APPENDIX 6.3: METHODOLOGY FOR OPERATIONAL PHASE ASSESSMENT

Atmospheric Dispersion Modelling

1.1 The atmospheric dispersion model AERMOD (Lakes Environmental, Version 9.9.5) has been used to assess the potential air quality impacts associated with the operation of the proposed battery manufacturing facility. This dispersion model is widely used and accepted for the purpose of undertaking assessments to support both planning and Environmental Permit applications.

Meteorological Data

1.2 The meteorological data used in the air quality modelling has been obtained from ADM Limited and is from the Newcastle Airport recording station, covering the period between 1st January 2016 and 31st December 2020. Every year has in excess of 97.6% data capture, with the majority of years achieving greater than 99% data capture.

1.3 The site is located at an altitude of approximately 38m AOD. The Newcastle Airport recording station is located approximately 19km to the north west, at an altitude of approximately 81m AOD. This recording station is considered to be most representative of the conditions at the site.

1.4 The 2016 to 2020 wind roses for the Newcastle Airport meteorological recording station are shown in Figure 6.3/1. Each year has been run separately in the model.

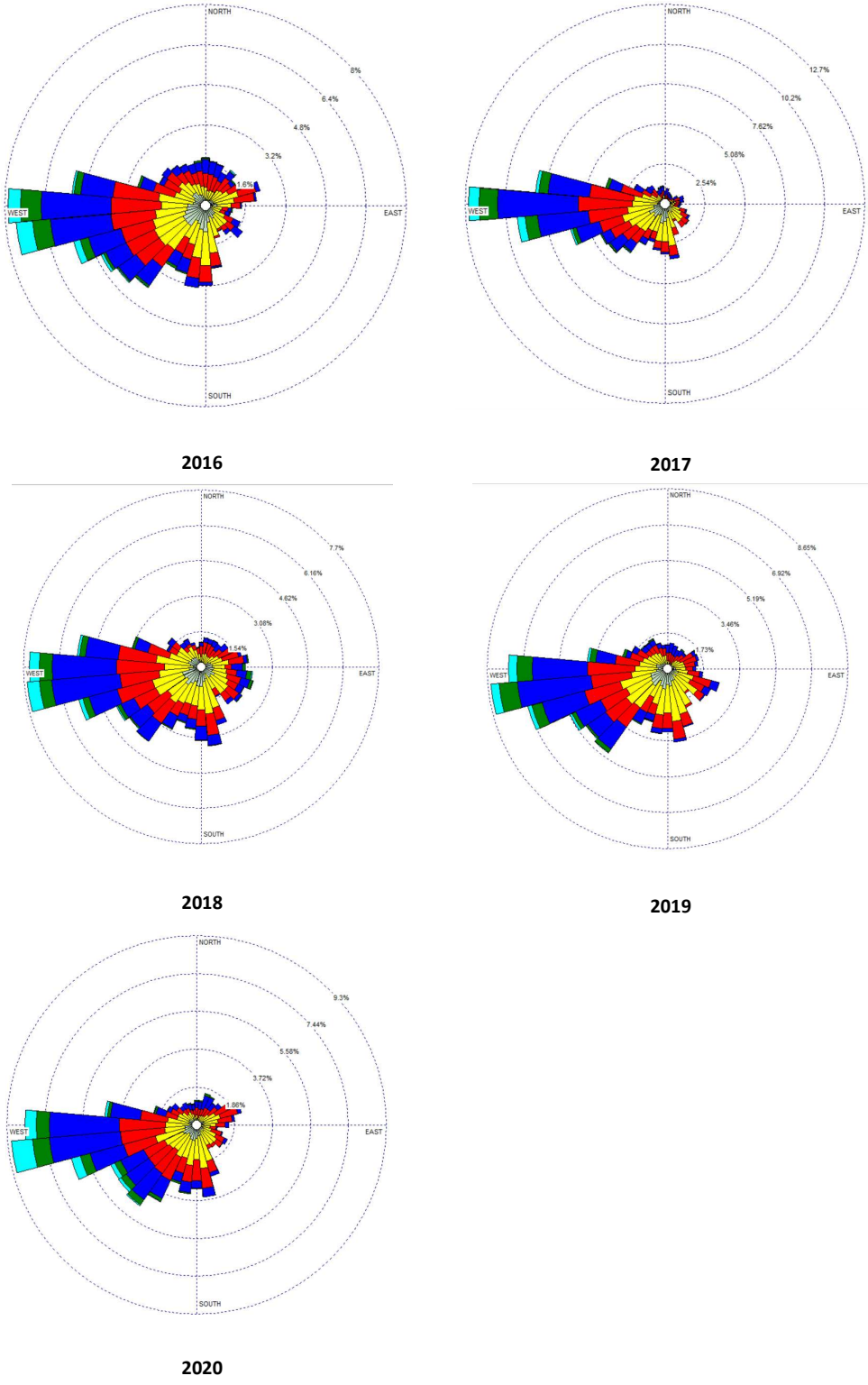

Figure 6.3/1: 2016 to 2020 Wind Roses for Newcastle Airport Meteorological Station

Surface Characteristics

1.5 The predominant characteristics of land use in an area provides a measure of the vertical mixing and dilution that takes place in the atmosphere due to factors such as surface roughness and albedo.

1.6 The meteorological data has been processed using AERMET, the supporting meteorological pre-processing software (Lakes Environmental, Version 9.9.5), to enable the surface characteristics to be set in the model.

1.7 The values set within the model are included in Table 6.3/1.

