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NOISE IMPACT STUDY

Proposed Wastewater Treatment Plant

Talbotville, Ontario

Prepared for

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HGC Project No. 01601514

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1 INTRODUCTION & SUMMARY

HGC Engineering was retained by PGL Environmental Consultants ("PGL") to undertake a noise impact study of a proposed wastewater treatment plant ("WWTP") in Talbotville, Ontario, to support development approvals processes. A scaled location map of the surrounding area is included as Figure 1. This study uses predictive analysis to assess the potential impact of sound sources associated with the site with respect to Ontario Ministry of the Environment and Climate Change ("MOECC") guideline NPC-300, which is acceptable to the Township of Southwold.

Sound emissions from key items of equipment associated with the site were based on measurements of the same type of equipment conducted by HGC Engineering at a similar facility, manufacturer's data, and predictions using standard acoustical engineering calculations from reference texts. The source sound levels were used to develop an acoustical model of the facility in order to predict the sound levels of the proposed facility at the nearest sound sensitive points of reception, for evaluation with respect to MOECC limits.

The analysis indicates that the sound emissions from the proposed facility are predicted to be within the applicable sound level limits of MOECC guideline NPC-300. The reader is referred to the main body of the report for assumptions and results of the analysis.

2 SITE DESCRIPTION & NOISE SOURCES

The site is located 4 kilometres northwest of the City of St. Thomas on the south side of Talbotville Gore Road, approximately 375 metres from Regional Road 4. The facility will serve a proposed residential subdivision to the northwest, and will consist of a central treatment plant comprised of modular shipping containers housing mechanical equipment (e.g. pumps, blowers, etc.) and enclosed aeration tanks. The mechanical equipment will operate continuously, 24 hours per day. In addition, a truck will visit the site approximately once every two weeks to deliver consumables (i.e. chemicals, etc.) or to remove solid waste material, and an emergency generator will be tested bi-weekly, during daytime hours. The facility is to be developed in two phases; this study considers the "ultimate" build out of the site, including both phases of development.

During a visit to the site and surrounding area by HGC Engineering personnel on November 11, 2016, the background sound in the area was observed to be dominated by road traffic on Regional Road 4. The area surrounding the subject site is best categorized as a Class 2 ("semi-urban") acoustical environment, under the applicable MOECC noise assessment guideline.

Figure 2 is a satellite image of the proposed site and surrounding lands. The nearest existing sound sensitive point of reception to the proposed facility is a single-family home to the north, represented by locations R1 (façade of the home) and R1A (rear yard). In addition, this study considers future, single family dwellings within a proposed residential subdivision northwest of the site, the most potentially impacted lots on which are represented herein by locations R2/R2A and R3/R3A (locations R2 and R3 represent the upper storey window of the assumed two storey dwellings).

The lands on which the Talbotville WWTP is to be located are approximately 15 metres lower in elevation than the existing home to the north and proposed subdivision to the northwest.

3 CRITERIA

In Ontario, the MOECC guideline that forms the basis of environmental noise assessment is publication NPC-300[1] This guideline draws a distinction between "stationary sources" (industrial or commercial sounds), and other types of sources such as road traffic or construction activities, for example. The sound sources associated with the Talbotville WWTP are classified as stationary sources. The sound level limit for stationary sources of sound are site specific and depend on the background sound in the vicinity, which includes road traffic sound but excludes the source under assessment. The guideline also stipulates that the assessment consider the potential noise impact during a "predictable worst case hour" of operation, which is defined as a situation when the normally busy activity of the source coincides with an hour of low background sound. In other words, the principle of assessment involves evaluating the subject source against the background sound, on an hourly basis. If the acoustic environment in the vicinity is such that the ambient sound level falls off significantly during quiet hours, there are exclusionary minimum sound level limits, which set the lower bound for the acceptability criteria. Specifically, NPC-300 states that the sound

[1] Ontario Ministry of the Environment and Climate Change Publication NPC-300, *Environmental Noise Guideline, Stationary and Transportation Sources - Approval and Planning,* August, 2013.

level limit for a stationary source in a Class 2 environment is the greater of the minimum one-hour energy-equivalent ambient sound level (L_{EQ}) during any hour that the subject source may operate or the exclusionary minimum limits of 50 dBA during daytime hours (07:00 to 23:00) and 45 dBA during nighttime hours (23:00 to 07:00) at the plane of an outdoor window. For outdoor points of reception, the exclusionary minimum limits are 50 dBA during daytime hours and 45 dBA during evening hours.

Characteristic ambient sound levels can be determined through automatic sound level monitoring (typically for a period of at least 48 hours), or predicted from road traffic volumes in areas where traffic sound is dominant. Where it can be demonstrated that the hourly background sound levels remain greater than the exclusionary minimum limit noted above, the criterion becomes the lowest measured/predicted one-hour L_{EQ} sound level. At locations where the ambient sound levels are low, the exclusionary minimum criteria of 50/45 dBA apply.

Observations made in the vicinity of the points of reception neighbouring the subject site indicate that background sound levels are likely to fall as low as the exclusionary minimum levels set out by NPC-300. Therefore, the exclusionary minimum limits outlined above are applicable at the representative points of reception.

NPC-300 stipulates that sound emissions from emergency equipment operating in non-emergency situations, such as maintenance testing, be assessed independently of all other stationary sources of noise. Further, the sound level limits for emergency equipment are 5 dB greater than the limits otherwise applicable to stationary sources. Since the emergency generator at the subject site will be tested during daytime hours only, the sound level limit applicable thereto is 55 dBA (5 dB greater than the daytime exclusionary minimum criterion of 50 dBA), summarized in Table 1, below.

Table 1: Applicable Sound Level Limits, L_{EQ} [dBA]

Point of Reception	Daytime (07:00 to 19:00)	Evening (19:00 to 23:00)	Nighttime (23:00 to 07:00)	Generator Testing
R1, R2, R3	50	50	45	55
R1A, R2A, R3A	50	45	--	55

4 OPERATING ASSUMPTIONS & ANALYSIS METHODS

The primary sources of sound at the proposed facility will be the mechanical equipment housed within the buildings central to the site, sound from which will be emitted to the outdoors via ventilation openings (two of which, in each phase, will be equipped with fans), and through the walls and roof structures. In addition, this study includes sound associated with occasional onsite truck traffic and testing of the emergency generator.

Because the facility has not yet been constructed, sound emissions from key items of equipment were based on a combination of measurements conducted by HGC Engineering at a similar facility, manufacturer's sound data and predictions using standard acoustical engineering calculations from reference texts. The sound power level of each source is summarized in Table A1 of Appendix A. The location of each sound source on the site is depicted in Figure 3. For the purposes of this study, all sources were assumed to operate continuously, 24 hours per day, with the exception of the onsite trucking and testing of the emergency generator. Based on input from project personnel, a predictable worst case daytime hour was also assumed to include one truck visiting the site per hour, and testing of the emergency generator for 20 minutes.

The site plans and equipment layout drawings provided by PGL indicate a total of five ventilation openings in each of the two phases of the WWTP development. Each ventilation opening is to be equipped with a "sound hood", lined with an acoustically absorptive material. In the absence of acoustical performance data for the sound hood, the modest attenuation of an architectural louvre, affording a sound reduction of approximately 4 dBA, was assumed.

