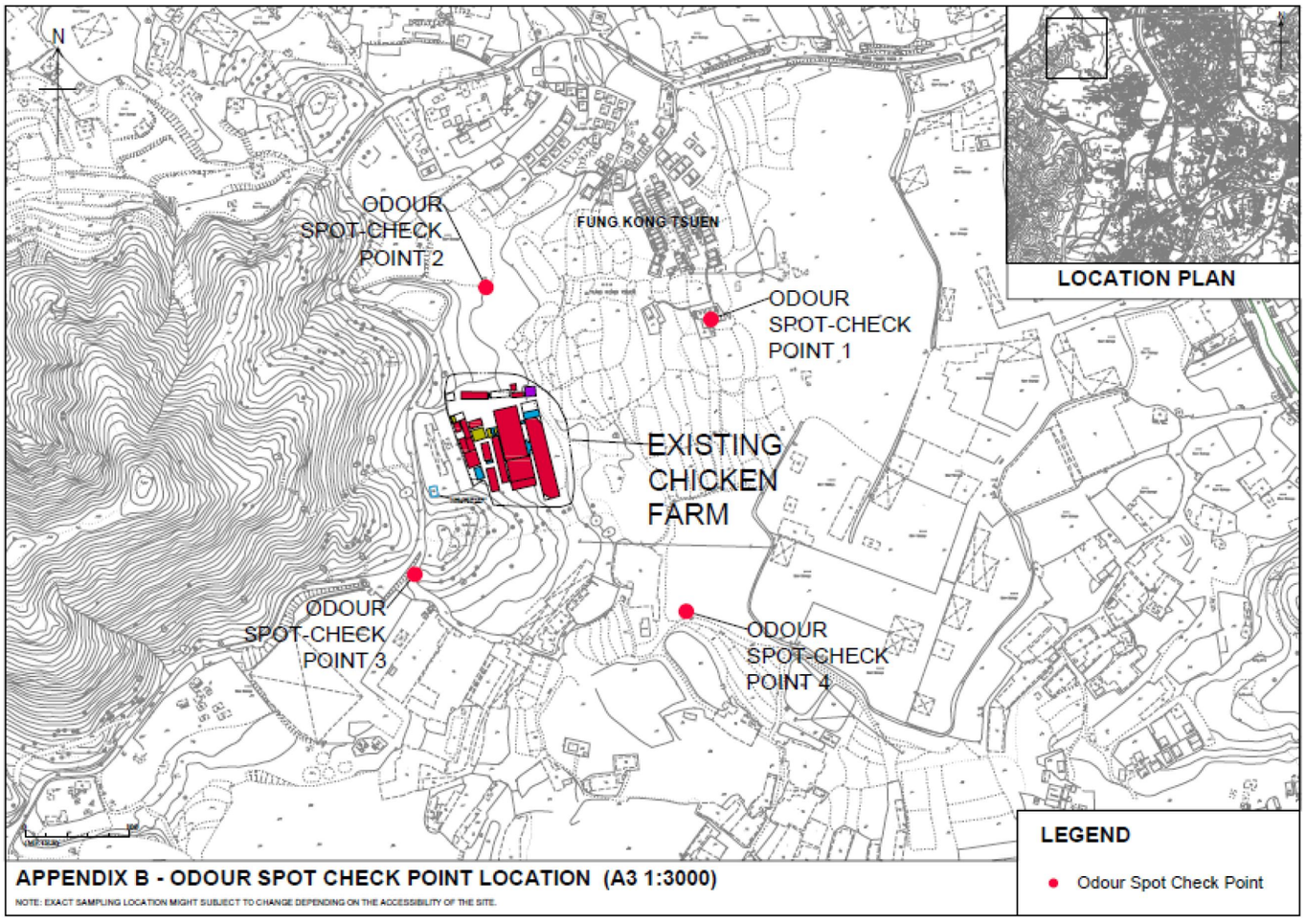
Appendix A1: Sampling location (Flux Hood) in the chicken farm at Hung Shui Kiu



Appendix A2: Sampling location (ambient samples) in the chicken farm at Hung Shui Kiu