Table 6.3/1: Surface Characteristics Included in Model

Setting	Urban	Cultivated Land
Albedo	0.2075	0.28
Bowen ratio	1.625	0.75
Surface roughness	1m	0.0725m

1.8 Buildings can also have a significant influence on the behaviour of the local airflow and 'downwash' can occur, where an emission plume can be drawn down in the vicinity of buildings. There are a number of existing buildings near to the sources of the emissions, as well as the proposed buildings, and therefore building effects have been included within the model.

1.9 Further details of the buildings included in the model are provided later in this appendix.

Terrain

1.10 To consider the impact of terrain surrounding the Proposed Development, on the dispersion of pollutants, OS Terrain 5 data has been used in the model (in x.y.z format). This has been processed using the in-built AERMAP terrain processor.

Emission Parameters

1.11 A number of emission sources have been considered within the air dispersion model. These relate to different parts of the battery manufacturing process, and further information on the process is included in Chapter XX of the Environmental Statement.

1.12 The fifteen sources considered within the assessment, and the pollutants considered for each source, are as follows:

- 4 No. cathode stacks associated with electrode manufacturing (N-Methyl-2-Pyrrolidone, NMP);

- 4 No. stacks associated with the electrolyte coating process (Ethyl Carbonate);
- 2 No. stacks associated with the steam generating boilers (NO_x and CO); and
- 5 No. stacks associated with the Low Temperature Hot Water (LTHW) boilers (NO_x and CO).

1.13 Information regarding the flues for the sources has been provided by the client and a number of suppliers. Information was provided by Durr Megtec for the cathode stacks, Envision AESC for the electrode stacks, and Babcock Wanson for the boiler and LTHW stacks. The parameters included in the model are shown in Table 6.3/2 below.