Some types of sound have a distinctive character which may tend to increase their audibility and potential for disturbance or annoyance. For tonal sound, MOECC guideline NPC-104[2] stipulates that an adjustment of +5 dBA is to be added to the measured source level. A tonal sound is defined as one which has a "pronounced audible tonal quality such as a whine, screech, buzz or hum." In the subsequent analysis, a tonal penalty has been applied to sound emissions from all ventilation

[2] Ontario Ministry of the Environment and Climate Change Publication NPC-104, *Sound Level Adjustments*, August, 1978.

openings, walls and roof structures of the Phase 1 and 2 buildings housing mechanical equipment, based on the observed tonal character of sound emissions from a similar facility visited by HGC Engineering for the purposes of this study.

Considering the source sound levels detailed in Table A1 and the operating parameters outlined above, a computational acoustical model of the site was created using Cadna/A software, which is a computer implementation of ISO standard 9613-2, "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General Method of Calculation" to predict sound levels at the nearest noise sensitive points of reception. The ISO method accounts for reduction in sound level with distance due to geometrical spreading, air absorption, ground attenuation and acoustical shielding by intervening structures such as buildings. Topographical details were included in the acoustical model based on site grading plans for the subject site, and Ontario Base Mapping for the surrounding lands.

5 ANALYSIS RESULTS

Given the operating assumptions detailed in Section 4 and Table A1 of Appendix A, the sound levels of the proposed Talbotville WWTP facility were predicted at the selected points of reception, the results of which are summarized in the following table.

Table 2: Predicted Facility Sound Levels, L_{EQ} [dBA]

Point of Reception	Facility Sound Level			Performance Limits				Within Limits?
	Non-Emergency Equipment		Testing of Emergency Equipment	Non-Emergency Equipment			Testing of Emergency Equipment	
	Day	Even'g/ Night		Day	Even'g	Night		
R1	46	45	49	50	50	45	55	Yes
R1A	46	45	50	50	45	--	55	Yes
R2	41	41	40	50	50	45	55	Yes
R2A	38	38	35	50	45	--	55	Yes
R3	41	40	38	50	50	45	55	Yes
R3A	42	42	36	50	45	--	55	Yes

The prediction results outlined in Table 2 and detailed in Appendix B indicate that sound emissions from the proposed Talbotville WWTP will be within the applicable limits at the selected points of reception during all hours of the day and night. Figures 4 and 5 show the predicted energy-equivalent

(L_{EQ}) sound level contours resulting from operation of non-emergency equipment at the subject site during daytime and evening/nighttime hours, respectively. Figure 6 shows the sound level contours resulting from testing of the emergency generator.

6 CONCLUSION

The acoustical measurements and analysis indicate that sound emissions from the proposed Talbotville WWTP are predicted to be within the applicable sound level criteria under typical "predictable worst case" operating conditions.

This report has been prepared for the purpose of obtaining appropriate land use approvals for the site, from the Township of Southwold, and satisfying MOECC requirements for a noise study as part of an Environmental Assessment. It is also the responsibility of proponent, pursuant to Section 9 of the Environmental Protection Act, to obtain an Environmental Compliance Approval from the MOECC, to demonstrate compliance with the applicable air and noise emission limits.