Appendix B: Odour spot-check points near the chicken farm at Hung Shui Kiu



Certificate for a Qualified Odour Panel Member

Odour Research Centre
The Technological and Higher Education Institute
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THEi Building, 20A Tsing Yi Road, Tsing Yi Island,
Hong Kong
Tel: (852) 2176 1836 / 9133 7248
Fax: (852) 2176 1419

26 June 2015

Re: A Certificate for a Qualified Odour Panel Member

This is to certify that Mr. Harry Ho participated in a set of n-butanol screening tests in our centre between 22 June 2015 –26 June 2015 and his odour threshold of n-butanol in nitrogen gas was found to be in the range of 20 – 80 ppb/v and a standard deviation of R < 2.3. According to the requirement of the European Standard Method of Air Quality – Determination of Odour Concentration by Dynamic Olfactometry (EN13725), he is qualified to participate olfactometry analysis to determine odour concentration.

Yours sincerely

Professor H. Chua
Odour Research Centre at THEi

Certificate for a Qualified Odour Panel Member

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THEi Building, 20A Tsing Yi Road, Tsing Yi Island,
Hong Kong
Tel: (852) 2176 1836 / 9133 7248
Fax: (852) 2176 1419

26 June 2015

Re: A Certificate for a Qualified Odour Panel Member

This is to certify that Mr. Rex Li participated in a set of n-butanol screening tests in our centre between 22 June 2015 –26 June 2015 and his odour threshold of n-butanol in nitrogen gas was found to be in the range of 20 – 80 ppb/v and a standard deviation of R < 2.3. According to the requirement of the European Standard Method of Air Quality – Determination of Odour Concentration by Dynamic Olfactometry (EN13725), he is qualified to participate olfactometry analysis to determine odour concentration.

Yours sincerely

Professor H. Chua
Odour Research Centre at THEi

Certificate for a Qualified Odour Panel Member

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Tel: (852) 2176 1836 / 9133 7248
Fax: (852) 2176 1419

26 June 2015

Re: A Certificate for a Qualified Odour Panel Member

This is to certify that Mr. Ng Kin-hung participated in a set of n-butanol screening tests in our centre between 22 June 2015 –26 June 2015. His odour threshold of n-butanol in nitrogen gas was found to be in the range of 20 – 80 ppb/v and a standard deviation of R < 2.3, which comply with the requirement of the European Standard Method of Air Quality – Determination of Odour Concentration by Dynamic Olfactometry (EN13725). The valid period is three months from the date of this certificate.

Yours sincerely

Professor H. Chua
Odour Research Centre at THEi

Certificate for a Qualified Odour Panel Member

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Fax: (852) 2176 1419

26 June 2015

Re: A Certificate for a Qualified Odour Panel Member

This is to certify that Mr. Samuel Chow participated in a set of n-butanol screening tests in our centre between 22 June 2015 –26 June 2015 and his odour threshold of n-butanol in nitrogen gas was found to be in the range of 20 – 80 ppb/v and a standard deviation of R < 2.3. According to the requirement of the European Standard Method of Air Quality – Determination of Odour Concentration by Dynamic Olfactometry (EN13725), he is qualified to participate olfactometry analysis to determine odour concentration.

Yours sincerely

Professor H. Chua
Odour Research Centre at THEi

Certificate for a Qualified Odour Panel Member

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Fax: (852) 2176 1419

26 June 2015

Re: A Certificate for a Qualified Odour Panel Member

This is to certify that Miss. Ashley Zhu participated in a set of n-butanol screening tests in our centre between 22 June 2015 –26 June 2015 and her odour threshold of n-butanol in nitrogen gas was found to be in the range of 20 – 80 ppb/v and a standard deviation of R < 2.3. According to the requirement of the European Standard Method of Air Quality – Determination of Odour Concentration by Dynamic Olfactometry (EN13725), she is qualified to participate olfactometry analysis to determine odour concentration.