Table 6.3/2: Model Parameters for Sources Included in Model

Parameter	Input in Model														
	Cathode Stack 1 (STCK 1)	**Cathode Stack 2 (STCK 2)**	**Cathode Stack 3 (STCK 3)**	**Cathode Stack 4 (STCK 4)**	**Electrolyte Stack 1 (STCK 5)**	**Electrolyte Stack 2 (STCK 6)**	**Electrolyte Stack 3 (STCK 7)**	**Electrolyte Stack 4 (STCK 8)**	**Boiler Stack 1 (STCK 9)**	**Boiler Stack 2 (STCK 10)**	**LTHW Stack 1 (STCK 11)**	**LTHW Stack 2 (STCK 12)**	**LTHW Stack 3 (STCK 13)**	**LTHW Stack 4 (STCK 14)**	**LTHW Stack 5 (STCK 15)**
Flue location	433196.8, 558674.4	433199.9, 558675.6	433199.0, 558668.6	433202.1, 558670.0	433187.1, 558670.0	433233.4, 558691.3	433236.9, 558685.2	433283.3, 558581.6	433109.1, 558758.3	433101.9, 558756.4	433117.0, 558763.3	433119.3, 558764.4	433121.6, 558765.4	433123.9, 558766.4	433126.1, 558767.4
Base elevation	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD	38.70m AOD
Exhaust height[a]	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m	30.5m
Exhaust diameter	0.176m	0.176m	0.176m	0.176m	1.00m	1.00m	1.00m	1.00m	0.85m	0.85m	0.50m	0.50m	0.50m	0.50m	0.50m
Exhaust gas flow at exit	1,310 Am³/hr (0.364 Am³/s)	1,310 Am³/hr (0.364 Am³/s)	1,310 Am³/hr (0.364 Am³/s)	1,310 Am³/hr (0.364 Am³/s)	25,164 Am³/hr (6.99 Am³/s)	25,164 Am³/hr (6.99 Am³/s)	25,164 Am³/hr (6.99 Am³/s)	25,164 Am³/hr (6.99 Am³/s)	15,144 Am³/hr (4.21 Am³/s)	15,144 Am³/hr (4.21 Am³/s)	5,281 Am³/hr (1.467 Am³/s)	5,281 Am³/hr (1.467 Am³/s)	5,281 Am³/hr (1.467 Am³/s)	5,281 Am³/hr (1.467 Am³/s)	5,281 Am³/hr (1.467 Am³/s)
Exhaust efflux velocity	15m/s	15m/s	15m/s	15m/s	8.9m/s	8.9m/s	8.9m/s	8.9m/s	7.2m/s	7.2m/s	7.5m/s	7.5m/s	7.5m/s	7.5m/s	7.5m/s

Table 6.3/2: Model Parameters for Sources Included in Model															
Parameter	**Input in Model**														
	Cathode Stack 1 (STCK 1)	**Cathode Stack 2 (STCK 2)**	**Cathode Stack 3 (STCK 3)**	**Cathode Stack 4 (STCK 4)**	**Electrolyte Stack 1 (STCK 5)**	**Electrolyte Stack 2 (STCK 6)**	**Electrolyte Stack 3 (STCK 7)**	**Electrolyte Stack 4 (STCK 8)**	**Boiler Stack 1 (STCK 9)**	**Boiler Stack 2 (STCK 10)**	**LTHW Stack 1 (STCK 11)**	**LTHW Stack 2 (STCK 12)**	**LTHW Stack 3 (STCK 13)**	**LTHW Stack 4 (STCK 14)**	**LTHW Stack 5 (STCK 15)**
Exhaust gas exit temp.	25°C	25°C	25°C	25°C	20°C	20°C	20°C	20°C	64°C	64°C	135°C	135°C	135°C	135°C	135°C
[a] Exhaust height assumed to be 3m above roof eaves, which is 27.5m above base level. The ridge of each roof section is 30m above base level, however the width of the relevant building sections mean that the stacks are located c.50m from the highest part of the roof. It should also be noted that the roof sections are curved and therefore provide a gentle slope between the ridge and eaves															

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1.14 The locations of the stacks included within the model are shown in Figure 6.3/2.