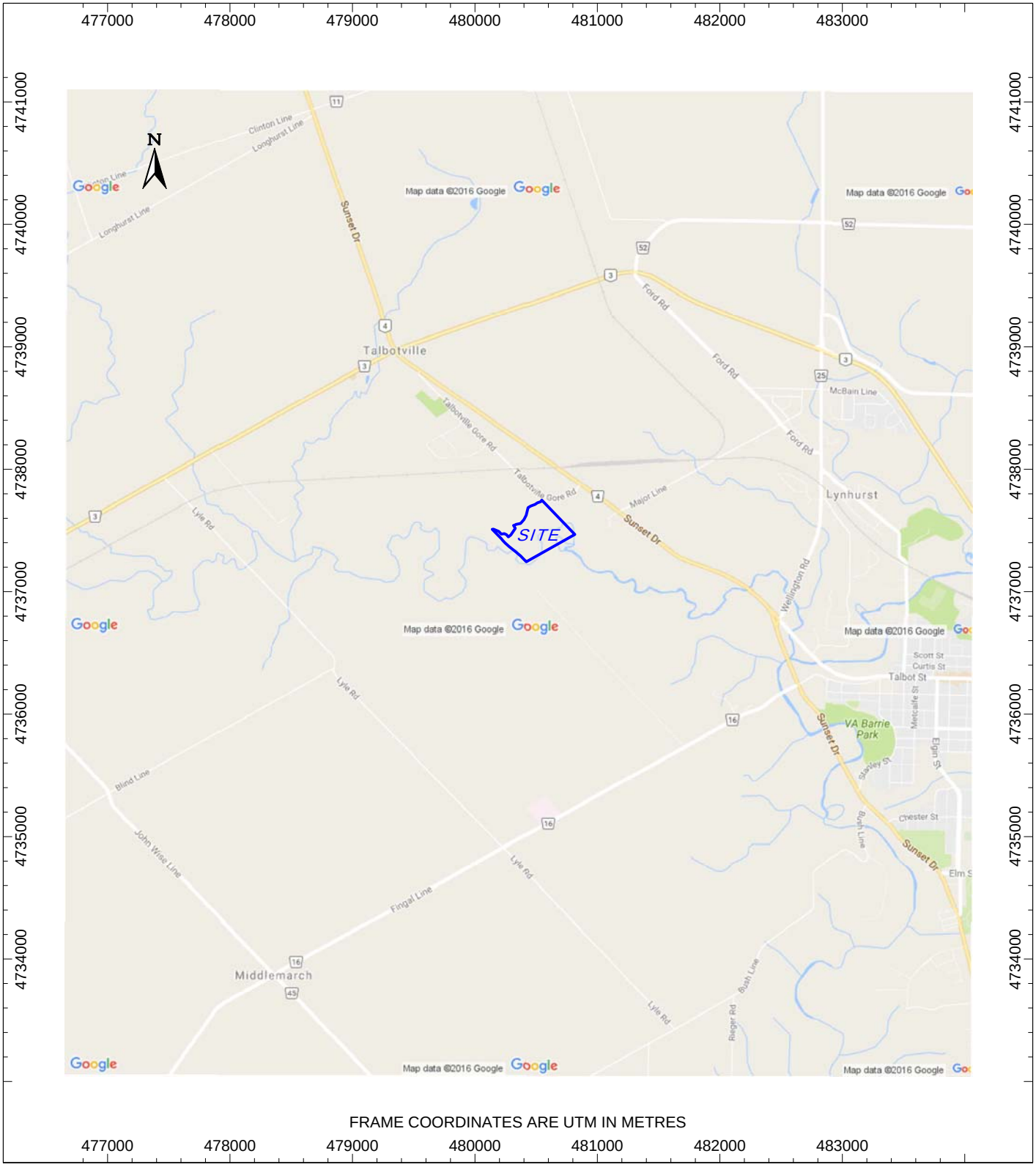

Figure 1: Location Plan

Figure 2: Satellite Image Showing Talbotville WWTP and Points of Reception

Figure 3: Talbotville WWTP Site Plan Showing Locations of Noise Sources

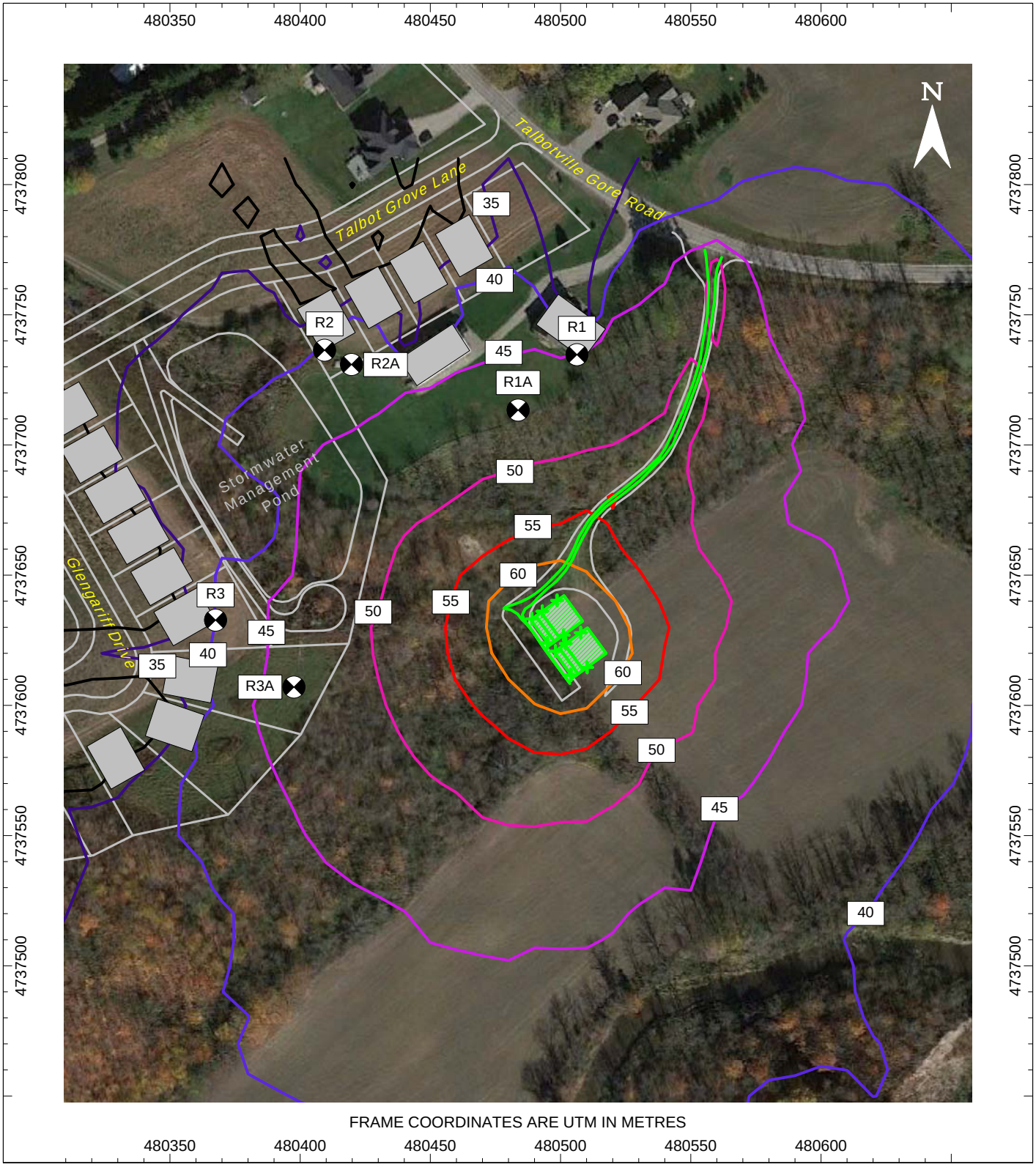

Figure 4: Satellite Image Showing Talbotville WWTP, Points of Reception and Predicted Daytime Sound Level Contours, Leq [dBA], Non-Emergency Equipment Prediction Elevation = 4.5 metres Above Grade

