The London Resort Development Consent Order

BC080001

Environmental Statement
Volume 2: Appendices

Appendix 15.4 – Operational noise and vibration assessment

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Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
Regulation 5(2)(a)
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Regulation 12(1)

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Appendix 15.4 Operational Noise & Vibration Assessment

INTRODUCTION

15.4.1 The 3D acoustic modelling reported in this section predicts how the operation of the Proposed Development will affect the existing noise climate of the area. The maximum development parameters have been used for this assessment.

15.4.2 The modelling in this Appendix includes:

- Traffic noise assessment, comparing baseline noise models produced from measured noise level data (Appendix 15.1) to predicted traffic flow data at the point of reaching maturity for the London Resort (taken to be in 2038);
- Assessment of ride and attraction noise impact assessment for noise sensitive receptors surrounding the Kent Project Site and those in Essex (located across the River Thames);
- Assessment of noise limits for the Proposed Development's fixed utility buildings and mechanical plant locations;
- Assessment of noise breakout from external loudspeaker systems located within the London Resort pay line, investigating the potential impact of outdoor events with amplified music or speech (e.g. resort entertainment or external conference centre exhibitions);
- Passenger ferry noise impact to sensitive receptors in the Kent and Essex Project Sites.
- Assessment of the potential impact of low frequency noise propagation from dredgers landing material at the existing CEMEX wharf, on the proposed London Resort accommodation buildings.
- Noise limits and typical stand-off distances for helicopter landing locations.

DESKTOP NOISE ASSESSMENTS

Traffic Noise Predictions

Traffic Noise Assessment Criteria

15.4.3 Commonly, the significance of traffic noise changes can be determined from the following assessment criteria:

Table 15.4.1: Criteria for determining magnitude of impact of noise changes in the short term after completion of the Proposed Development (Source: DMRB).

Magnitude	Criteria $L_{A10,18hr}$ noise change from existing traffic levels
Large	5 dB or more
Medium	3 – 4.9 dB
Small	1 – 2.9 dB
Negligible	0.1 – 0.9 dB
No change	0 dB

Table 15.4.2: Criteria for determining magnitude of impact of noise changes in the long term after completion of the Proposed Development (Source: DMRB).

Magnitude	Criteria $L_{A10,18hr}$ noise change from existing traffic levels
Large	10 dB or more
Medium	5 – 9.9 dB
Small	3 – 4.9 dB
Negligible	0.1 – 2.9 dB
No change	0 dB

15.4.4 According to the Design Manual for Roads and Bridges (DMRB), a 3 dB LA10, 18h change in the long term (typically 15 years after project opening) is considered just perceptible.

15.4.5 The limitations of basing traffic noise impact significance of the London Resort in 2038 on the long term DMRB impact guidance is acknowledged. The operational traffic noise impact assessment within this ES is therefore based on the short-term DRMB criteria (shown in Table 15.4.1) with a +1dB noise level increase due to traffic considered to be just perceptible by most people.

2038 operational traffic noise assessment

15.4.6 Annual average weekday traffic (AAWT) flow counts have been provided for the year at which the London Resort reaches full maturity in 2038. This future year provides a worst-case assessment of operational traffic impacts, with the London Resort operating at a peak visitor design level.

15.4.7 The table below shows the magnitude of the effect on the local roads around the Kent and Essex Project Sites due to the 2038 predictions.

Table 15.4.3: Magnitude of impact due to the peak 2038 design day operational traffic

APT Link	Road Names	APT 2018 baseline traffic flow data		APT 2038 future traffic flow data		Predicted change in traffic noise level - dB	Magnitude of impact
		Total traffic flow 18h	% HGV	Total traffic flow 18h	% HGV		
121	A2(T)	132254	8.06	159103	7.61	0.5	Negligible
122	A2(T)	143444	7.87	169994	7.50	0.3	Negligible
125	A226	9654	4.78	13633	3.93	0.9	Negligible
126	A226 & Thames Way	4937	8.43	6490	5.69	0.3	Negligible
127	A2260	8340	6.37	11994	4.02	0.7	Negligible
128	A2260	19466	6.76	28405	4.29	0.7	Negligible
130	A2260	9386	7.29	13953	3.13	2.4	Small
132	A2(T)	135015	8.36	155125	8.28	0.4	Negligible
133	A2(T) Slip road	5054	5.86	7566	5.09	0.2	Negligible
134	A2(T) Slip road	5883	6.17	10276	3.48	2.2	Small
135	A2(T) Slip road	13223	4.09	19816	2.58	2.4	Small
136	A2(T) Slip road	14451	4.14	19421	2.52	-0.1	No change
138	B2175 High Street	8103	4.06	12674	3.05	1.5	Small
139	Springhead Road	9118	2.73	10472	2.65	0.6	Negligible
140	Thames Way	8047	2.85	9522	2.52	0.5	Negligible
141	Springhead Road	12718	2.62	16455	2.52	1.1	Small
142	A2(T) Slip road	9319	3.01	12684	2.38	1.0	Small
144	Station Road	8093	2.12	10167	2.46	1.2	Small
146	A2(T) Slip road	8971	3.32	12168	3.30	1.3	Small
188	Lower Thames Crossing	0	0.00	0	0.00	0.0	No change
229	B259	12516	4.81	17127	2.89	0.4	Negligible
230	Stanhope Road	11434	5.27	15015	3.56	0.4	Negligible
231	Stanhope Road	3648	12.22	5226	7.37	0.2	Negligible
232	Swanscombe High Street	2644	16.13	3864	9.69	0.1	Negligible
233	Swanscombe Street	728	0.00	24	1.55	-17.4	No change
234	Milton Road	1486	1.86	2212	2.23	2.1	Small
235	London Road	10636	7.92	14845	5.70	0.8	Negligible
236	Craylands Lane	4687	9.23	5377	10.06	1.1	Small

APT Link	Road Names	APT 2018 baseline traffic flow data		APT 2038 future traffic flow data		Predicted change in traffic noise level - dB	Magnitude of impact
		Total traffic flow 18h	% HGV	Total traffic flow 18h	% HGV		
237	Milton Street	1692	0.83	2860	0.52	2.1	Small
238	London Road	14174	8.86	18552	7.47	1.3	Small
239	Alkerden Lane	2198	3.31	2880	0.53	-1.2	No change
240	London Road	12699	8.02	16513	7.08	1.0	Small
241	London Road	13073	7.84	17032	6.89	1.0	Small
242	Knockhall Road	1476	18.31	2039	12.60	0.4	Negligible
245	Mounts Road	352	0.00	519	0.75	1.4	Small
68	A1089 - Essex Project Site	23956	10.39	31539	10.15	1.2	Small
248		26844	10.39	35331	10.15	1.2	Small

15.4.8 Table 15.4.3 shows 'no change' to 'small' magnitude of impacts on the noise emissions from additional traffic on the local roads in 2038. The significance of these noise emission increases on sensitive NSRs is largely minor, rising to minor adverse (in the locations marked with small magnitude of impact in Table 15.4.3).

15.4.9 The effect of the peak 2038 London Resort visitor traffic around the Kent and Essex Project Site roads are considered to be acceptable, limited to affects below the SOAEL rating.

15.4.10 To further assess the noise impact from traffic caused by the operation of a fully matured London Resort (in 2038) on NSRs, the predicted changes in traffic volumes, HGV percentages and traffic speeds were incorporated into a 3D acoustic (CadnaA 2019) model. As well as the project's transport consultant local road predictions, additional traffic flows were input on the internal London Resort roads, to include noise considerations for staff, visitor accommodation, service vehicle and fast-track bus transport routes. Diagram 15.4.1 and Table 15.4.4. indicate the traffic flows on the Proposed Development's access roads.

Diagram 15.4.1: Image showing planned Kent and Essex Project Site Access Routes.

Table 15.4.4: Existing and predicted traffic movements with respect to the Proposed Development's access routes.