Yours sincerely

Professor H. Chua
Odour Research Centre at THEi

THEi *K.H. Ng*

Certificate for a Qualified Odour Panel Member

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Fax: (852) 2176 1419

26 June 2015

Re: A Certificate for a Qualified Odour Panel Member

This is to certify that Miss. Venus Choi participated in a set of n-butanol screening tests in our centre between 22 June 2015 –26 June 2015 and her odour threshold of n-butanol in nitrogen gas was found to be in the range of 20 – 80 ppb/v and a standard deviation of R < 2.3. According to the requirement of the European Standard Method of Air Quality – Determination of Odour Concentration by Dynamic Olfactometry (EN13725), she is qualified to participate olfactometry analysis to determine odour concentration.

Yours sincerely

Professor H. Chua
Odour Research Centre at THEi

THEi *K.H. Ng*

Appendix C**: Procedure of Dynamic Olfactometry Used at THEi**

1. Introduction

The method of odour measurement in our odour research centre follows the European Standard Method (EN13725). The scope of the method includes the measurements of odour concentration of pure substances, defined mixtures and undefined mixtures of gaseous odorants in air or nitrogen, using dynamic olfactometry with a panel of human assessors being the sensor. The unit of measurement is the odour unit per cubic meter (OU_E /m^3). The odour concentration is measured by determining the dilution factor required reaching the detection threshold. The odour concentration at the detection threshold is by definition 1 OU_E /m^3. The odour concentration is then expressed in terms of multiples of the detection threshold. The range of measurement is typically from 2^2 to 2^{17} OU_E /m^3 (excluding pre-dilution). The Dynamic Olfactometer (TO9) is a dilution apparatus designed to perform the odour threshold measurements. One measurement, using a panel of 4 - 8 persons, can be completed in less than ten minutes.

2. Principle of odour measurement

The odor concentration of a gaseous sample is measured by determining the dilution factor required reaching the detection threshold. The odor concentration at the detection threshold is by definition 1 OU_E/m^3, which has a probability of 50%, being detected under the conditions of the test. The odor concentration of the examined sample is then expressed in terms of multiples of one OU_E in a cubic of neutral gas at standard conditions. The range of measurement is typically from 2^2 to 2^{17} OU_E/m^3 (excluding pre-dilution).

The quality assurance for the performance of the analytical method as a whole and of equipment used to present the sample to the assessor is the core of the standard method. The principal indicators of data quality are its bias and precision, which when combined, express its accuracy which indicates the closeness of agreement between the test results and the accepted reference value. In addition, the instrumental calibration of olfactometers is done using a tracer gas (sulfur hexafluoride) at regular intervals and if the results of the calibration show that the instrument is not functioning within the requirements, technical intervention, such as maintenance or adjustment of settings may be required. The instability of dilutions produced by olfactometers is also determined. The calibration of the sensor of the sensory measurement, in this case the odor panel, is done on the basis of the reference odorant, n-butanol.

3. Odour measurement

3.1. Materials and apparatus

Olfactometer; carbon filter, sulfur hexafluorid monitor; tubing for connecting gas cylinders, and vent lines; flow meter; Window 7 PC; Olfactometer Software, Odor free dry air; standard n-butanol gas (60 ppm); high purity nitrogen gas; standard sulfur hexafluoride gases in nitrogen (1000 ppm, 4 % and pure sulfur hexafluoride).

3.2. Procedure of odour measurement

a. *Procedure for operator*

1. Assign a number to each panelist, start from 1, 2 then 3 and so on;
2. Connect the sample bag into the olfactometer;
3. Start Olfactometer Software by double click on the corresponding icon;
4. Select measuring method of odour threshold;
5. Click on the “Start measurement” icon;
6. Select appropriate number of panelists as a team at olfactometer;
7. Select a start step;
8. Click on “OK” and measurement begins;
9. When the test is completed, print out the results and related information from Olfactometer Software.

b. Procedure for panelists

1. The panelists must take their places at the equipment;
2. When the initial signal lamps for inhalation illuminate-two circular LED’s for the panelists at the test positions, the sequence starts;
3. Press the key when the panelists perceive a positive odour impression;
4. By following odour impressions the panelists must press key again;
5. The panelists must not leave the equipment before the LED's are flickering;
6. The measurement is ended automatically as soon as all panelists have given a correct response to two successive dilution steps.