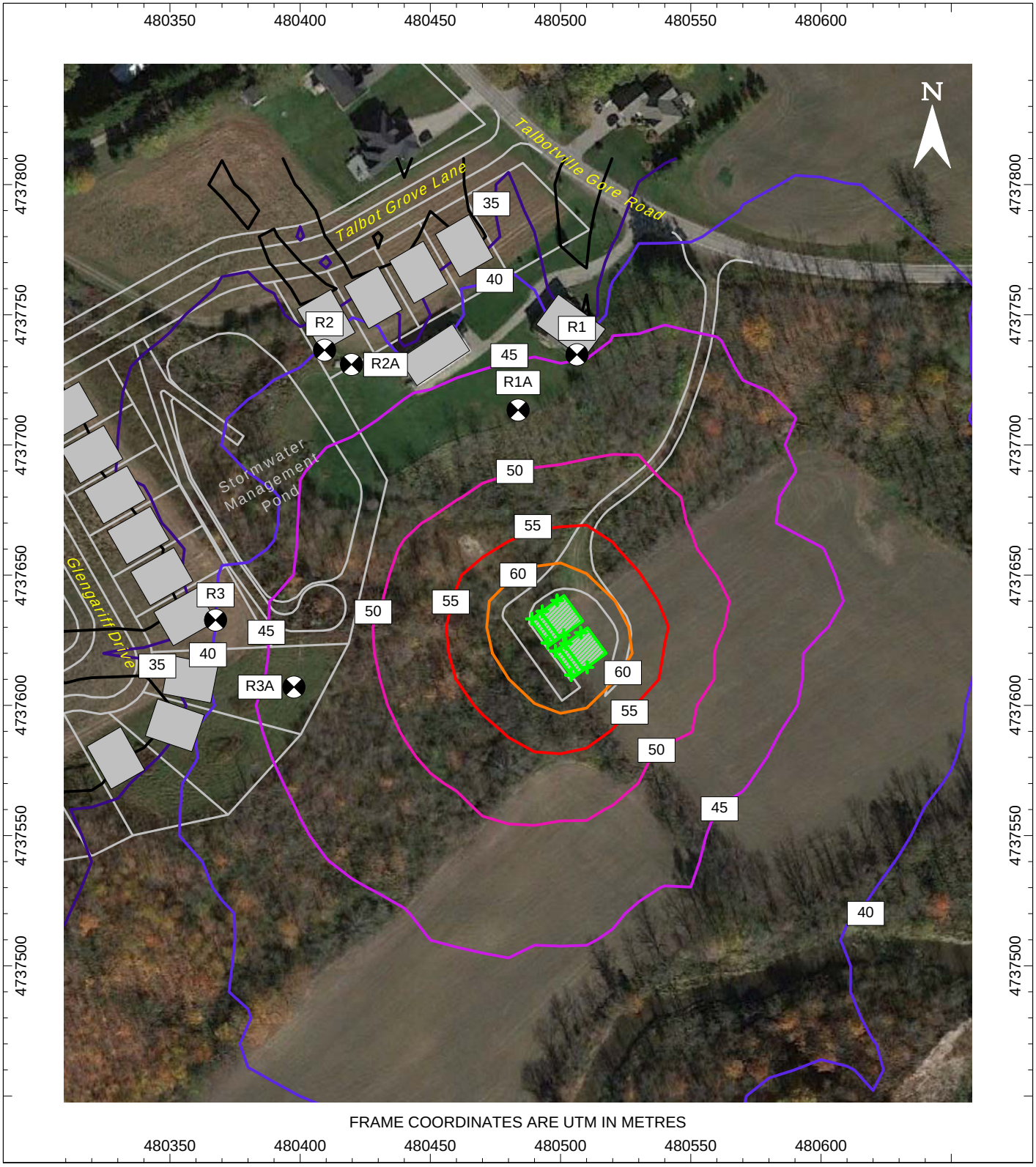

Figure 5: Satellite Image Showing Talbotville WWTP, Points of Reception and Predicted Evening/Nighttime Sound Level Contours, Leq [dBA], Non-Emergency Equipment Prediction Elevation = 4.5 metres Above Grade

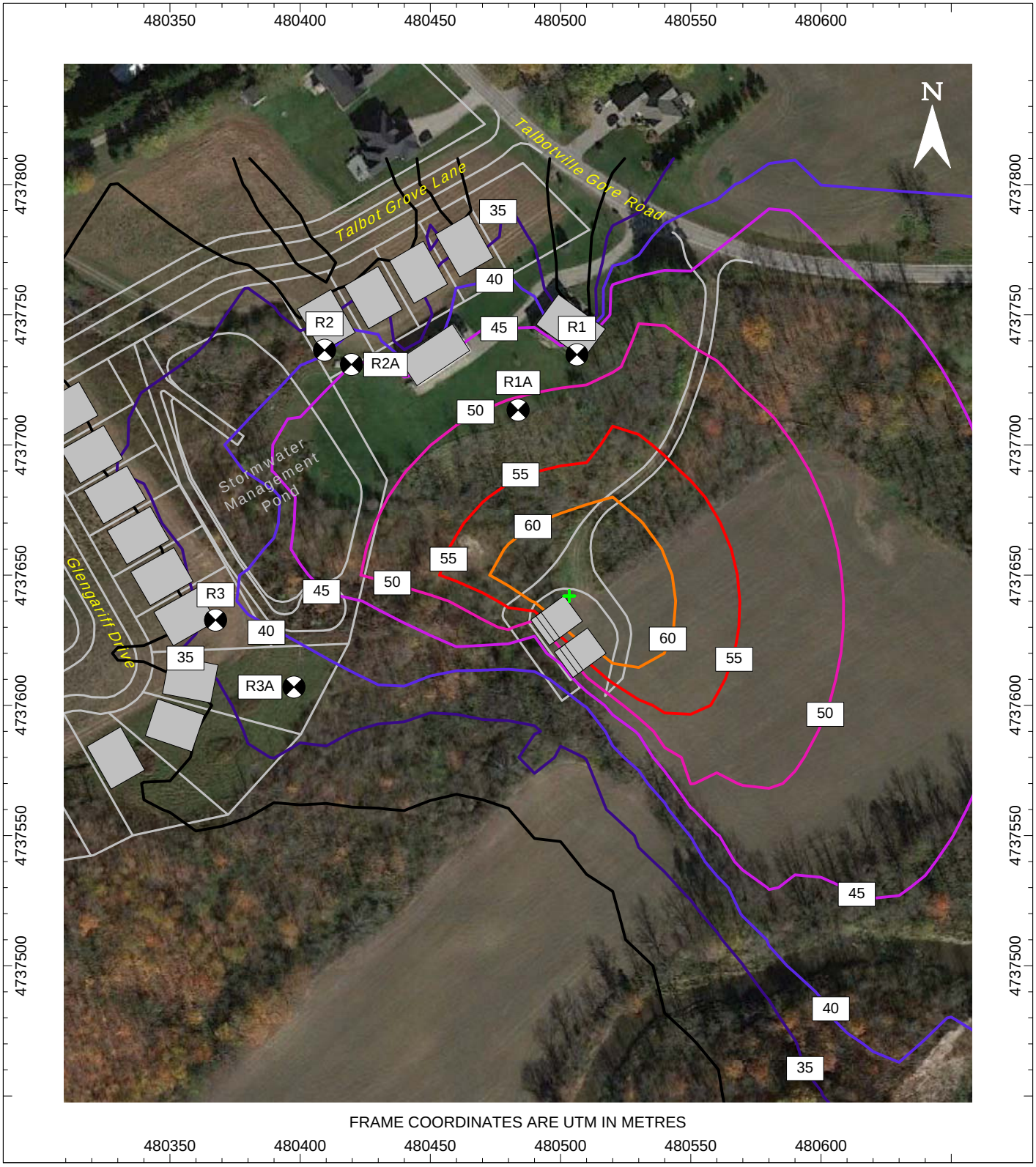

Figure 6: Satellite Image Showing Talbotville WWTP, Points of Reception and Predicted Sound Level Contours, Leq [dBA], Emergency Equipment Prediction Elevation = 4.5 metres Above Grade

APPENDIX A

Equipment Sound Power Levels

Equipment Sound Power Levels

Src ID	Src Name	Octave Band Centre Frequency, Hz								A	Notes
		63	125	250	500	1000	2000	4000	8000		
NS-01/08	BLD-7910 North Ventilation Opening	70	69	68	67	68	65	61	55	72	1, 2, 3
NS-02/09	BLD-7930 North Ventilation Opening	89	81	80	83	83	78	68	64	86	1, 2, 3, 4
NS-03/10	BLD-7930 South Ventilation Opening	89	80	77	72	71	67	64	63	76	1, 2, 3
NS-04/11	BLD-7960 North Ventilation Opening	86	78	79	83	83	78	67	61	86	1, 2, 3, 4
NS-05/12	BLD-7960 West Ventilation Opening	88	80	77	72	71	67	64	62	76	1, 2, 3
NS-06/13	WWTP Roof (Total)	88	81	84	78	71	65	58	43	79	2, 5
NS-07/14	WWTP Walls (Total)	94	87	90	83	77	71	64	48	85	2, 5
NS-15	Arriving/Departing Truck	108	90	92	90	94	91	84	77	97	6
NS-16	Emergency Generator	103	103	98	99	100	98	97	104	107	7

Notes:

1. Sound power calculated based on mechanical equipment housed within respective building, sound emissions from which were based on manufacturer's data (where available) and predictions using standard acoustical engineering calculations from reference texts. Direct and reverberant contributions to ventilation opening sound power levels were calculated based on the interior dimensions and surface finishes of each building, using standard acoustical engineering calculations.
2. Excludes +5 dB penalty for tonality, assumed to be applicable in accordance with MOECC publication NPC-104.
3. Excludes attenuation of sound hood, with assumed attenuation of an architectural louvre (approximately 4 dBA).
4. Equipped with a powered ventilation fan with a sound power level of 86 dBA (based on manufacturer's data).
5. Sound power based on measurements conducted by HGC Engineering of similar equipment at another site, with adjustments applied to account for the relative difference in interior sound levels.
6. Excludes time weighting, which was applied based on an assumed onsite speed of 10 km/hr.
7. Based on a manufacturer's specification of 75 dBA at 7 metres; spectral shape assumed from manufacturer's data for a comparably sized unit. Excludes time weighting (tested 20 minutes/hr).