Road ID	Prediction Assumption Description
AR1	Tiltman Avenue - to be used as a development service vehicle route. 20 service vehicle movements are predicted for each 18hr day. These were added to the existing traffic level from the noise model calibration.
AR2	Staff bus service and express taxi route – to be developed specifically for the Proposed Development. Average electric vehicle bus pickups every 30minutes in each direction (72 movements predicted for each 18hr day). If 3% of guests arrive by taxis along this route with an average of 3 people per taxi equates to 500 cars / 1,000 vehicle movements every 18hr day. The predicted traffic flow was also added to the existing London Road traffic numbers to the east of the access road entrance.
AR3 AR4	Prediction data for the new access roads during the 2038 future year scenario has been provided for the Proposed Development. The daily transport flow is expected to be 3,832 vehicle movements during an 18hr day. The car parks located at the termination of these roads were also modelled as area sources in CadnaA, which calculates emissions using RLS-90 methodology The three large internal car park facilities were modelled at full capacity, understood to be 2,400 spaces, with the overflow car park modelled with 700 spaces.
AR5	Northfleet Industrial Estate road to be used as a Proposed Development service delivery access road. 20 heavy vehicle movements are predicted for each 18hr day.
AR6	New access road running between the ferry terminal and the Proposed Development entrance (subsequently connecting into AR3). This road will be used primarily for Taxi drop- offs to the hotels as well as the electric transport vehicle. 500 taxi movements have been predicted alongside a fast track bus service, operating every 30 minutes in each direction (72 movements every 18hr day).
AR7	Traffic Consultants provided prediction data for the new access roads planned to take visitors directly from the A2(T) to the Proposed Development. During the 2038 future year scenario the daily transport flow is expected to be 3,832 vehicle movements during an 18hr day.
AR8	Traffic consultants predicted a 26,500-traffic flow increase along the A2(T) during the 2038 design day scenario. This figure was added to the existing traffic level from the noise model calibration.
AR9	Traffic consultants predicted an 8,487-traffic flow increase in the Essex Project Site, along the A1089 (for the 2038 design day scenario). This was added to the existing traffic level from the noise model calibration. The Tilbury car park was modelled as an area source in CadnaA, which calculates emissions using RLS-90 methodology. The facility was modelled at full capacity, which is understood to be 2,100 spaces.

Desktop traffic noise model results

15.4.11 The following diagrams show a comparison between the baseline ambient noise climate model (produced from measured noise level data as detailed in Appendix 15.1) and the predicted noise climate due to 2038 traffic movements over a single peak visitor day.

15.4.12 Noise contours are used to show the difference in levels caused by the Proposed Development. Because both sets of data are computed in terms of A-weighted (dBA) quantities, their difference is expressed in terms of dB – although expressing the difference in terms of dBA would yield the same result.

15.4.13 The colours within the noise contours represent the following calculated changes to the noise levels of the area:

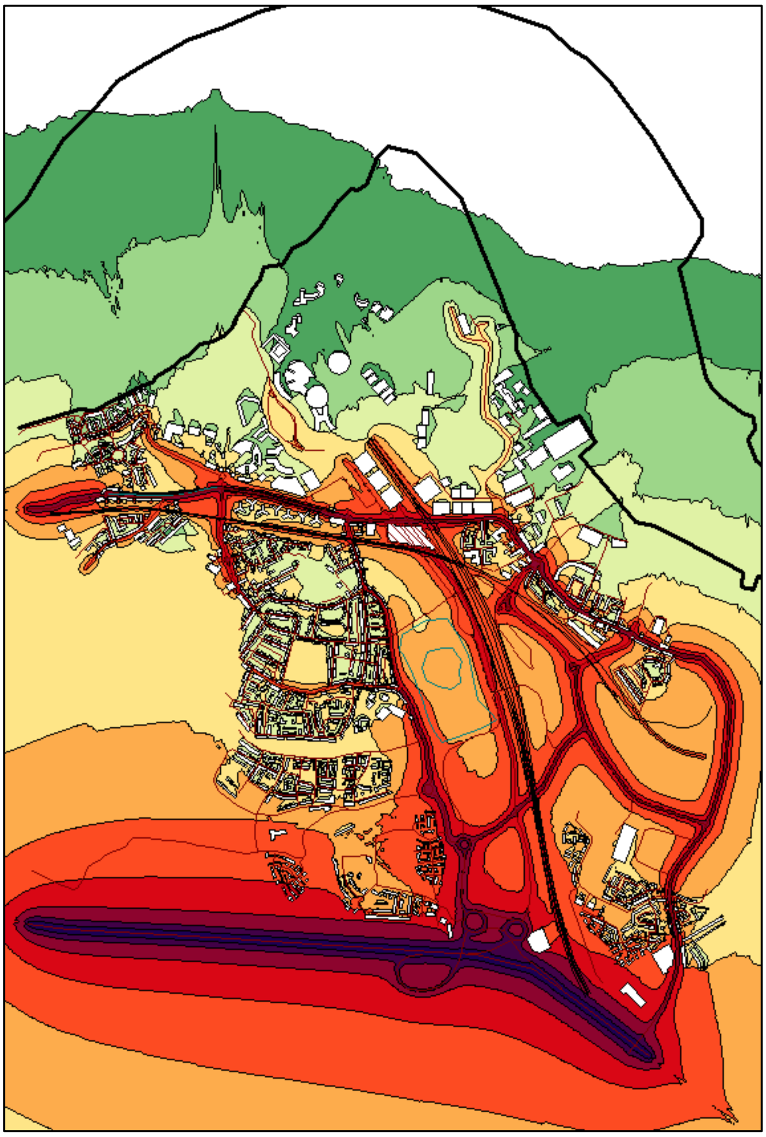
- The purple area shows the distance at which the noise from the Proposed Development traffic flows will likely cause the existing noise climate to increase by a level equal to or greater than 10 dB.

- The orange area shows the limiting distance at which the noise from the Proposed Development traffic flows will likely cause the existing noise climate to increase by a level between 3 and 5 dB.

- The yellow area shows the limiting distance at which the noise from the Proposed Development traffic flows will likely cause the existing noise climate to increase by a level between 1 and 3 dB.

- The green areas show the locations where the noise from the Proposed Development traffic flows will likely have a minimal to no effect on the baseline ambient noise level of the region (level changes between 0 and 1 dB).

Diagram 15.4.2: Calculated 06:00-00:00 levels LA10,18hr dB(A) for the area surrounding Kent Project Site, calibrated to noise survey and 2038 traffic prediction data.



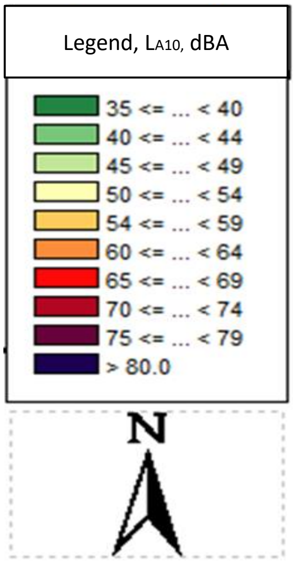


Diagram 15.4.3: Image showing the difference between the LA10,18hr (dB) noise climate during 2038 London Resort operation design day and baseline ambient noise level conditions around the Kent Project Site.