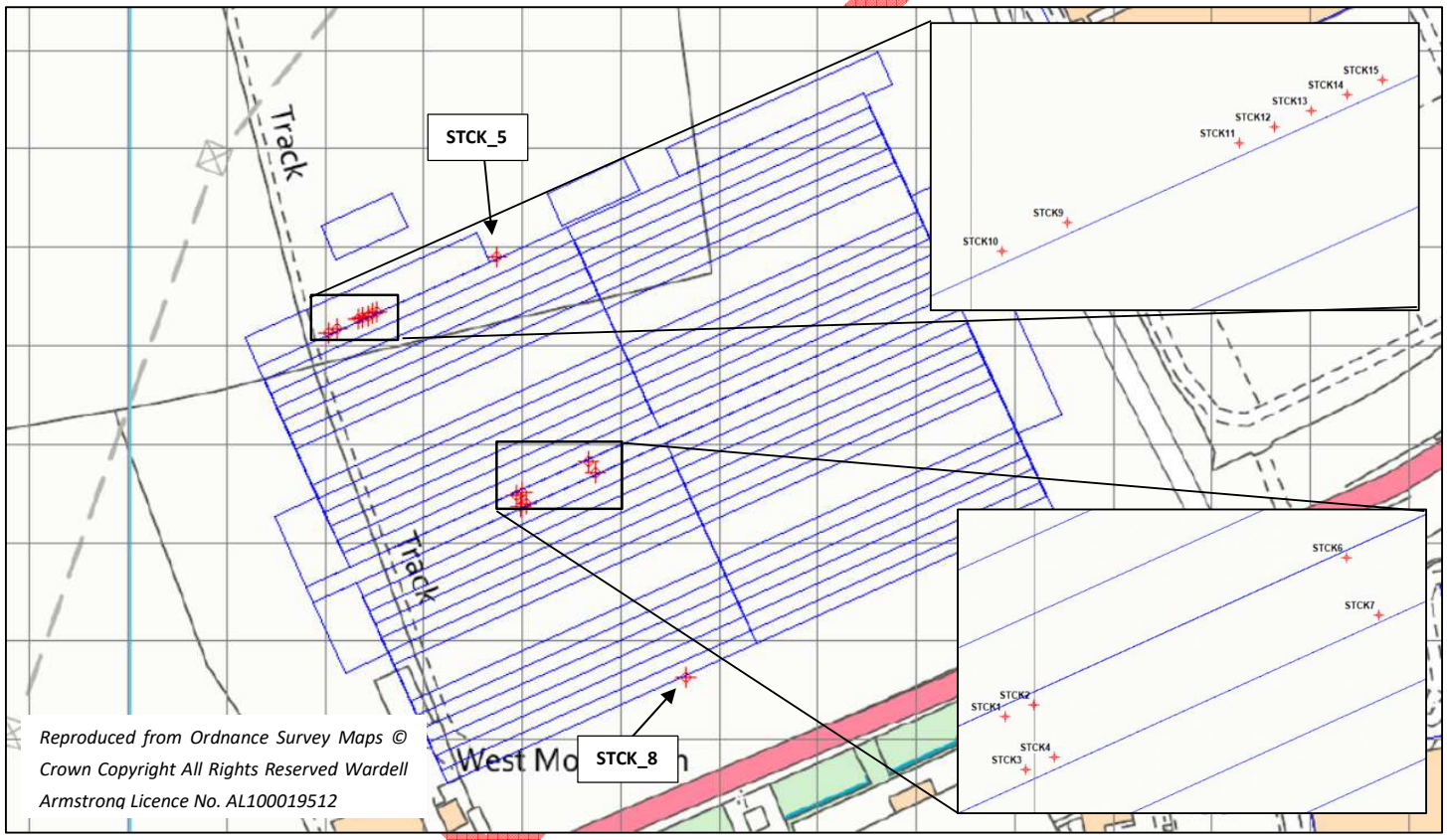
Track
STCK_5
STCK_8
STCK15
STCK14
STCK13
STCK12
STCK11
STCK9
STCK10
STCK6
STCK7
STCK2
STCK1
STCK4
STCK3
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Figure 6.3/2: Location of Emission Sources in Model

1.15 The emission concentrations for each substance, as provided by Durr Megtec, Envision AESC and Babcock Wanson, as well as the calculated emission rates are shown in Table 6.3/3 below.

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Table 6.3/3: Emission Rates for Sources Included in Model

Emitted Substance	Input in Model														
	Cathode Stack 1 (STCK 1)	Cathode Stack 2 (STCK 2)	Cathode Stack 3 (STCK 3)	Cathode Stack 4 (STCK 4)	Electrolyte Stack 1 (STCK 5)	Electrolyte Stack 2 (STCK 6)	Electrolyte Stack 3 (STCK 7)	Electrolyte Stack 4 (STCK 8)	Boiler Stack 1 (STCK 9)	Boiler Stack 2 (STCK 10)	LTHW Stack 1 (STCK 11)	LTHW Stack 2 (STCK 12)	LTHW Stack 3 (STCK 13)	LTHW Stack 4 (STCK 14)	LTHW Stack 5 (STCK 15)
	Emission Concentration (mg/Nm^3)														
NMP[a]	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
Ethyl Carbonate[b]	-	-	-	-	8.4	8.4	8.4	8.4	-	-	-	-	-	-	-
NO_x[c]	-	-	-	-	-	-	-	-	80	80	100	100	100	100	100
CO[c]	-	-	-	-	-	-	-	-	100	100	80	80	80	80	80
	Emission Rate (g/s)														
NMP	0.0003	0.0003	0.0003	0.0003	-	-	-	-	-	-	-	-	-	-	-
Ethyl Carbonate	-	-	-	-	0.055	0.055	0.055	0.055	-	-	-	-	-	-	-
NO_x	-	-	-	-	-	-	-	-	0.263	0.263	0.098	0.098	0.098	0.098	0.098
CO									0.329	0.329	0.079	0.079	0.079	0.079	0.079