APPENDIX B

Summary of Calculations

In the following tables of calculation results, the column headings for the various sound attenuation mechanisms follow the terminology of ISO Standard 9613-2. LxD and LxN are the A-weighted, one-hour energy-equivalent source sound power levels for day and night, respectively, which include the effects of any source-abatement measures included in the model, and any time-averaging effects for intermittent sources. LrD and LrN are the A-weighted, one-hour energy-equivalent sound levels at the points of reception. The results are presented in terms of overall A-weighted results, at the most impacted off-site points of reception.

Summary of Calculations

R1	Existing two storey home appox. 110 metres north of WWTP	480506	4737735	235.1														
Src ID	Src Name	Easting	Northing	Elevation	LxD	LxN	Adiv	K0	Dc	Agnd	Abar	Aatm	Afol	Ahous	Cmet	Refl	LrD	LrN
NS-01	Ph1 BLD-7910 North Ventilation Opening	480499	4737641	216.4	73	73	51	3	0.0	0.2	0.0	0.5	0.0	0.0	0.0	0.0	25	25
NS-02	Ph1 BLD-7930 North Ventilation Opening	480493	4737636	216.6	87	87	51	3	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.0	39	39
NS-03	Ph1 BLD-7930 South Ventilation Opening	480501	4737628	216.0	78	78	52	3	0.0	1.0	9.2	0.2	0.0	0.0	0.0	2.0	20	20
NS-04	Ph1 BLD-7960 North Ventilation Opening	480489	4737633	216.9	87	87	51	3	0.0	0.1	0.0	0.4	0.0	0.0	0.0	0.0	38	38
NS-05	Ph1 BLD-7960 West Ventilation Opening	480495	4737624	216.3	77	77	52	3	0.0	1.0	11.7	0.1	0.0	0.0	0.0	0.0	16	16
NS-06	Ph1 WWTP Roof 1	480500	4737635	216.7	83	83	51	0	0.0	0.9	0.0	0.3	0.0	0.0	0.0	1.3	31	31
NS-06	Ph1 WWTP Roof 2	480497	4737629	220.0	76	76	52	0	0.0	0.2	0.0	0.2	0.0	0.0	0.0	0.0	24	24
NS-06	Ph1 WWTP Roof 3	480492	4737631	216.7	76	76	52	0	0.0	1.9	6.9	0.2	0.0	0.0	0.0	0.0	15	15
NS-07	Ph1 WWTP Walls 1	480497	4737630	215.2	88	88	51	3	0.0	2.6	2.5	0.3	0.0	0.0	0.0	0.0	35	35
NS-07	Ph1 WWTP Walls 2	480496	4737628	218.6	85	85	51	3	0.0	0.6	2.5	0.2	0.0	0.0	0.0	0.0	33	33
NS-08	Ph2 BLD-7910 North Ventilation Opening	480508	4737628	215.7	73	73	52	3	0.0	0.0	3.1	0.5	0.0	0.0	0.0	1.7	22	22
NS-09	Ph2 BLD-7930 North Ventilation Opening	480502	4737624	216.0	87	87	52	3	0.0	-0.2	1.9	0.5	0.0	0.0	0.0	0.0	36	36
NS-10	Ph2 BLD-7930 South Ventilation Opening	480510	4737615	215.4	78	78	53	3	0.0	0.4	9.7	0.2	0.0	0.0	0.0	2.1	20	20
NS-11	Ph2 BLD-7960 North Ventilation Opening	480498	4737621	216.1	87	87	52	3	0.0	-0.1	8.8	0.4	0.0	0.0	0.0	0.0	29	29
NS-12	Ph2 BLD-7960 West Ventilation Opening	480504	4737612	215.6	77	77	53	3	0.0	0.4	11.8	0.1	0.0	0.0	0.0	0.0	15	15
NS-13	Ph2 WWTP Roof 1	480509	4737620	216.0	83	83	52	0	0.0	0.5	0.0	0.3	0.0	0.0	0.0	1.8	31	31
NS-13	Ph2 WWTP Roof 2	480504	4737618	219.3	76	76	52	0	0.0	-0.1	0.0	0.3	0.0	0.0	0.0	0.0	23	23
NS-13	Ph2 WWTP Roof 3	480501	4737617	216.0	76	76	52	0	0.0	1.4	7.8	0.2	0.0	0.0	0.0	0.0	14	14
NS-14	Ph2 WWTP Walls 1	480505	4737624	214.8	88	88	52	3	0.0	1.7	4.0	0.3	0.0	0.0	0.0	0.0	33	33
NS-14	Ph2 WWTP Walls 2	480504	4737620	218.5	85	85	52	3	0.0	0.1	1.5	0.3	0.0	0.0	0.0	0.0	34	34
NS-15	Arriving/Departing Truck	480521	4737798	222.2	83	--	47	0	0.0	-0.1	0.0	7.8	0.0	0.0	0.0	0.0	33	--
NS-16	Emergency Generator	480503	4737641	215.4	102	--	51	0	0.0	0.1	0.0	2.8	0.0	0.0	0.0	0.0	49	--