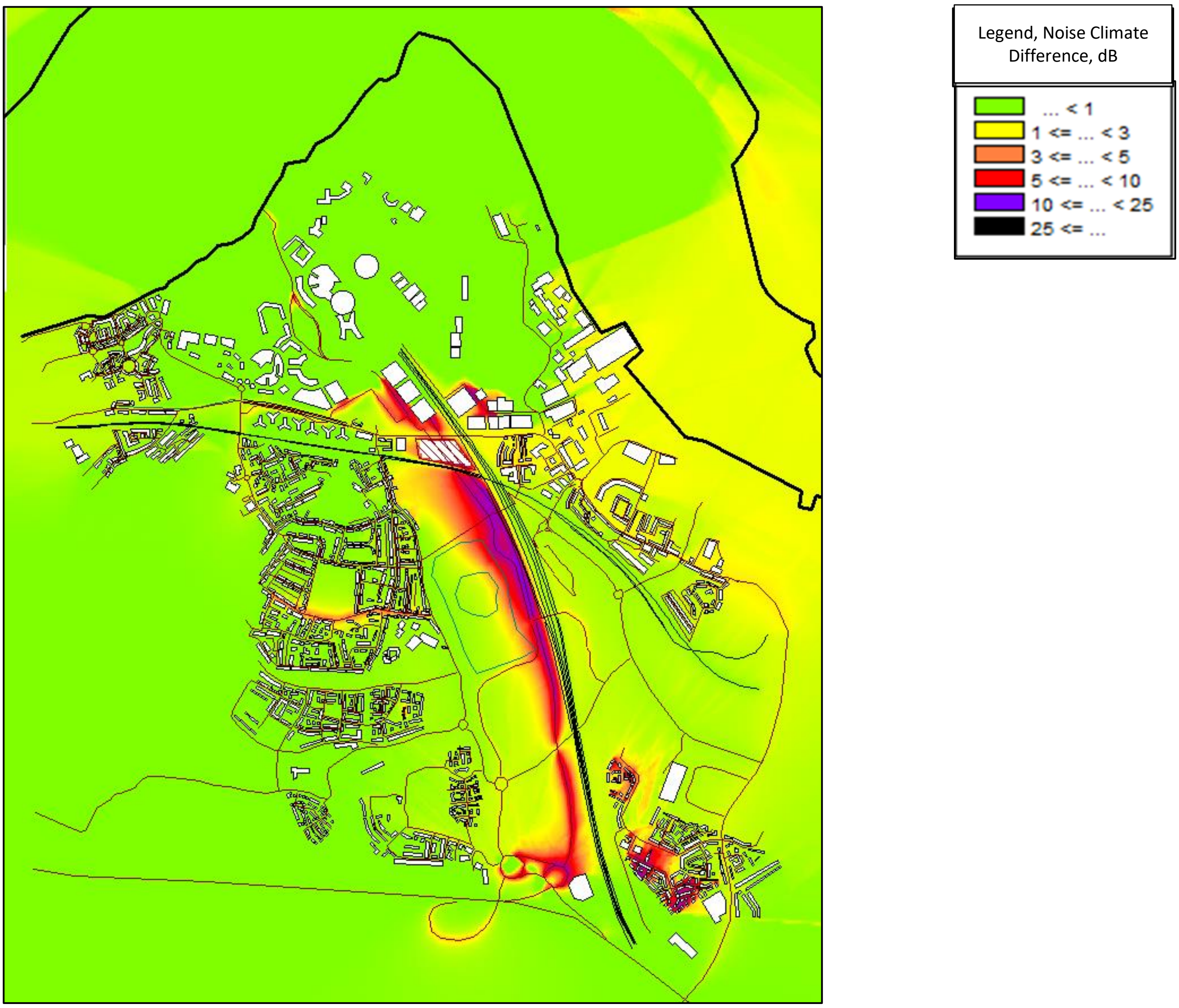


Diagram 15.4.4: Calculated 06:00-00:00 levels LA10,18hr dB(A) for the area surrounding Essex Project Site, calibrated to noise survey and 2038 traffic consultant prediction data.

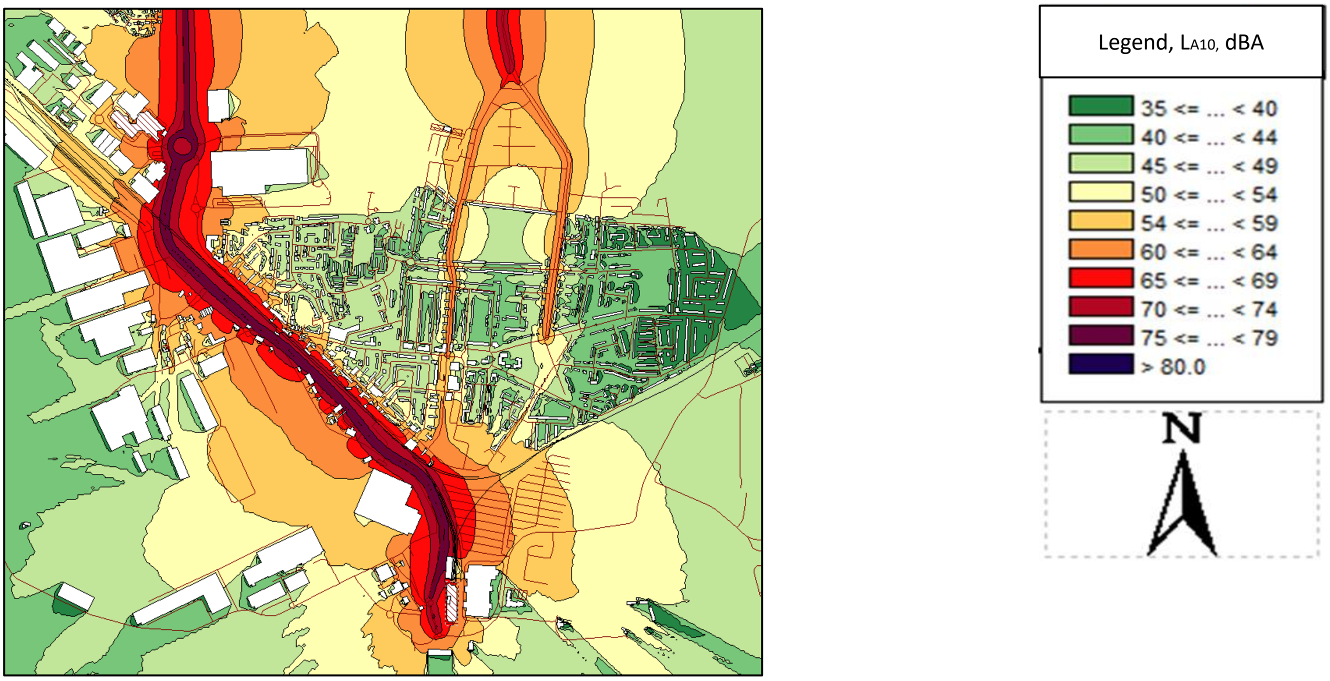


Diagram 15.4.5: Image showing the difference between the LA10,18hr (dB) noise climate during 2038 London Resort operation design day and baseline ambient noise level conditions around the Essex Project Site.

15.4.14 Inspecting diagram 15.4.3 which considers the effect of road traffic noise in the Kent Project Site, in terms of LA10,18hrs, the results show the new access road from the A2(T) to cause the most significant changes when the Proposed Development is ‘switched on’ within the model.

15.4.15 It is worth noting that the modelled access roads are considered to represent worst-case scenario. The noise shielding that would result from the underpass and covered sections necessary to pass under other infrastructure are not considered in the results in order to give a worst-case assessment.

15.4.16 Diagram 15.4.5 shows the Tilbury car park to cause the greatest noise level change to the existing noise climate in proximity. It is however the increased traffic on the A1089 that is shown to cause the most significant changes to the noise climate at sensitive receptors.

15.4.17 The following breakdown of affected areas is limited to developments in a direct line of sight to the new access roads, and those located near to the A1089 in the Essex Project Site

15.4.18 Diagrams 15.4.3 and 15.4.5 show ambient noise level increases by 1 dB (Low impact magnitude) for properties in the following NSR locations:

Table 15.4.5: Kent and Essex Project Site NSRs with a +1dB LA10,18hour noise level change

South East of Access Road	North East of Access Road	West of Access Road	Essex Project Site
Conrad Mews	Robinson Way (Including Phoenix Court and Back Eagle Drive)	High Street	Dock Road
Marlow Close		Stanhope Street	Melbourne Road
Thackeray Drive			Church Road
Wellesley Corner	Snowdon Hill		Ellerman Road
Caxton Park			Newton Road
Colby Mews			Hume Avenue
Springhead Parkway			
Paris Drive			
Stratford Way			
Amsterdam Way			

15.4.19 The only other predicted change to the noise climate due to new roads are due to the electric land vehicle moving along the Gate 1 Kent Project Site access roads, where there was previously no significant noise activity and around the Resort’s parking areas. However, the calculations show that the noise from these areas is unlikely to propagate to any residential areas.

Traffic prediction sensitivity analyses

15.4.20 Sensitivity analyses have been conducted to evaluate the potential impact of the following scenarios:

- Variations in predicted traffic flows for the 2038 design day scenario; and
- The effect of strong southerly winds, on sound propagation from the A2(T) and the London Resort access roads to NSRs.

15.4.21 The table below shows the magnitude of the effect on the local roads around the Kent and Essex Project Sites, with a 50% increase to the 2038 predictions used above.

Table 15.4.6: Magnitude of impact due to 1.5 times the peak 2038 design day operational traffic flows

APT Link	Road Names	APT 2018 baseline traffic flow data		APT 2038 future traffic flow data		Predicted change in traffic noise level - dB	Magnitude of impact
		Total traffic flow 18h	% HGV	Total traffic flow 18h	% HGV		
121	A2(T)	132254	8.06	172528	7.61	0.8	Negligible
122	A2(T)	143444	7.87	183269	7.50	0.6	Negligible
125	A226	9654	4.78	15623	3.93	1.5	Small
126	A226 & Thames Way	4937	8.43	7267	5.69	0.8	Negligible
127	A2260	8340	6.37	13822	4.02	1.3	Small
128	A2260	19466	6.76	32875	4.29	1.4	Small
130	A2260	9386	7.29	16237	0.00	0.0	No change
132	A2(T)	135015	8.36	165180	3.13	3.1	Medium
133	A2(T) Slip road	5054	5.86	8821	8.28	0.7	Negligible
134	A2(T) Slip road	5883	6.17	12473	5.09	0.9	Negligible
135	A2(T) Slip road	13223	4.09	23113	3.48	3.0	Medium
136	A2(T) Slip road	14451	4.14	21906	2.58	3.1	Medium
138	B2175 High Street	8103	4.06	14960	2.52	0.4	Negligible
139	Springhead Road	9118	2.73	11148	3.05	2.2	Small
140	Thames Way	8047	2.85	10260	2.65	0.9	Negligible
141	Springhead Road	12718	2.62	18323	2.52	0.8	Negligible