3.3. Flushing the olfactometer

After the completion of a testing run, the olfactometer should be flushed with clean air for a period in excess of required to purge all odorous air form the system of the olfactometer. Prior to the commencement of a run with an odour sample it is essential that the olfactometer is purged with the odour sample for a time sufficient to ensure that all odour free air, or any previous sample is completely purged form the olfactometer.

3.4. Measurement results

Here the value ZITE,pan is stated as a geometric mean of all the retrospective selections for valid panel member responses in a measurement. If the dilution value ZITE,pan is reduced back to the EROM value of 123µg/m^3, stated in EN 13725:2003, due to a reference substance measurement, then this dilution value can be stated on the odour threshold as OU_E/ m^3 (OU_E = European odour units). In the report the possible representation as per EN 13725:2003 is stated in brackets as a decimal figure after the code. Doing so is useful for an odour threshold = Cod, as the findings of a person are subject to a logarithmic scale on which the perceived effects are better represented. In the "Remarks" window a manual comment can be added to each measurement by the operator.

3.5. Presentation of results

The results should be presented on a sheet and an example calculation supplied. The results should be available for scrutiny and should include the number of panellists, their responses to each dilution for both the odour sample and the responses to the reference gas employed on that day.

4. Panel selection and control

4.1. Panel selection

In order to ensure repeatability of the sensor, composed of individual panel members, their olfactory sensitivity should be within a narrow bandwidth. To achieve this aim, assessors with a specific sensitivity to a reference odour are selected to be panel members. The screening is on reference material n-butanol with the concentration of 60 ppm in nitrogen (v/v).

At least 10 individual thresholds for the reference gas are collected for selection purposes. These data are collected in at least 3 sessions on separate days with a pause of at least one-day between sessions. To become a panel member, the data collected for that assessor must comply with certain criteria:

The geometric mean of the individual thresholds must fall between 20 and 80 ppb, when n-butanol standard gas is used.

A measuring history for each panel member is continuously recorded in following performance and compared with the selection criteria. If the panel member does not comply, he/she is excluded from all further measurements.

4.2. Panel control

Panellist must not eat or smoke for one hour prior to the session

Panellists should be in odour room 15 minutes before measurements.

Do not use perfumes, after shave lotions or any other fragrant essences before the session

Do not attend a session if you have a cold, influenza or any other health problem, which will affect your nose. If you don't tell us, we will tell you that your performance is not satisfactory.

Eating, drinking or smoking is not permitted while a session is in progress. The exception is during the mid-session break when water can be taken. If a lunch break is taken food can also be eaten, one hour before the session. Smoking is **NOT** permitted during any break.

Panellists should not leave the room during a session, without the consent of the operator.

Panellists should never discuss their results with other panellists or comment on their perceptions of the odour run in progress. Remember, there is no right or wrong answer. You are not being judged.

Panellist will be expected to stay until the end of each session.

No panellist should be involved for more than 4 hours of odour testing. Within this period at least 2 ten minutes breaks for olfactory rest should occur.

The panel should be housed in an air-conditioned room that ensures it is odour free and comfortable. The flushing from the olfactometer should be exhausted from the room in which testing is being performed without contaminating the room air.

5. Quality requirement

To assess compliance with the overall quality criterion for accuracy of odour concentration measurements within one laboratory, a series of ten measurements should be carried out using 60 ppm n-butanol in nitrogen as a reference material in two days.

Geometric Repeatability $r' = e^{(t\, S_r\, \sqrt{2})} < 3$

Where t – *a factor from the Student's t-distribution for n-1 degrees of freedom with a confidence level of 95%*

s_r – standard deviation of odour measurement under constant conditions

The value of r' is the greatest ratio between two single measurement values obtained (with the same method, with an identical sample, under constant conditions as regards the laboratory, investigator and apparatus, and with a short interval of time) will, with a probability of 95%, be smaller than that value.

Geometric Reproducibility $R' = e^{(t\, S_R\, \sqrt{2})} < 4$

Where t – *a factor from the Student's t-distribution for n-1 degrees of freedom with a confidence level of 95%*

s_R – standard deviation of odour measurement under different conditions

The value of R' is the greatest ratio between two single measurement values obtained (with the same method, with an identical sample, under different conditions as regards the laboratory, investigator and apparatus, and with a short interval of time) will, with a probability of 95%, be smaller than that value.