R1A	Outdoor amenity space (rear yard) approx. 90 metres north of WWTP	480484	4737714	230.4														
Src ID	Src Name	Easting	Northing	Elevation	LxD	LxN	Adiv	K0	Dc	Agnd	Abar	Aatm	Afol	Ahous	Cmet	Refl	LrD	LrN
NS-01	Ph1 BLD-7910 North Ventilation Opening	480499	4737641	216.4	73	73	49	3	0.0	1.2	0.0	0.5	0.0	0.0	0.0	0.0	26	26
NS-02	Ph1 BLD-7930 North Ventilation Opening	480493	4737636	216.6	87	87	49	3	0.0	1.5	0.0	0.4	0.0	0.0	0.0	0.0	40	40
NS-03	Ph1 BLD-7930 South Ventilation Opening	480501	4737628	216.0	78	78	50	3	0.0	5.1	6.3	0.2	0.0	0.0	0.0	1.9	21	21
NS-04	Ph1 BLD-7960 North Ventilation Opening	480489	4737633	216.9	87	87	49	3	0.0	1.5	0.0	0.4	0.0	0.0	0.0	0.0	39	39
NS-05	Ph1 BLD-7960 West Ventilation Opening	480495	4737624	216.3	77	77	50	3	0.0	4.0	8.2	0.1	0.0	0.0	0.0	0.0	18	18
NS-06	Ph1 WWTP Roof 1	480500	4737633	216.7	83	83	49	0	0.0	3.5	0.0	0.3	0.0	0.0	0.0	0.8	30	30
NS-06	Ph1 WWTP Roof 2	480496	4737631	220.0	76	76	50	0	0.0	3.0	0.0	0.3	0.0	0.0	0.0	0.0	23	23
NS-06	Ph1 WWTP Roof 3	480493	4737630	216.7	76	76	50	0	0.0	3.9	4.8	0.2	0.0	0.0	0.0	0.0	18	18
NS-07	Ph1 WWTP Walls 1	480497	4737629	215.3	88	88	49	3	0.0	5.2	2.2	0.3	0.0	0.0	0.0	0.0	34	34
NS-07	Ph1 WWTP Walls 2	480496	4737626	218.6	85	85	49	3	0.0	3.8	2.2	0.2	0.0	0.0	0.0	0.0	33	33
NS-08	Ph2 BLD-7910 North Ventilation Opening	480508	4737628	215.7	73	73	50	3	0.0	2.6	3.2	0.4	0.0	0.0	0.0	2.2	22	22
NS-09	Ph2 BLD-7930 North Ventilation Opening	480502	4737624	216.0	87	87	50	3	0.0	2.6	2.4	0.4	0.0	0.0	0.0	0.0	35	35
NS-10	Ph2 BLD-7930 South Ventilation Opening	480510	4737615	215.4	78	78	51	3	0.0	4.9	6.4	0.2	0.0	0.0	0.0	1.7	20	20
NS-11	Ph2 BLD-7960 North Ventilation Opening	480498	4737621	216.1	87	87	51	3	0.0	3.2	10.0	0.3	0.0	0.0	0.0	0.0	26	26
NS-12	Ph2 BLD-7960 West Ventilation Opening	480504	4737612	215.6	77	77	51	3	0.0	4.9	9.2	0.1	0.0	0.0	0.0	0.0	15	15
NS-13	Ph2 WWTP Roof 1	480510	4737624	216.0	83	83	51	0	0.0	3.4	0.0	0.3	0.0	0.0	0.0	1.8	30	30
NS-13	Ph2 WWTP Roof 2	480503	4737619	219.3	76	76	51	0	0.0	3.0	0.0	0.3	0.0	0.0	0.0	0.0	22	22
NS-13	Ph2 WWTP Roof 3	480502	4737617	216.0	76	76	51	0	0.0	6.0	5.8	0.1	0.0	0.0	0.0	0.0	13	13
NS-14	Ph2 WWTP Walls 1	480505	4737628	214.9	88	88	51	3	0.0	4.8	3.5	0.3	0.0	0.0	0.0	0.6	32	32
NS-14	Ph2 WWTP Walls 2	480503	4737617	218.6	85	85	51	3	0.0	3.7	1.4	0.3	0.0	0.0	0.0	0.0	32	32
NS-15	Arriving/Departing Truck	480520	4737803	222.1	83	--	45	0	0.0	0.0	0.0	6.1	0.0	0.0	0.0	0.0	35	--
NS-16	Emergency Generator	480503	4737641	215.4	102	--	49	0	0.0	0.7	0.0	2.5	0.0	0.0	0.0	0.0	50	--

R2	Future two storey home approx. 145 metres northwest of WWTP	480409	4737737	235.2														
Src ID	Src Name	Easting	Northing	Elevation	LxD	LxN	Adiv	K0	Dc	Agnd	Abar	Aatm	Afol	Ahous	Cmet	Refl	LrD	LrN
NS-01	Ph1 BLD-7910 North Ventilation Opening	480499	4737641	216.4	73	73	53	3	0.0	0.8	3.9	0.7	0.0	0.0	0.0	0.0	17	17
NS-02	Ph1 BLD-7930 North Ventilation Opening	480493	4737636	216.6	87	87	53	3	0.0	0.6	4.1	0.5	0.0	0.0	0.0	0.0	32	32
NS-03	Ph1 BLD-7930 South Ventilation Opening	480501	4737628	216.0	78	78	54	3	0.0	2.1	9.3	0.2	0.0	0.0	0.0	0.0	15	15
NS-04	Ph1 BLD-7960 North Ventilation Opening	480489	4737633	216.9	87	87	53	3	0.0	0.5	4.2	0.5	0.0	0.0	0.0	0.0	32	32
NS-05	Ph1 BLD-7960 West Ventilation Opening	480495	4737624	216.3	77	77	54	3	0.0	1.7	2.9	0.6	0.0	0.0	0.0	0.0	21	21
NS-06	Ph1 WWTP Roof 1	480500	4737634	216.7	83	83	54	0	0.0	2.5	2.2	0.3	0.0	0.0	0.0	0.0	24	24
NS-06	Ph1 WWTP Roof 2	480495	4737630	220.0	76	76	54	0	0.0	0.4	0.0	0.3	0.0	0.0	0.0	0.0	21	21
NS-06	Ph1 WWTP Roof 3	480493	4737629	216.7	76	76	54	0	0.0	2.8	1.9	0.3	0.0	0.0	0.0	0.0	17	17
NS-07	Ph1 WWTP Walls 1	480499	4737628	215.3	88	88	54	3	0.0	3.3	4.0	0.3	0.0	0.0	0.0	0.0	30	30
NS-07	Ph1 WWTP Walls 2	480495	4737631	218.6	85	85	54	3	0.0	0.9	1.8	0.3	0.0	0.0	0.0	0.0	32	32
NS-08	Ph2 BLD-7910 North Ventilation Opening	480508	4737628	215.7	73	73	54	3	0.0	0.9	5.6	0.6	0.0	0.0	0.0	0.0	14	14
NS-09	Ph2 BLD-7930 North Ventilation Opening	480502	4737624	216.0	87	87	54	3	0.0	0.7	9.6	0.4	0.0	0.0	0.0	0.0	25	25
NS-10	Ph2 BLD-7930 South Ventilation Opening	480510	4737615	215.4	78	78	55	3	0.0	1.7	9.5	0.3	0.0	0.0	0.0	0.0	14	14
NS-11	Ph2 BLD-7960 North Ventilation Opening	480498	4737621	216.1	87	87	54	3	0.0	0.2	2.5	0.6	0.0	0.0	0.0	0.0	33	33
NS-12	Ph2 BLD-7960 West Ventilation Opening	480504	4737612	215.6	77	77	55	3	0.0	0.5	0.0	0.6	0.0	0.0	0.0	0.0	24	24
NS-13	Ph2 WWTP Roof 1	480508	4737620	216.0	83	83	55	0	0.0	1.1	0.2	0.4	0.0	0.0	0.0	0.0	26	26
NS-13	Ph2 WWTP Roof 2	480504	4737618	219.3	76	76	55	0	0.0	0.4	0.1	0.4	0.0	0.0	0.0	0.0	21	21
NS-13	Ph2 WWTP Roof 3	480502	4737616	216.0	76	76	55	0	0.0	1.3	0.0	0.4	0.0	0.0	0.0	0.0	20	20
NS-14	Ph2 WWTP Walls 1	480507	4737619	214.8	88	88	55	3	0.0	2.7	3.8	0.3	0.0	0.0	0.0	0.0	30	30
NS-14	Ph2 WWTP Walls 2	480505	4737613	218.5	85	85	55	3	0.0	0.6	1.5	0.3	0.0	0.0	0.0	0.0	31	31
NS-15	Arriving/Departing Truck	480521	4737810	222.7	83	--	53	0	0.0	0.0	7.8	14.2	0.0	0.0	0.0	0.0	24	--
NS-16	Emergency Generator	480503	4737641	215.4	102	--	54	0	0.0	1.3	4.3	2.9	0.0	0.0	0.0	0.0	40	--