APT Link	Road Names	APT 2018 baseline traffic flow data		APT 2038 future traffic flow data		Predicted change in traffic noise level - dB	Magnitude of impact
		Total traffic flow 18h	% HGV	Total traffic flow 18h	% HGV		
142	A2(T) Slip road	9319	3.01	14367	2.52	1.5	Small
144	Station Road	8093	2.12	11205	2.38	1.6	Small
146	A2(T) Slip road	8971	3.32	13766	2.46	1.6	Small
229	B259	12516	4.81	19432	0.00	0.0	No change
230	Stanhope Road	11434	5.27	16806	2.89	0.9	Negligible
231	Stanhope Road	3648	12.22	6014	3.56	0.8	Negligible
232	Swanscombe High Street	2644	16.13	4474	7.37	0.8	Negligible
233	Swanscombe Street	728	0.00	-328	9.69	0.8	Negligible
234	Milton Road	1486	1.86	2576	1.55	-60.8	No change
235	London Road	10636	7.92	16949	2.23	2.7	Small
236	Craylands Lane	4687	9.23	5722	5.70	1.4	Small
237	Milton Street	1692	0.83	3444	10.06	1.4	Small
238	London Road	14174	8.86	20741	0.52	2.9	Small
239	Alkerden Lane	2198	3.31	3221	7.47	1.8	Small
240	London Road	12699	8.02	18420	0.53	-0.7	No change
241	London Road	13073	7.84	19011	7.08	1.5	Small
242	Knockhall Road	1476	18.31	2321	6.89	1.5	Small
245	Mounts Road	352	0.00	602	12.60	1.0	Small
68	A1089 - Essex Project Site	23956	10.39	35330	0.75	2.0	Small
248		26844	10.39	39574	10.15	1.7	Small

15.4.22 The table above shows the magnitude of impact to remain as small (minor impact significance) on the local roads around the Kent and Essex Project Sites. However, with 50% greater traffic flows, the magnitude of impact from the A2(T) slip road increases to medium.

15.4.23 As the closest NSR grouping is located approximately 400m away from these locations and is shielded by barrier attenuation, the London Resort operational traffic is not considered to cause a noise issue at these locations. Potential mitigation measures have been provided in the ES (appendix 15.5).

15.4.24 The following diagrams show a comparison between the baseline ambient noise climate model (produced from measured noise level data as detailed in Appendix 15.1) and the predicted noise climate due to 2038 traffic movements over an 18hr period (06:00-24:00) with an traffic flow prediction uplift of 50%.

Diagram 15.4.6: Image showing the difference between the LA10,18hr (dB) noise climate during 2038 London Resort operation design day with a 50% traffic flow uplift and baseline ambient noise level conditions around the Kent Project Site.

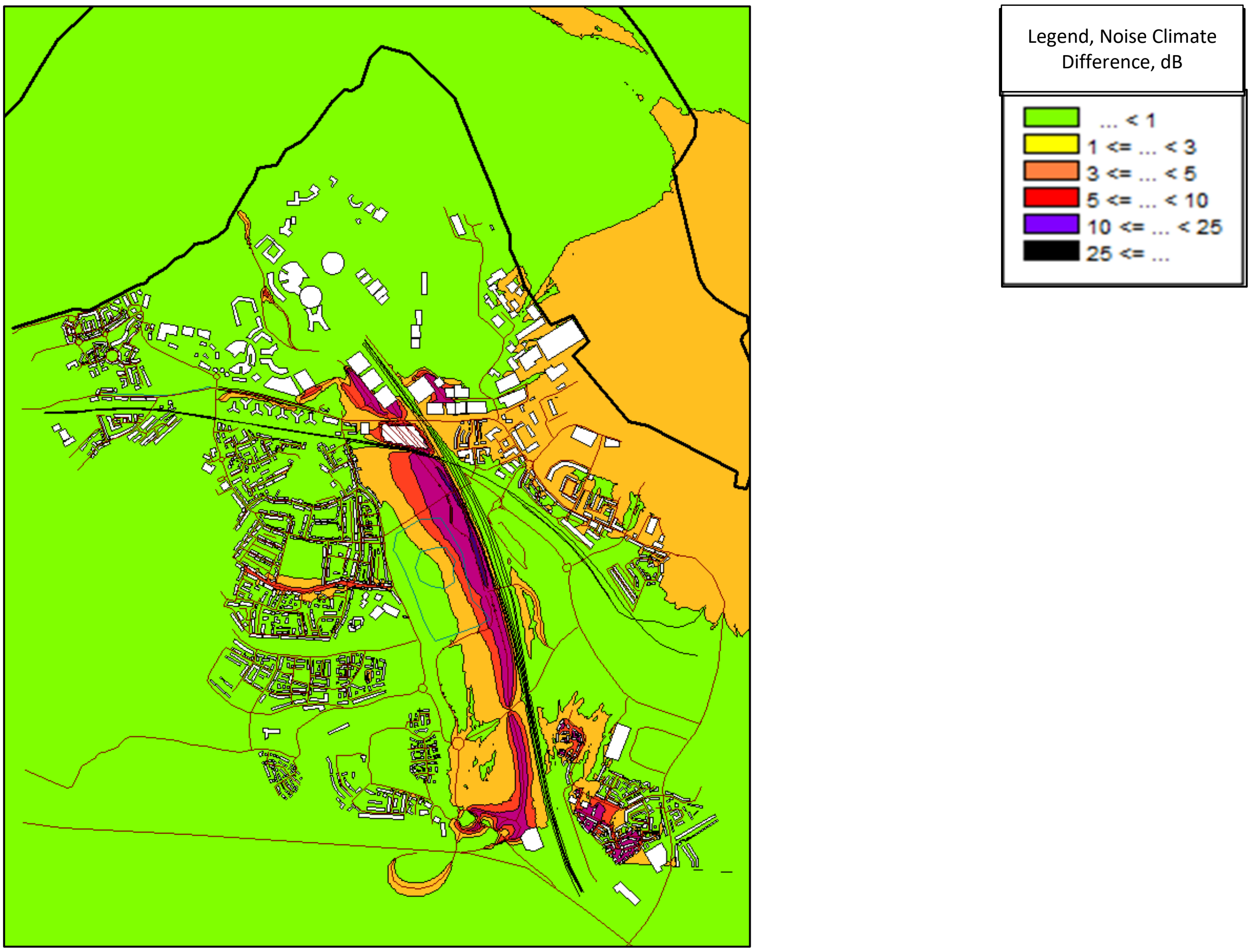
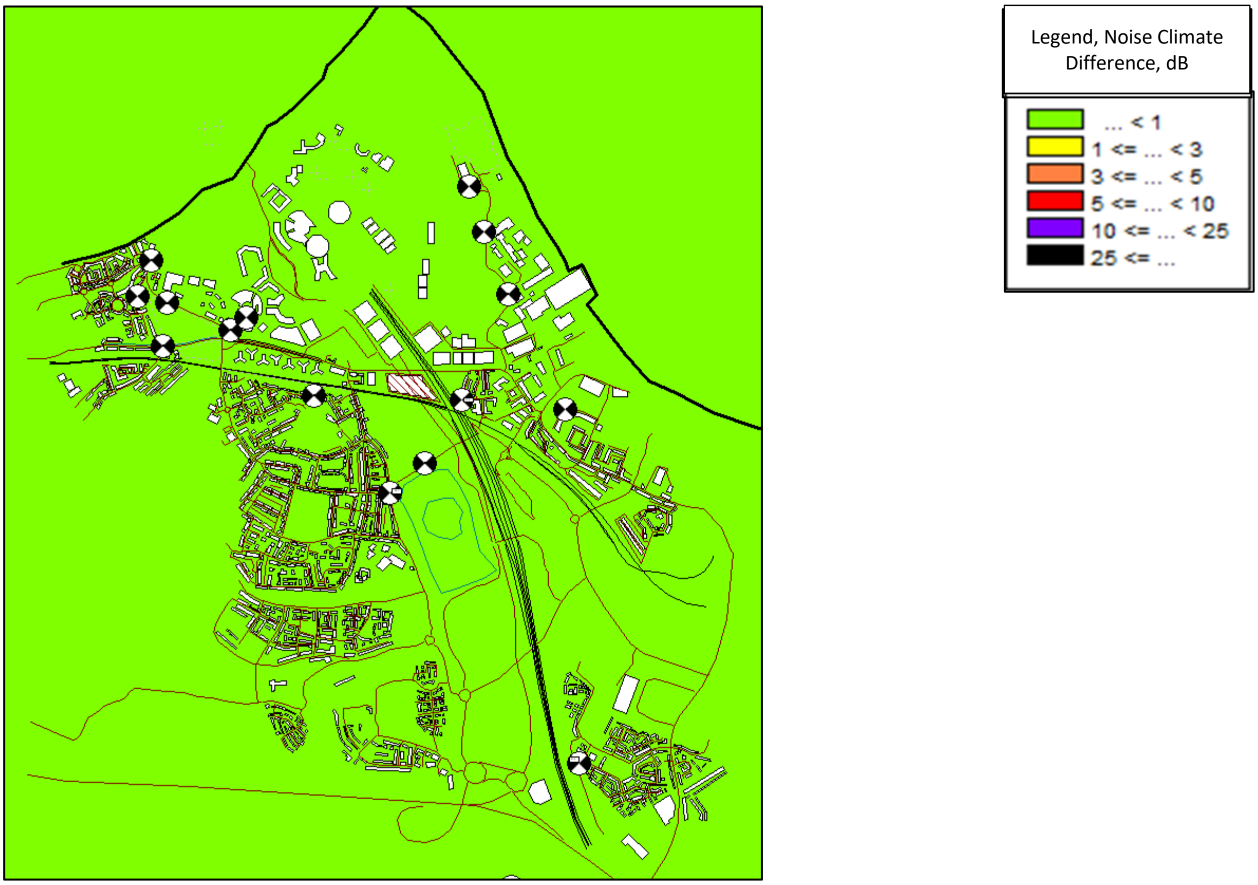


Diagram 15.4.7: Image showing the difference between the LA10,18hr (dB) noise climate during 2038 London Resort operation design day with a 50% traffic flow uplift and baseline ambient noise level conditions around the Essex Project Site.