This implies that two measurement values will differ from each other by no more than a factor of 3 and 4 respectively, with a probability of 95%.

6. Instrumental Calibration

The instrumental calibration of the olfactometer is required in EN13725. The objective of the calibration is to check the accuracy and repeatability of the dilution settings of the olfactometer at a regular interval (every year) and to establish a calibration history of the olfactometer. The calibration uses sulfur hexafluoride as a tracer gas and a sulfur hexafluoride monitor. The

accuracy and repeatability of the olfactometer are calculated from two sulfur hexafluoride concentrations: one measured at the sniffing port of the olfactometer and one with certified sulfur hexafluoride concentrations.

6.1. Procedure of olfactometer calibration

1. Activate the sampling system, measure and record the sulfur hexafluoride concentration of the room air in the lab;
2. Connect the sampling line to one port of the olfactometer;
3. Take a measure of reference air from the olfactometer. If this air contains over 1ppm sulfur hexafluoride, check for the cause before starting the calibration;
4. Continue with the calibration, taking five measurements for each dilution setting. Between measurements all controls of the instrument should be changed. Preferably use series of increasing concentration, as is done in normal olfactometry sessions. Mark exactly when the operator, or the control software, signals that the dilution that has been set is ready for "sniffing", this is the mark for the start of the calculation of results;
5. Check regularly the background concentrations in the neutral gas from the olfactometer and the room air;
6. Each measurement should provide about 12 individual readings. The time between subsequent readings should be a minimum of the lag-time of the calibration unit (about 5s);
7. The accuracy criterion requires that the averaged sulfur hexafluoride concentration measured at the sniffing port is within 20% of the expected sulfur hexafluoride value for each dilution setting. The repeatability criterion requires that the deviation of the measured sulfur hexafluoride concentration must be less than 5 % in any dilution setting with a probability of 95%;
8. Spot checks of the dilution produced in the different ports of a single diluting channel multi-port machine should be made to ensure that no systematic differences occur between the ports. Multiple diluting channel machines must have each channel and each dilution individually measured;
9. Take notes of all observations that may in any way be relevant;
10. Ensure safe storage of all data;
11. After completing measurements, check the neural gas from the olfactometer and the room air. If sulfur hexafluoride concentrations are higher than 1ppm, check the zero of the calibration unit using zero gas. If the zero has not drifted, check for any recycling of vented sulfur hexafluoride mixture back through the compressor or air conditioning unit.

6.2. Instrumental quality requirement

The accuracy criterion requires that the averaged sulfur hexafluoride concentration measured at the sniffing port is within 20% of the designed sulfur hexafluoride value for each dilution setting. The repeatability criterion requires that the deviation of the measured sulfur hexafluoride concentration must be less than 5% in any dilution setting with a probability of 95%. One set of recent calibration data are presented in the following table.