Where: Lr = Lx - Adiv + K0 + Dc - Agnd - Abar - Aatm - Afol - Ahous + Cmet + Refl

R2A	Outdoor amenity space (rear yard) approx. 130 metres northwest of WWTP	480420	4737731	232.0														
Src ID	Src Name	Easting	Northing	Elevation	LxD	LxN	Adiv	K0	Dc	Agnd	Abar	Aatm	Afol	Ahous	Cmet	Refl	LrD	LrN
NS-01	Ph1 BLD-7910 North Ventilation Opening	480499	4737641	216.4	73	73	53	3	0.0	3.5	3.8	0.5	0.0	0.0	0.0	0.0	15	15
NS-02	Ph1 BLD-7930 North Ventilation Opening	480493	4737636	216.6	87	87	53	3	0.0	3.5	3.2	0.4	0.0	0.0	0.0	0.0	31	31
NS-03	Ph1 BLD-7930 South Ventilation Opening	480501	4737628	216.0	78	78	53	3	0.0	5.1	9.5	0.2	0.0	0.0	0.0	0.0	12	12
NS-04	Ph1 BLD-7960 North Ventilation Opening	480489	4737633	216.9	87	87	53	3	0.0	3.4	3.2	0.4	0.0	0.0	0.0	0.0	31	31
NS-05	Ph1 BLD-7960 West Ventilation Opening	480495	4737624	216.3	77	77	53	3	0.0	2.2	4.0	0.4	0.0	0.0	0.0	0.0	20	20
NS-06	Ph1 WWTP Roof 1	480500	4737634	216.7	83	83	53	0	0.0	4.0	2.9	0.3	0.0	0.0	0.0	0.0	22	22
NS-06	Ph1 WWTP Roof 2	480495	4737630	220.0	76	76	53	0	0.0	3.5	1.9	0.3	0.0	0.0	0.0	0.0	17	17
NS-06	Ph1 WWTP Roof 3	480492	4737631	216.7	76	76	53	0	0.0	4.1	2.9	0.3	0.0	0.0	0.0	0.0	16	16
NS-07	Ph1 WWTP Walls 1	480498	4737631	215.3	88	88	53	3	0.0	5.9	5.5	0.2	0.0	0.0	0.0	0.0	26	26
NS-07	Ph1 WWTP Walls 2	480495	4737631	218.6	85	85	53	3	0.0	4.3	3.1	0.3	0.0	0.0	0.0	0.0	28	28
NS-08	Ph2 BLD-7910 North Ventilation Opening	480508	4737628	215.7	73	73	54	3	0.0	4.7	7.1	0.5	0.0	0.0	0.0	0.0	10	10
NS-09	Ph2 BLD-7930 North Ventilation Opening	480502	4737624	216.0	87	87	54	3	0.0	4.0	6.2	0.4	0.0	0.0	0.0	0.0	26	26
NS-10	Ph2 BLD-7930 South Ventilation Opening	480510	4737615	215.4	78	78	54	3	0.0	5.1	9.8	0.2	0.0	0.0	0.0	0.0	11	11
NS-11	Ph2 BLD-7960 North Ventilation Opening	480498	4737621	216.1	87	87	54	3	0.0	3.3	3.9	0.5	0.0	0.0	0.0	0.0	29	29
NS-12	Ph2 BLD-7960 West Ventilation Opening	480504	4737612	215.6	77	77	54	3	0.0	2.0	3.7	0.5	0.0	0.0	0.0	0.0	20	20
NS-13	Ph2 WWTP Roof 1	480508	4737620	216.0	83	83	54	0	0.0	3.9	2.6	0.3	0.0	0.0	0.0	0.0	22	22
NS-13	Ph2 WWTP Roof 2	480505	4737617	219.3	76	76	54	0	0.0	3.5	1.9	0.3	0.0	0.0	0.0	0.0	16	16
NS-13	Ph2 WWTP Roof 3	480501	4737618	216.0	76	76	54	0	0.0	4.0	2.6	0.3	0.0	0.0	0.0	0.0	15	15
NS-14	Ph2 WWTP Walls 1	480505	4737622	214.8	88	88	54	3	0.0	5.3	6.3	0.3	0.0	0.0	0.0	0.0	25	25
NS-14	Ph2 WWTP Walls 2	480504	4737611	218.5	85	85	54	3	0.0	4.1	2.8	0.3	0.0	0.0	0.0	0.0	27	27
NS-15	Arriving/Departing Truck	480521	4737822	222.5	83	--	52	0	0.0	0.0	20.3	12.8	0.0	0.0	0.0	0.0	21	--
NS-16	Emergency Generator	480503	4737641	215.4	102	--	53	0	0.0	4.8	8.2	1.2	0.0	0.0	0.0	0.0	35	--