Table 6.3/3: Emission Rates for Sources Included in Model														
Emitted Substance	**Input in Model**													
	Cathode Stack 1 (STCK 1)	**Cathode Stack 2 (STCK 2)**	**Cathode Stack 3 (STCK 3)**	**Cathode Stack 4 (STCK 4)**	**Electrolyte Stack 1 (STCK 5)**	**Electrolyte Stack 2 (STCK 6)**	**Electrolyte Stack 3 (STCK 7)**	**Electrolyte Stack 4 (STCK 8)**	**Boiler Stack 1 (STCK 9)**	**Boiler Stack 2 (STCK 10)**	**LTHW Stack 1 (STCK 11)**	**LTHW Stack 2 (STCK 12)**	**LTHW Stack 3 (STCK 13)**	**LTHW Stack 4 (STCK 14)**	**LTHW Stack 5 (STCK 15)**
	Emission Concentration (mg/Nm^3)													

[a] *Guaranteed emission limit provided by Durr Megtec*

[b] *Average total VOC emissions obtained from monitoring data at existing battery manufacturing plant. Monitoring carried out by EPA Environmental Consultants*

[c] *Guaranteed emission limit provided by Babcock Wanson*

Treatment of Buildings

1.16 The proposed building for the battery manufacturing processes has been included within the model. The building has been split into different sections, to represent the different heights of each part of the building.

1.17 There are also a number of existing buildings located in the neighbouring industrial area to the south, and the buildings within Phase 1 of IAMP to the north east.

1.18 The buildings included within the model are detailed in Table 6.3/4.

Table 6.3/4: Onsite Buildings Included in Model

Building Number	Building Name in Model	Building Description	Base Elevation (m)	Height of Building (m)	Grid Reference of SW Corner	
					X	Y
1[a]	BLD_1	On-site Building 1	38.70	30.00	433066.17	558739.48
2[a]	BLD_2	On-site Building 2	38.70	30.00	433162.10	558527.66
3[a]	BLD_3	On-site Building 3	38.70	16.00	433269.18	558708.39
4[a]	BLD_4	On-site Building 4	38.70	16.00	433318.84	558598.61
5	BLD_5	On-site Building 5	38.70	11.20	433093.90	558619.79
6	BLD_6	On-site Building 6	38.70	16.00	433110.19	558593.86
7	BLD_7	On-site Building 7	38.70	16.00	433090.40	558627.56
8	BLD_8	On-site Building 8	38.70	16.00	433419.48	558776.35
9	BLD_9	On-site Building 9	38.70	16.00	433451.44	558705.23
10	BLD_10	On-site Building 10	38.70	8.00	433066.16	558739.49
11	BLD_11	On-site Building 11	38.70	11.75	433279.52	558836.00
12	BLD_12	On-site Building 12	38.70	8.00	433105.33	558793.93
13	BLD_13	On-site Building 13	38.70	8.00	433220.06	558811.15
14	BLD_14	Off-site Building 1	38.79	12.00	433026.14	558095.42
15	BLD_15	Off-site Building 2	40.50	12.00	433262.55	558264.52
16	BLD_16	Off-site Building 3	35.18	15.00	433725.71	558146.97
17	BLD_17	Off-site Building 4	36.54	25.00	433674.63	558585.11
18	BLD_18	Off-site Building 5	35.96	19.00	433536.75	558773.64
19	BLD_19	Off-site Building 6	35.67	15.00	433659.35	559063.87

Table 6.3/4: Onsite Buildings Included in Model						
Building Number	**Building Name in Model**	**Building Description**	**Base Elevation (m)**	**Height of Building (m)**	**Grid Reference of SW Corner**	
					X	**Y**
20	BLD_20	Off-site Building 7	36.05	15.00	433714.85	559264.98
[a] Modelled as tiered buildings to take into account the curvature of the roof. The ridge has been set to 30m above base elevation and the eaves at 27.5m above base elevation						

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1.19 The locations of the on-Site buildings are shown in Figure 6.3/3, and the off-Site buildings are shown in Figure 6.3/4 below.