15.4.25 Kent Project Site affected NSR remain equivalent to those with a direct line of sight to the main access road shown in Table 15.4.5.

15.4.26 Essex project the approximate 1dB increase due the sensitivity analysis causes noise to propagate further into the residential areas reaching down North View Avenue, Christchurch Road and Fielding Avenue.

Diagram 15.4.7: Image comparing the LA10,18hr (dB) noise climate predictions with and without the inclusion of a $15ms^{-1}$ southerly wind.



15.4.27 Diagram 15.4.7 shows there to be a low modelling sensitivity for the noise climate predictions with and without wind for the 2038 traffic predictions.

15.4.28 Wind changes to less frequent, strong southerly winds is not anticipated to cause additional noise impacts on existing NSRs or the Proposed Development. The assessment in Diagram 15.4.7 showed negligible effects on noise propagation from the A2(T).

London Resort Ride and Attraction Noise Break-out Assessment

Criteria for 'Scream' and 'Mechanical' noise impact significance

15.4.29 The following assessments are based on the likelihood of rides and attractions being clearly audible outside residential premises when all other peak noise sources are absent. This represents the quiet time between road traffic events when the noise from a ride or attraction (including shouts and screams) is most likely to be audible.

15.4.30 The assumption made here is that $L_{A,max,f}$ noise levels that are more than 5dB below background (L_{A90}) noise levels are unlikely to be clearly audible, even in the gaps between other peak noise events such as road traffic.

15.4.31 It was not considered suitable to assess the noise impact from the rides and attractions against $L_{Aeq,T}$ or $L_{A,max,f}$ noise levels. Noise survey data in conjunction with 3D acoustic modelling has shown that the current noise climate to the south and east of Gate 2 is strongly influenced by the peaks in noise caused by the movements of HGV vehicles along Manor Way. As these HGV movements will cease due to the construction of the London Resort, future baseline measurements may not include the noise emissions from these sources.

15.4.32 The lowest background noise level measured on-site was 48 dB(A) at monitoring location 1 (to the West of Gate 2, as detailed in Appendix 15.1). Against this an $L_{A,max,f}$ of 43 dB(A) is taken to be a threshold level for audibility of ride noise in the following assessments.

15.4.33 In modelling noise from the London Resort attractions, six outdoor rides have been modelled in the Gate 1 investigation. This is increased by a further three outdoor rides and a series of six 'boxed' (indoor) rides within the assessment of the London Resort during years with Gate 1 and Gate 2 operation. This is in line with the design development of the Proposed Development.

15.4.34 The ride and attraction noise data used in the model was based on the LA,max,f noise levels recorded during a survey of Europa Park, Germany (data detailed in Appendix 15.1). Measurements were taken for different rides and attractions at various locations. The LA,max,f is considered to represent the loudest noise features inclusive of visitor 'screams' as well as the mechanical clanking noise as roller coasters move to apex positions.

15.4.35 Against the measurement indices and threshold methodology discussed above, the following assessment is considered to represent a worst-case scenario for sound propagation from rides.

Desktop noise assessment of 'Scream' and 'Mechanical' ride noise

15.4.36 The following diagrams show the LA,max,f noise propagation from rides, under the Gate 1 and concurrent Gate 1 and 2 operation scenarios.

15.4.37 Noise contours are used to show the noise propagation. The point at which the sound pressure level falls below the 43 dB(A) threshold is indicated on the diagrams in blue.

Diagram 15.4.8: Calculated daytime (07:00-23:00) levels $L_{A,max,f}$ dB(A) for the area surrounding the Kent Project Site with only the Gate One rides and attractions in operation (no road traffic or any other sources of noise modelled). 43 dB(A) noise climate threshold is indicated in blue.

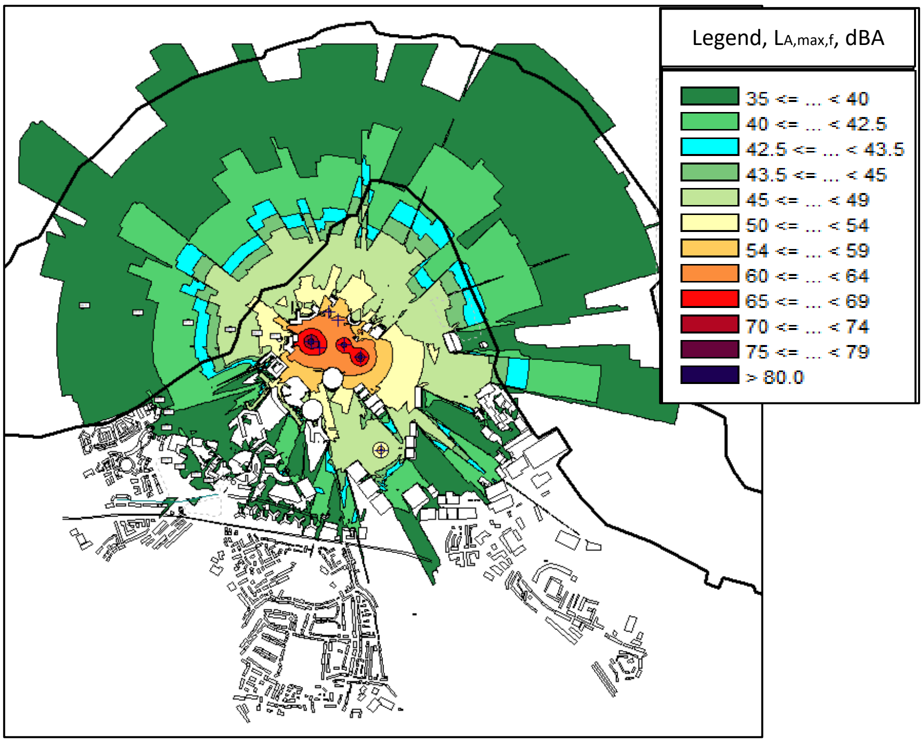
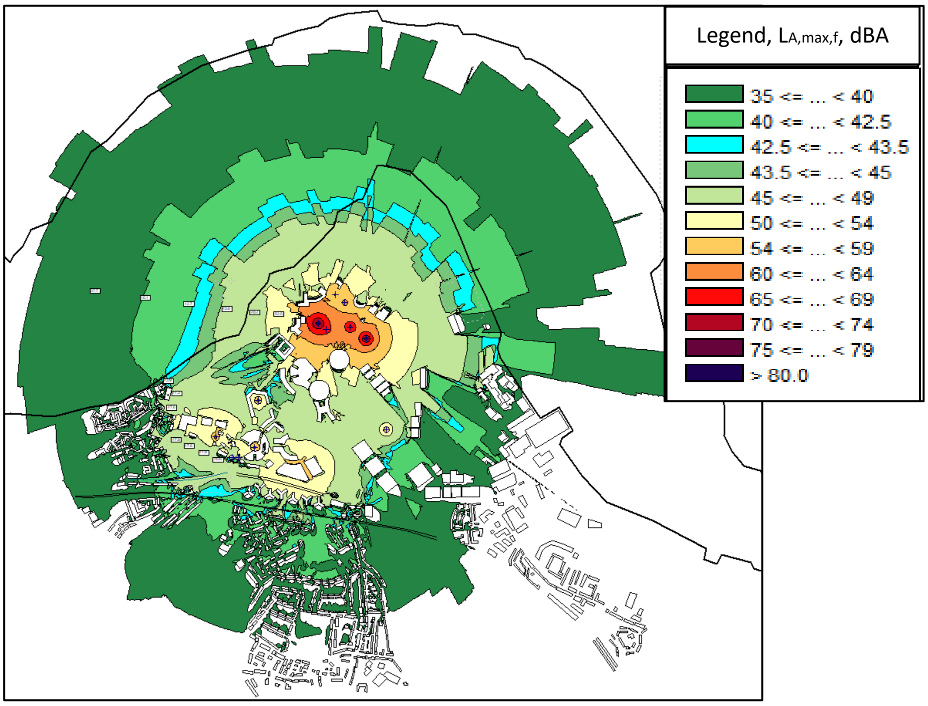


Diagram 15.4.9: Calculated daytime (07:00-23:00) levels $L_{A,max,f}$ dB(A) for the area surrounding The Kent Project Site, with the Gate One and Gate Two rides and attractions in operation (no road traffic or any other sources of noise modelled). 43 dB(A) noise climate threshold is indicated in blue.