R3	Future two storey home approx. 135 metres west of WWTP	480368	4737633	234.4														
Src ID	Src Name	Easting	Northing	Elevation	LxD	LxN	Adiv	K0	Dc	Agnd	Abar	Aatm	Afol	Ahous	Cmet	Refl	LrD	LrN
NS-01	Ph1 BLD-7910 North Ventilation Opening	480499	4737641	216.4	73	73	53	3	0.0	0.7	4.0	0.7	0.0	0.0	0.0	0.0	17	17
NS-02	Ph1 BLD-7930 North Ventilation Opening	480493	4737636	216.6	87	87	53	3	0.0	0.5	4.4	0.5	0.0	0.0	0.0	0.0	32	32
NS-03	Ph1 BLD-7930 South Ventilation Opening	480501	4737628	216.0	78	78	54	3	0.0	1.2	12.0	0.2	0.0	0.0	0.0	2.2	16	16
NS-04	Ph1 BLD-7960 North Ventilation Opening	480489	4737633	216.9	87	87	53	3	0.0	0.5	4.6	0.5	0.0	0.0	0.0	0.0	32	32
NS-05	Ph1 BLD-7960 West Ventilation Opening	480495	4737624	216.3	77	77	53	3	0.0	1.9	3.0	0.5	0.0	0.0	0.0	0.5	22	22
NS-06	Ph1 WWTP Roof 1	480501	4737633	216.7	83	83	54	0	0.0	2.3	4.5	0.3	0.0	0.0	0.0	0.0	22	22
NS-06	Ph1 WWTP Roof 2	480495	4737631	220.0	76	76	53	0	0.0	0.4	0.0	0.3	0.0	0.0	0.0	0.0	22	22
NS-06	Ph1 WWTP Roof 3	480493	4737629	216.7	76	76	53	0	0.0	2.9	2.0	0.3	0.0	0.0	0.0	2.4	20	20
NS-07	Ph1 WWTP Walls 1	480499	4737632	215.2	88	88	53	3	0.0	4.3	3.7	0.3	0.0	0.0	0.0	0.0	30	30
NS-07	Ph1 WWTP Walls 2	480495	4737629	218.5	85	85	53	3	0.0	1.2	4.7	0.3	0.0	0.0	0.0	0.0	29	29
NS-08	Ph2 BLD-7910 North Ventilation Opening	480508	4737628	215.7	73	73	54	3	0.0	1.2	9.8	0.5	0.0	0.0	0.0	0.0	10	10
NS-09	Ph2 BLD-7930 North Ventilation Opening	480502	4737624	216.0	87	87	54	3	0.0	0.5	4.7	0.5	0.0	0.0	0.0	0.0	31	31
NS-10	Ph2 BLD-7930 South Ventilation Opening	480510	4737615	215.4	78	78	54	3	0.0	1.3	12.3	0.2	0.0	0.0	0.0	0.0	12	12
NS-11	Ph2 BLD-7960 North Ventilation Opening	480498	4737621	216.1	87	87	53	3	0.0	0.5	4.4	0.5	0.0	0.0	0.0	0.0	32	32
NS-12	Ph2 BLD-7960 West Ventilation Opening	480504	4737612	215.6	77	77	54	3	0.0	1.9	2.9	0.5	0.0	0.0	0.0	0.0	21	21
NS-13	Ph2 WWTP Roof 1	480509	4737625	216.0	83	83	54	0	0.0	2.3	4.9	0.3	0.0	0.0	0.0	0.0	21	21
NS-13	Ph2 WWTP Roof 2	480503	4737618	219.3	76	76	54	0	0.0	0.4	0.0	0.3	0.0	0.0	0.0	0.0	21	21
NS-13	Ph2 WWTP Roof 3	480502	4737616	216.0	76	76	54	0	0.0	2.9	1.9	0.3	0.0	0.0	0.0	2.3	19	19
NS-14	Ph2 WWTP Walls 1	480509	4737626	214.8	88	88	54	3	0.0	4.1	5.3	0.3	0.0	0.0	0.0	0.6	28	28
NS-14	Ph2 WWTP Walls 2	480503	4737619	218.5	85	85	54	3	0.0	0.7	2.7	0.3	0.0	0.0	0.0	0.0	31	31
NS-15	Arriving/Departing Truck	480521	4737828	222.5	83	--	54	0	0.0	0.0	0.0	17.4	0.0	0.0	0.0	0.0	25	--
NS-16	Emergency Generator	480503	4737641	215.4	102	--	54	0	0.0	0.8	7.3	2.1	0.0	0.0	0.0	0.0	38	--

R3A	Outdoor amenity space (rear yard) approx. 110 metres west of WWTP	480398	4737607	230.9														
Src ID	Src Name	Easting	Northing	Elevation	LxD	LxN	Adiv	K0	Dc	Agnd	Abar	Aatm	Afol	Ahous	Cmet	Refl	LrD	LrN
NS-01	Ph1 BLD-7910 North Ventilation Opening	480499	4737641	216.4	73	73	52	3	0.0	2.6	2.4	0.6	0.0	0.0	0.0	0.0	19	19
NS-02	Ph1 BLD-7930 North Ventilation Opening	480493	4737636	216.6	87	87	51	3	0.0	2.9	2.1	0.4	0.0	0.0	0.0	0.0	34	34
NS-03	Ph1 BLD-7930 South Ventilation Opening	480501	4737628	216.0	78	78	52	3	0.0	3.4	8.7	0.2	0.0	0.0	0.0	0.0	17	17
NS-04	Ph1 BLD-7960 North Ventilation Opening	480489	4737633	216.9	87	87	51	3	0.0	2.9	2.2	0.4	0.0	0.0	0.0	0.0	34	34
NS-05	Ph1 BLD-7960 West Ventilation Opening	480495	4737624	216.3	77	77	51	3	0.0	2.1	3.2	0.4	0.0	0.0	0.0	0.5	24	24
NS-06	Ph1 WWTP Roof 1	480501	4737633	216.7	83	83	52	0	0.0	3.8	5.4	0.2	0.0	0.0	0.0	0.0	21	21
NS-06	Ph1 WWTP Roof 2	480496	4737630	220.0	76	76	51	0	0.0	3.2	0.0	0.3	0.0	0.0	0.0	0.0	21	21
NS-06	Ph1 WWTP Roof 3	480493	4737629	216.7	76	76	51	0	0.0	4.0	2.2	0.3	0.0	0.0	0.0	2.4	21	21
NS-07	Ph1 WWTP Walls 1	480499	4737632	215.2	88	88	51	3	0.0	5.7	4.3	0.2	0.0	0.0	0.0	0.0	30	30
NS-07	Ph1 WWTP Walls 2	480496	4737626	218.5	85	85	51	3	0.0	4.1	3.1	0.2	0.0	0.0	0.0	0.0	30	30
NS-08	Ph2 BLD-7910 North Ventilation Opening	480508	4737628	215.7	73	73	52	3	0.0	3.5	6.1	0.5	0.0	0.0	0.0	0.0	14	14
NS-09	Ph2 BLD-7930 North Ventilation Opening	480502	4737624	216.0	87	87	52	3	0.0	2.9	2.1	0.4	0.0	0.0	0.0	0.0	34	34
NS-10	Ph2 BLD-7930 South Ventilation Opening	480510	4737615	215.4	78	78	52	3	0.0	3.7	9.3	0.2	0.0	0.0	0.0	0.0	15	15
NS-11	Ph2 BLD-7960 North Ventilation Opening	480498	4737621	216.1	87	87	51	3	0.0	2.9	2.1	0.4	0.0	0.0	0.0	0.0	34	34
NS-12	Ph2 BLD-7960 West Ventilation Opening	480504	4737612	215.6	77	77	52	3	0.0	2.2	3.2	0.5	0.0	0.0	0.0	0.6	24	24
NS-13	Ph2 WWTP Roof 1	480510	4737628	216.0	83	83	52	0	0.0	3.9	5.2	0.2	0.0	0.0	0.0	0.0	21	21
NS-13	Ph2 WWTP Roof 2	480504	4737618	219.3	76	76	52	0	0.0	3.3	0.0	0.3	0.0	0.0	0.0	0.0	21	21
NS-13	Ph2 WWTP Roof 3	480502	4737616	216.0	76	76	52	0	0.0	4.0	2.1	0.3	0.0	0.0	0.0	2.4	20	20
NS-14	Ph2 WWTP Walls 1	480508	4737621	214.8	88	88	52	3	0.0	5.6	4.6	0.3	0.0	0.0	0.0	0.6	30	30
NS-14	Ph2 WWTP Walls 2	480504	4737620	218.5	85	85	52	3	0.0	4.0	1.6	0.3	0.0	0.0	0.0	0.0	31	31
NS-15	Arriving/Departing Truck	480520	4737826	222.4	83	--	53	0	0.0	0.0	0.0	15.2	0.0	0.0	0.0	0.0	26	--
NS-16	Emergency Generator	480503	4737641	215.4	102	--	52	0	0.0	2.8	10.3	1.4	0.0	0.0	0.0	0.0	36	--

Where: Lr = Lx - Adiv + K0 + Dc - Agnd - Abar - Aatm - Afol - Ahous + Cmet + Refl