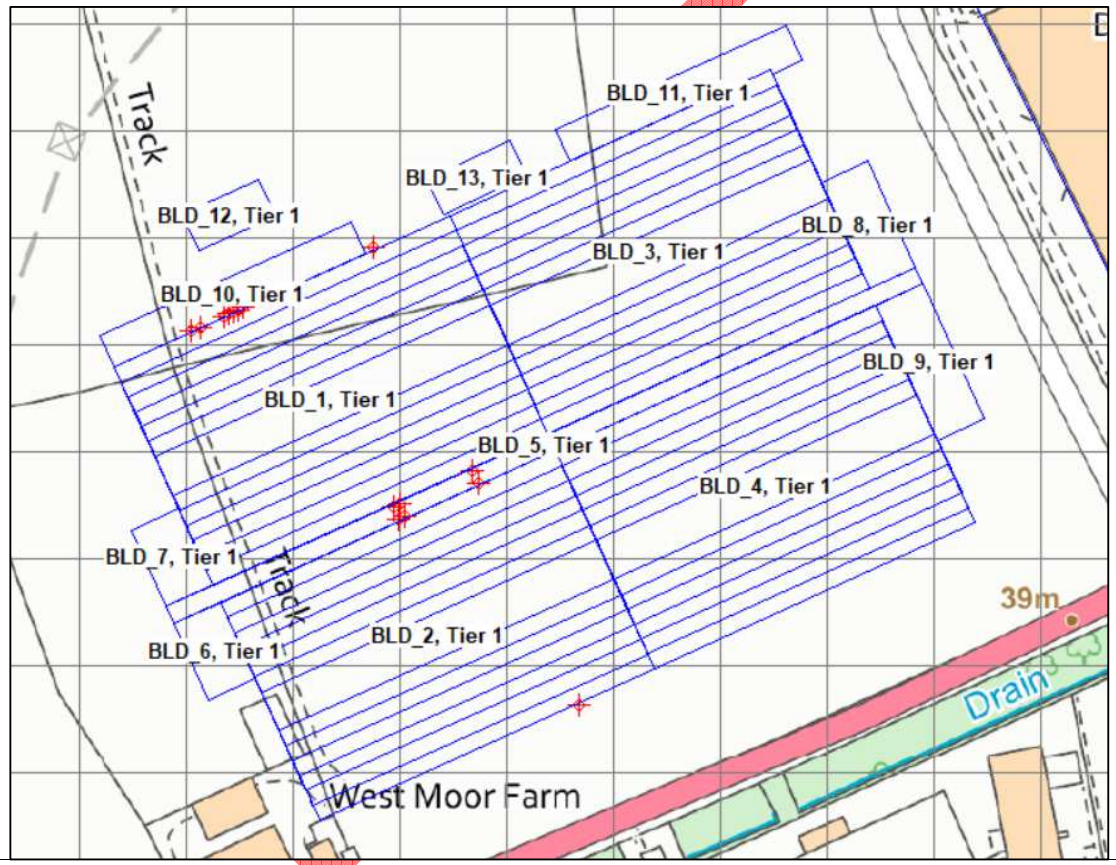
Track
BLD_11, Tier 1
BLD_13, Tier 1
BLD_12, Tier 1
BLD_8, Tier 1
BLD_3, Tier 1
BLD_10, Tier 1
BLD_9, Tier 1
BLD_1, Tier 1
BLD_5, Tier 1
BLD_4, Tier 1
BLD_7, Tier 1
Track
39m
BLD_2, Tier 1
BLD_6, Tier 1
Drain
West Moor Farm

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Figure 6.3/3: Location of On-site Buildings in Model