15.4.38 Diagram 15.4.8 shows the $L_{A,max,f}$ noise levels from Gate 1 rides is unlikely to produce noise levels at NSRs in excess of the 43 dBA threshold.

15.4.39 Diagram 15.4.8 and 15.4.9 show the $L_{A,max,f}$ noise levels are unlikely to propagate to NSRs across the River Thames (Essex Project Site). Noise level predictions are shown to be below 35dB.

15.4.40 Including the concurrent noise levels from Gate 2 rides, Diagram 15.5.9 predicts noise level above the threshold at the following NSR locations:

Table 15.4.7: Kent Project Site NSRs with noise levels predicted above the 43dB(A) threshold

Likely Noise Impact	Less Likely Noise Impact
Wainwright Avenue	Knockhall Road
Stonely Crescent	Ingress Gardens
Tiltman Avenue	Craylands Lane
Vaughan Avenue	Craylands Square
Duncannon Place	Caspian Way
Reed Court	Penstemon Drive
	Orchard Road
	Alma Road

15.4.41 The assessments above are limited to only those dwellings with a direct line of sight to the new rides and attractions.

15.4.42 Additionally, any new housing in the land between Tiltman Avenue and London Road with a direct line of sight to the new rides and attractions would be predicted to experience noise levels above the threshold.

15.4.43 Table 15.4.7 includes NSRs where it is less likely for noise from rides and attractions (screams and mechanical noise) to be audible. At these locations, audibility would depend on there being a sufficiently lengthy gap in road traffic noise on London Road. Nevertheless, they are included here for completeness.

Worst-case assessment of ride and attraction noise breakout over the River Thames

15.4.44 The desktop model configuration settings were adjusted to simulate the propagation of ride and attraction noise emissions under worst case simulation conditions.

15.4.45 To model sound wave propagation across the River Thames, the ground absorption in the model was set to 0 (simulating the highly reflective water properties), and a $15ms^{-1}$ northerly wind was applied. The resultant contour map is shown in Diagram 15.4.10.

15.4.46 To model sound wave propagation to NSRs west and south of the London Resort Gate 1 and Gate 2 rides and attractions, a $15ms^{-1}$ southerly wind was applied in the model. The resultant contour map is shown in Diagram 15.4.11.

Diagram 15.4.10: Calculated daytime (07:00-23:00) levels $L_{A,max,f}$ dB(A) considering a 0 ground absorption and 15ms^{-1} southerly wind, for a worst-case noise breakout assessment across the River Thames. 43 dB(A) noise climate threshold is indicated in blue.

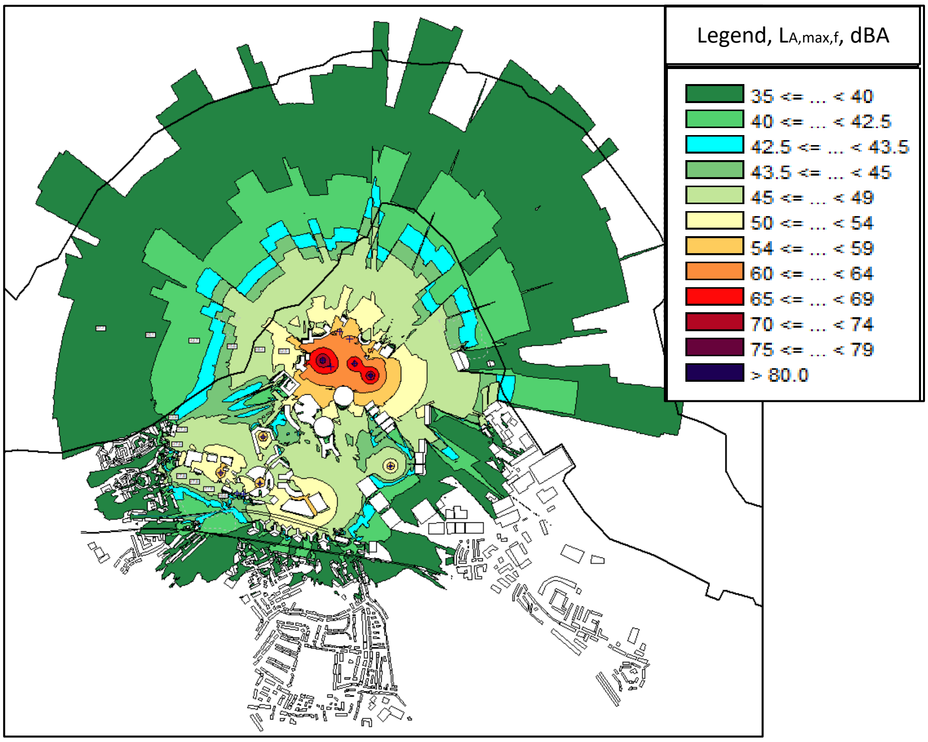
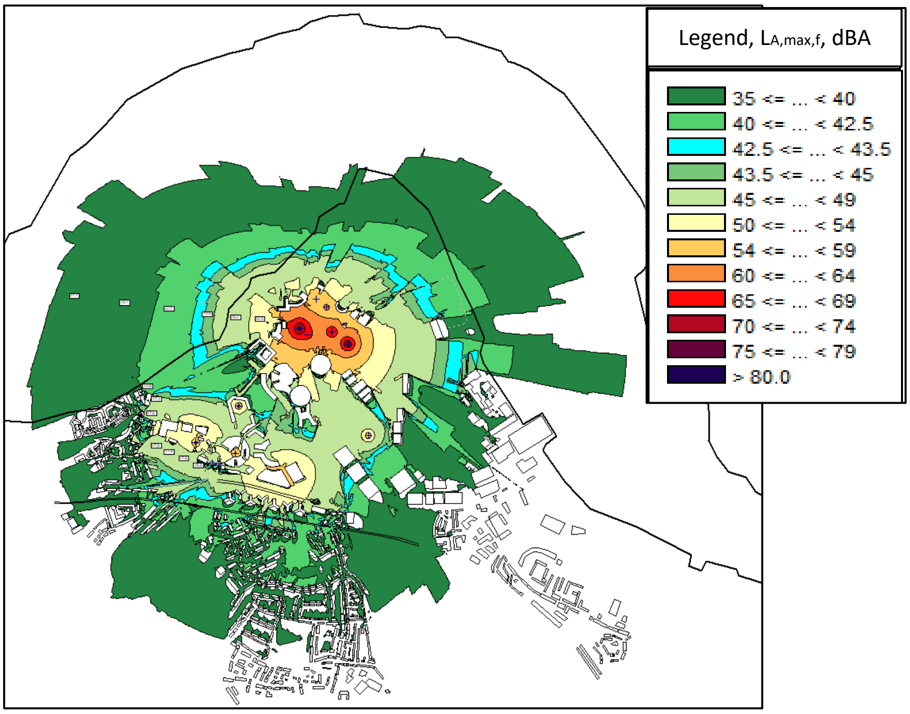


Diagram 15.4.11: Calculated daytime (07:00-23:00) levels $L_{A,max,f}$ dB(A) considering a 0.5 ground absorption and 15ms^{-1} northerly wind, for a worst-case noise breakout assessment to NSRs south of the London Resort rides and attractions. 43 dB(A) noise climate threshold is indicated in blue.



15.4.47 Diagram 15.4.10 shows that with the 0-ground absorption and a 15ms^{-1} southerly wind assumptions, noise breakout from the London Resort rides and attractions are not calculated to cause significant impacts at NSRs across the River Thames. Noise breakout is shown to be far below the 43 dBA $L_{A,max,f}$ threshold.

15.4.48 Diagram 15.4.11 exposes a low sensitivity between the noise impact on NSRs south of the London Resort rides and attractions. The 15ms^{-1} northerly wind produced a 43 dBA $L_{A,max,F}$ noise propagation contour equivalent to Diagram 15.4.9, maintaining a similar noise impacts at the NSRs in Table 15.4.7.

Assessment of London Resort Infrastructure Plant Limits

15.4.49 The London Resort plant items and plant compounds should be designed using BS 4142:2014+A1:2019 methodology to attain a rating level ($L_{Ar,T}$) that is 10dB below the existing background noise level ($L_{A90,T}$) at NSRs.