					Data of olfactometer calibration on 12 March 2015												
Date: 12 March 2015																	
Settings	**15**	**14**	**13**	**12**	**11**	**10**	**9 (39150 ppm)**	**9 (1025 ppm)**	**8 (39150 ppm)**	**8 (1025 ppm)**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Dilution Factor	137852.1	34493.4	17231.5	8615.8	4308.4	2154.2	1081.5	971.6	536.4	490.0	244.0	122.0	61.0	30.5	15.2	7.6	3.8
	137900.7	34466.1	17233.8	8617.7	4307.9	2155.6	1081.3	968.8	536.9	490.4	243.7	121.9	61.0	30.5	15.2	7.6	3.8
	137852.1	34469.1	17239.1	8615.8	4308.4	2154.4	1080.7	974.3	536.9	491.1	243.1	121.9	61.0	30.5	15.2	7.6	3.8
	137852.1	34432.7	17233.0	8613.9	4306.9	2154.2	1080.4	969.7	536.0	491.6	243.2	121.9	61.0	30.5	15.2	7.6	3.8
	137852.1	34469.1	17239.1	8617.7	4308.4	2155.1	1080.9	968.8	535.8	490.9	244.0	121.9	61.0	30.5	15.2	7.6	3.8
	137852.1	34466.1	17233.8	8615.8	4308.8	2155.1	1081.0	972.5	536.0	490.2	244.2	122.0	61.0	30.5	15.2	7.6	3.8
	137852.1	34432.7	17234.5	8617.7	4312.1	2154.2	1081.5	969.7	536.2	489.3	244.4	122.0	61.0	30.5	15.2	7.6	3.8
	137949.3	34466.1	17223.9	8617.7	4309.3	2153.7	1082.5	973.4	536.4	489.5	244.6	122.0	61.0	30.5	15.2	7.6	3.8
	137900.7	34466.1	17233.0	8615.8	4308.4	2153.9	1081.7	974.3	537.0	488.3	244.9	122.1	61.0	30.5	15.2	7.6	3.8
	137900.7	34493.4	17233.8	8617.7	4306.0	2157.5	1081.7	970.6	536.7	489.7	244.7	122.1	61.0	30.5	15.2	7.6	3.8
	137852.1	34466.1	17239.1	8613.9	4307.9	2154.2	1081.6	971.6	536.4	490.0	244.5	122.1	61.0	30.5	15.2	7.6	3.8
	137852.1	34469.1	17233.0	8619.6	4308.4	2154.7	1081.5	972.5	536.4	490.0	244.2	122.1	61.0	30.5	15.2	7.6	3.8
	137852.1	34493.4	17233.8	8617.7	4312.6	2154.2	1081.3	970.6	535.9	487.6	244.0	122.1	61.0	30.5	15.2	7.6	3.8
	137900.7	34469.1	17223.9	8617.7	4307.4	2154.9	1080.9	971.6	535.7	490.4	243.9	122.0	61.0	30.5	15.2	7.6	3.8
	137852.1	34466.1	17234.5	8621.4	4308.4	2153.0	1081.4	974.3	536.2	491.1	243.8	122.0	61.0	30.5	15.2	7.6	3.8
	137852.1	34432.7	17233.8	8617.7	4308.8	2154.2	1081.5	970.6	536.3	491.6	243.2	121.9	61.0	30.5	15.2	7.6	3.8
	137852.1	34469.1	17223.9	8615.8	4311.7	2154.1	1081.6	972.5	536.4	490.9	243.8	122.0	61.0	30.5	15.2	7.6	3.8
	137900.7	34493.4	17233.0	8617.7	4308.4	2153.7	1082.2	971.6	536.4	486.2	244.0	122.0	61.0	30.5	15.2	7.6	3.8
	137852.1	34469.1	17239.1	8619.6	4306.9	2154.4	1081.7	974.3	536.5	490.0	243.9	122.0	61.0	30.5	15.2	7.6	3.8
	137852.1	34466.1	17233.8	8617.7	4308.4	2153.7	1081.6	971.6	536.6	490.0	244.0	122.0	61.0	30.5	15.2	7.6	3.8
Average	137869.1	34467.4	17233.2	8617.2	4308.7	2154.4	1081.4	971.8	536.3	489.9	244.0	122.0	61.0	30.5	15.2	7.6	3.8
Standard Deviation (STDEV)	28.5	18.3	4.62	1.83	1.69	0.93	0.49	1.78	0.36	1.32	0.48	0.069	0.026	0.0066	0.0012	0.0004	0.0001
Instability (%)	0.04	0.104	0.053	0.042	0.077	0.085	0.089	0.36	0.131	0.528	0.39	0.111	0.084	0.042	0.015	0.011	0.005
Coefficient of Variation (%)							10.7		9.0								
Average for Coefficient of Variation (%)							9.9		9.9								
Average for Coefficient of Variation (%) / 2							**4.93**		**4.93**								
Adjusted Dilution Factor	**131072.2**	**32768.2**	**16383.6**	**8192.4**	**4096.2**	**2048.2**	**1028.1**	**1019.7**	**509.9**	**514.1**	**256.0**	**128.0**	**64.0**	**32.0**	**16.0**	**8.0**	**4.0**
Dilution Step	**131072**	**32768**	**16384**	**8192**	**4096**	**2048**	**1024**	**512**	**256**	**128**	**64**	**32**	**16**	**8**	**4**		