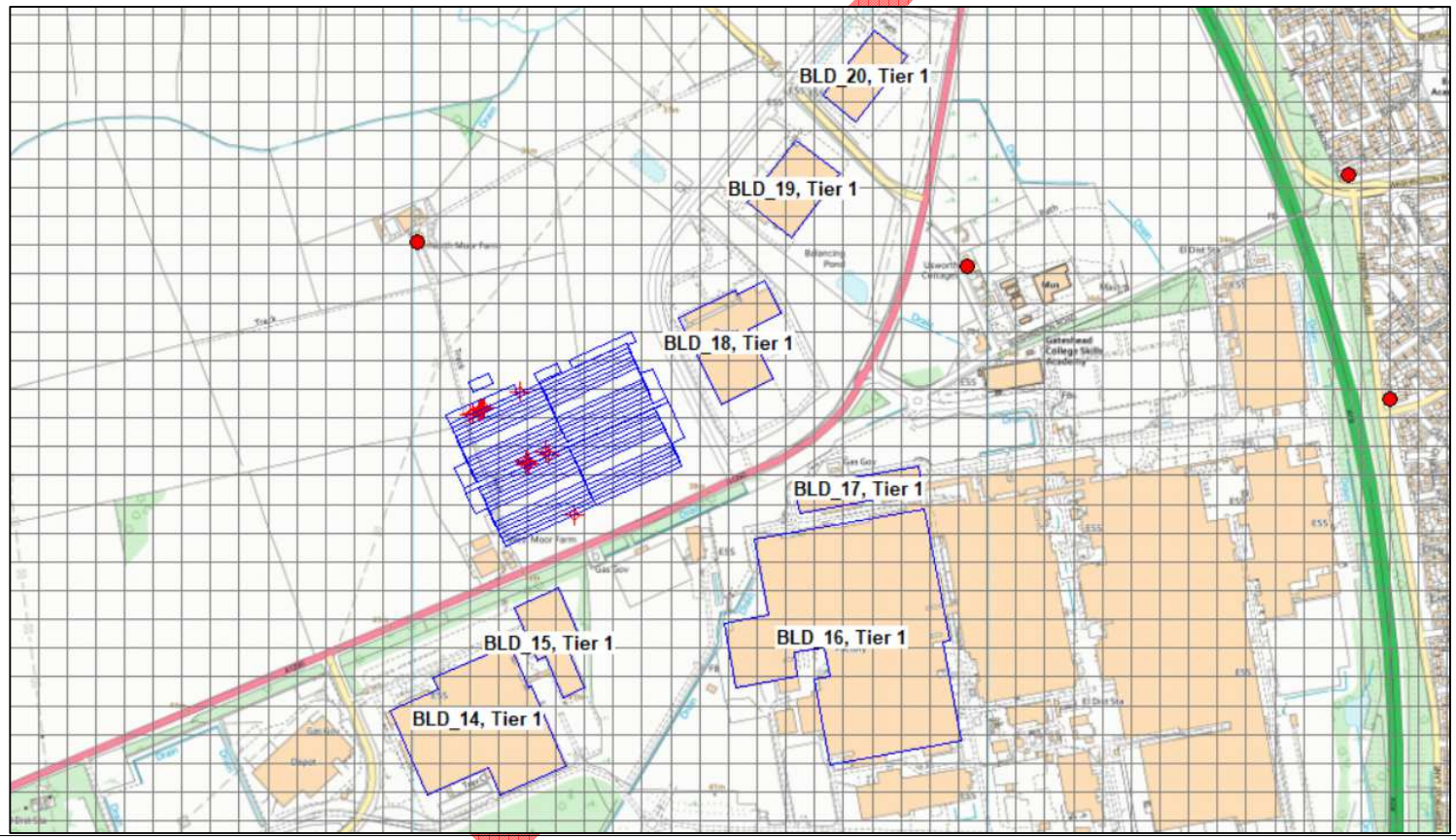
BLD_20, Tier 1
BLD_19, Tier 1
BLD_18, Tier 1
BLD_17, Tier 1
BLD_16, Tier 1
BLD_15, Tier 1
BLD_14, Tier 1

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Figure 6.3/4: Location of Off-site Buildings in Model