15.4.50 Attaining a rating level that is equal to or greater than 10dB below the existing background sound level, is considered to produce a 'no change' noise impact at the NSRs with a zero dB background noise creep.

15.4.51 The following assessments identify the required plant limits 1m from the facades of the fixed plant compound proposals to attain the criteria above at NSRs. The DCO application identifies all plant compound proposals are to be located within the Kent Project Site.

Diagram 15.4.12: Illustration of fixed infrastructure compound proposals, assessments IDs and nearby NSRs.

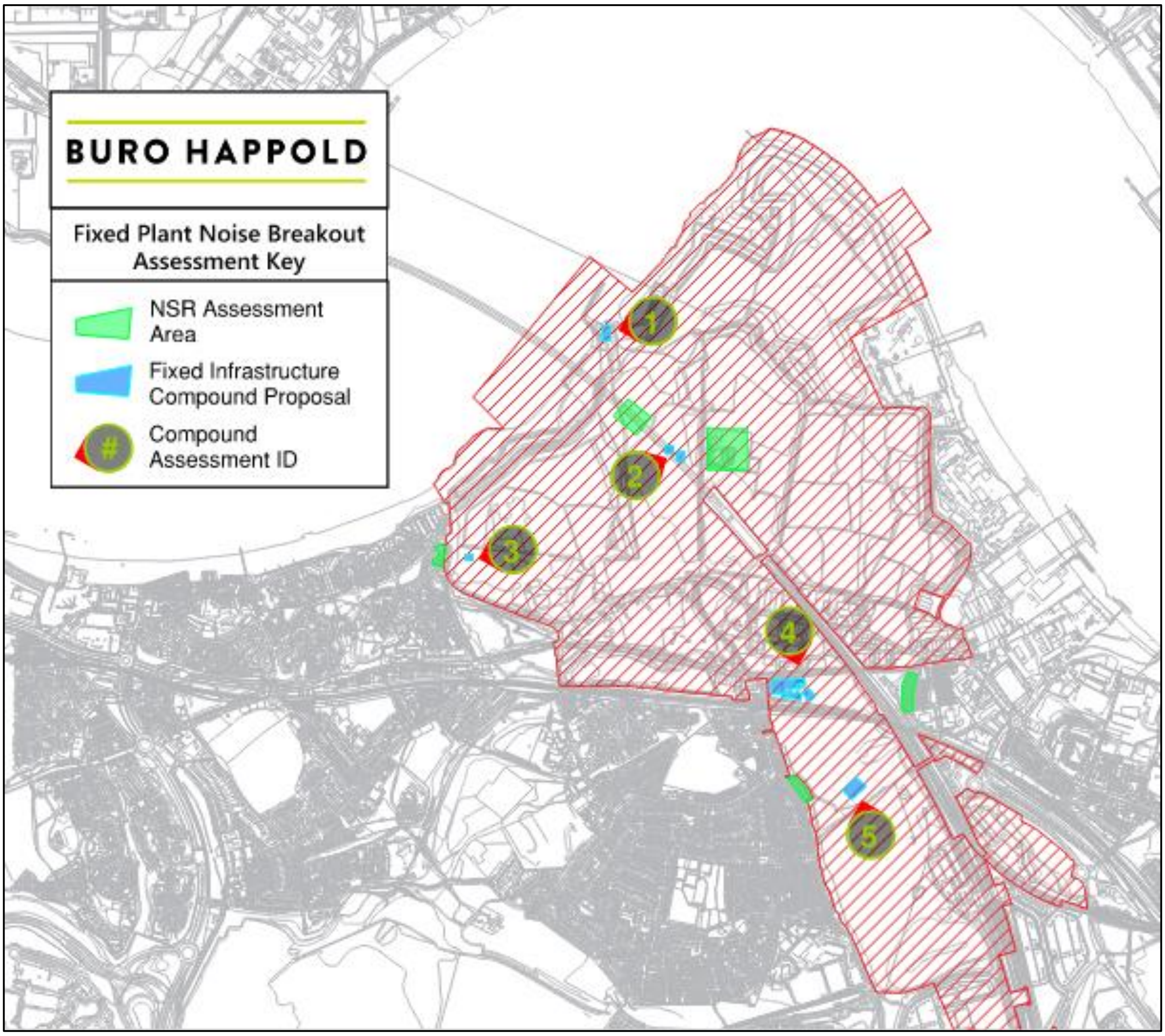


Table 15.4.8: Kent Project Site plant compound limits

Plant Compound ID	Existing (LA90,T) Background Noise Level - dBA	LAr,T BS 4142 Target - dBA	Distance to NSRs (m)	Rating Level ($L_{Ar,T}$) Plant Limit 1m from Current Plant Compound Proposal - dBA
1	44	34	200	84
2	44	34	50	68
3	48	38	88	77
4	45	35	275	84
5	41	31	100	71

Assessment of Noise from External Events and Outdoor Gatherings of Crowds

15.4.52 The Code of Practice on Environmental Noise at Concerts (1995) provides useful guidance for developments which will have amplified external music that may affect nearby noise sensitive receptors.

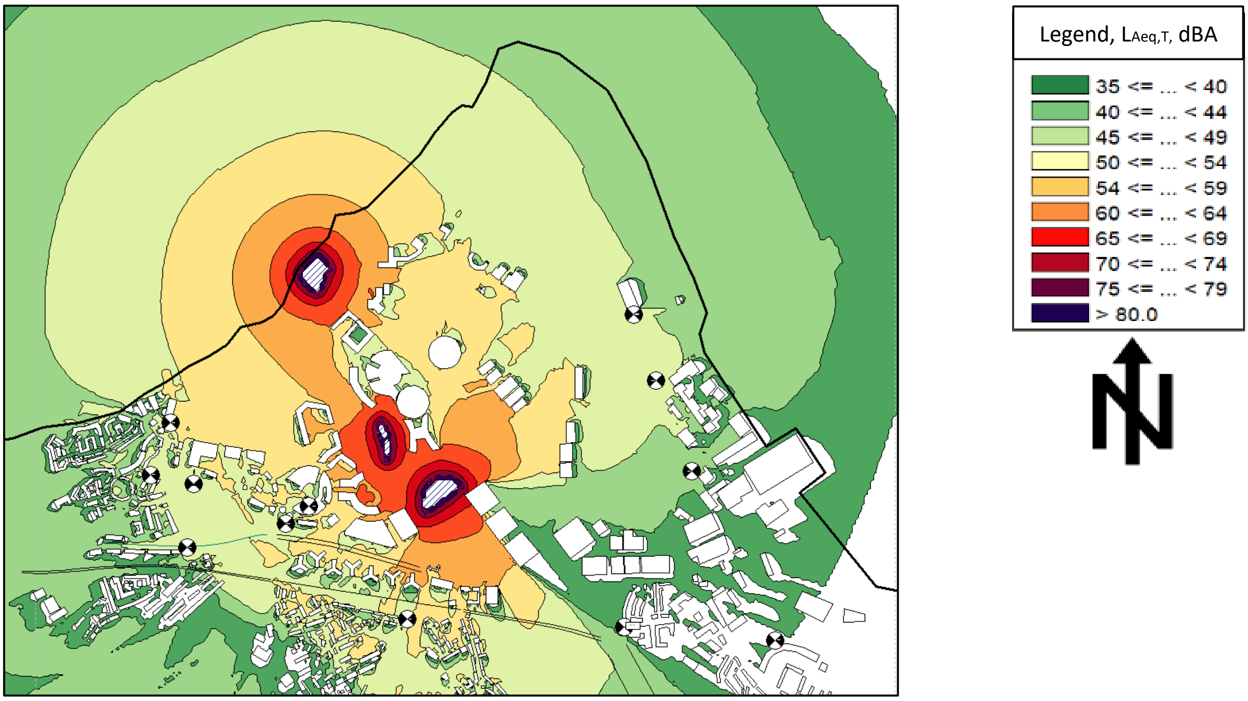
15.4.53 The most onerous criteria is provided for venues with 4 to 12 concert days per year. In this case *"The music noise level should not exceed the background noise level by more than 15 dB(A) over a 15-minute period".*

15.4.54 The entertainment performances and external loudspeaker applications in the London Resort are likely to require lower sound pressure levels than the large-scale concerts considered by the Code of Practice on Environmental Noise Concert. However, these events could be daily, therefore it is considered suitable to restrict the noise breakout from external events to more stringent levels than the guidance criteria.

15.4.55 It is more suitable to control the noise level from loudspeaker sound systems to levels below the existing ambient noise level at NSRs. This target should minimise potential annoyance or disturbance at nearby residential areas due to the external Resort events.

15.4.56 The diagram below contains an indicative analysis of the potential noise breakout due to external loudspeaker events within the London Resort pay line. The modelled area sources represent potential locations for entertainment as well as an external conference exhibition space near the Proposed Development's hotel accommodations.

Diagram 15.4.13: Calculated daytime (07:00-23:00) $L_{Aeq,t}$ dB(A) noise breakout from areas of potential external loudspeaker locations.



15.4.57 Diagram 15.4.13 shows suitable noise levels at NSR receptor locations, when operating external loudspeakers to attain 80 dBA at the border of the event space proposals (shows in the model).

15.4.58 $L_{Aeq,T}$ noise levels below 48 dBA are calculated within the model at the environmental noise survey locations 1, 2 and 3 (detailed in Appendix 15.1). As the lowest existing noise climate $L_{Aeq,T}$ was measured to be 53 dBA at monitoring location 1, Diagram 15.4.13 evidences external events can be held at the London Resort.

15.4.59 The model considers a worst-case noise breakout considering external event areas as omnidirectional sources with no stage shielding. Through acoustic design of the external event stages, controlling line array directivities and focusing loudspeakers away from NSR locations, noise levels at NSRs can be further reduced to maintain noise levels below the $L_{Aeq,T}$ environment recorded at the year of the event.

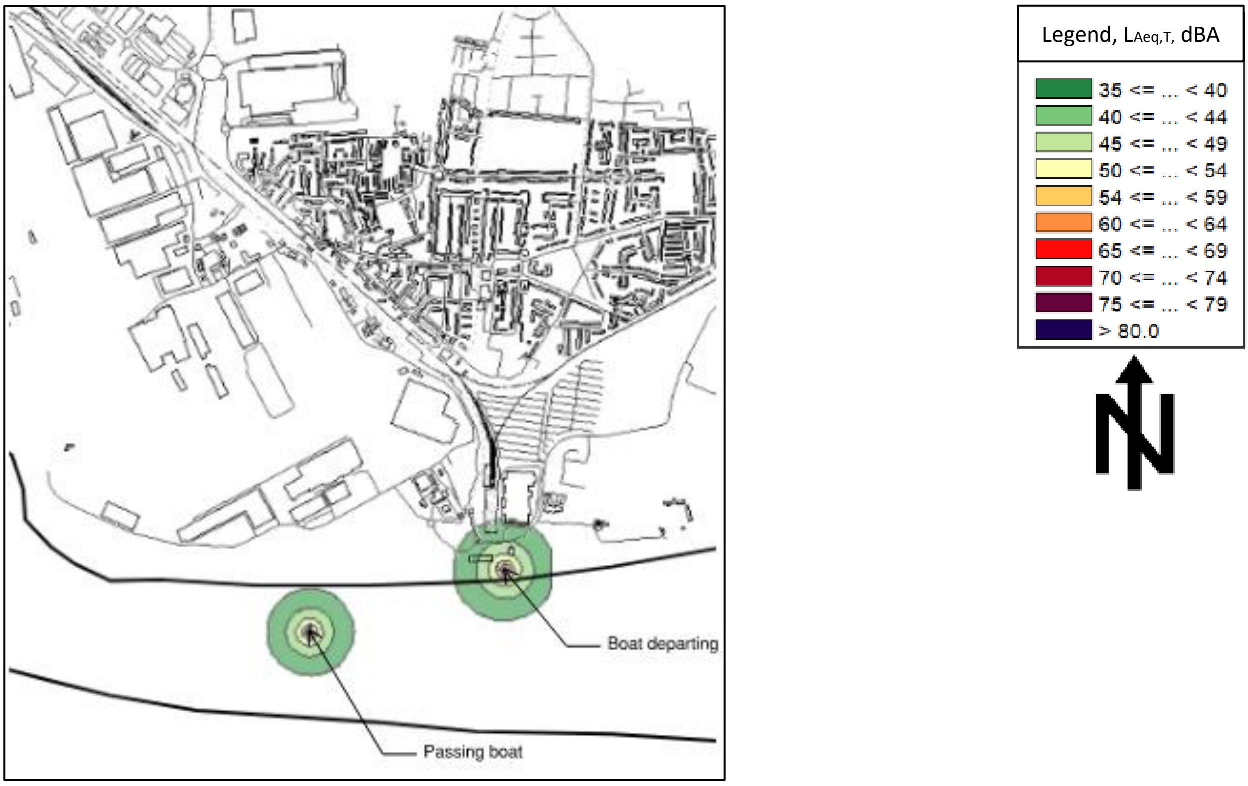
Assessment of Noise from the London Resort Passenger Ferry Service

15.4.60 The assessment compares the baseline ambient noise climate model (produced from measured noise level data as detailed in Appendix 15.1) and the predicted noise climate due to a passenger ferry.

15.4.61 For the Passenger Ferry services, the number of arrivals / departures at the pier during daytime (07:00-23:00) hours have been considered to be four per hour at peak time. Using this information, the $L_{Aeq,T}$ was calculated to give the total sound energy over the daytime period (07:00-2300). This then enables the noise levels from passing and departing passenger ferries to be compared against the sites existing noise climate as shown in Diagram 15.4.14 and Diagram 15.4.15.

Diagram 15.4.14. Acoustic Daytime (07:00-23:00) $L_{Aeq,T}$ dB(A) departing and passing boats predicted noise levels at the Kent Project Site

Diagram 15.4.15. Acoustic Daytime (07:00-23:00) $L_{Aeq,T}$ dB(A) Departing and passing boats predicted noise levels at the Essex Project Site



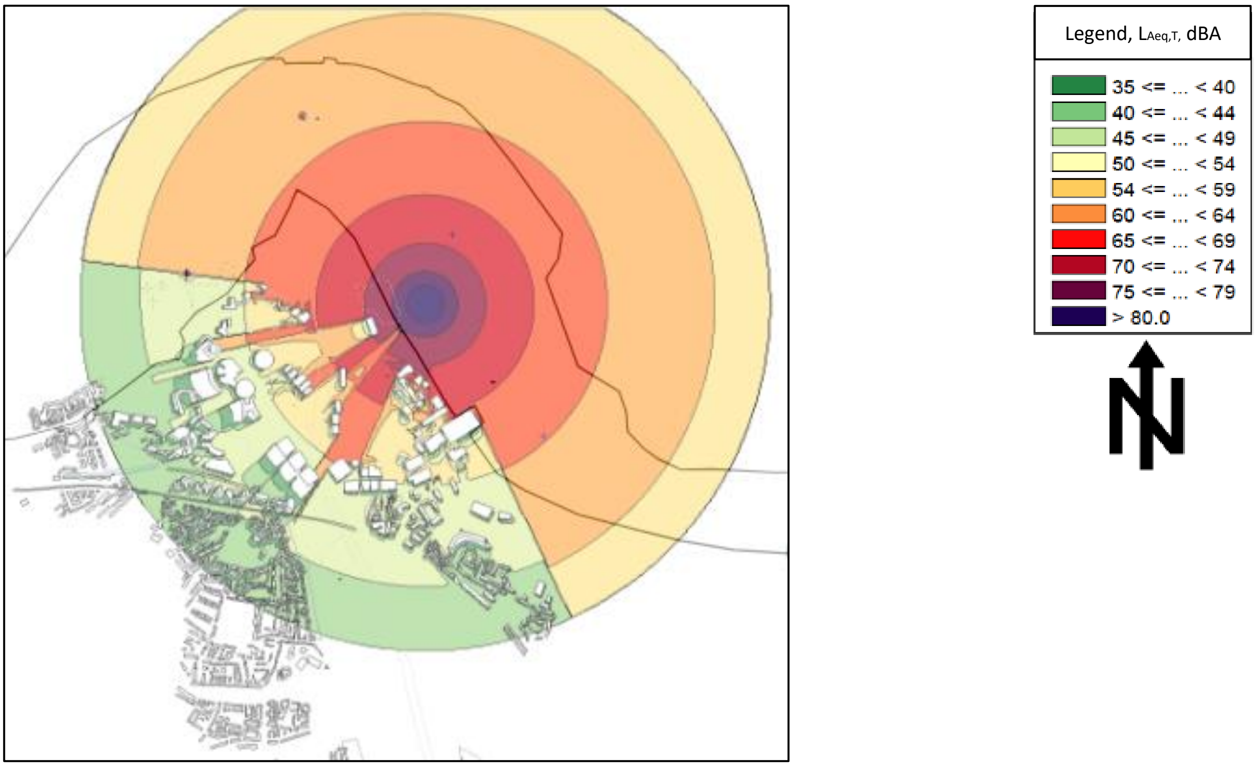
15.4.62 The acoustic models of the boats demonstrate that there should be no change in noise level at the Kent and Essex Project Sites or existing noise sensitive receptors. This is due to distance attenuation and other, higher, level noise sources at the Kent and Essex Project Sites effectively “masking” the noise from the boats at the pier. Overall, the noise climate is primarily associated with industrial noise and road traffic e.g. on Dartford Crossing.

Assessment of the Noise Impact of CEMEX Dredgers

15.4.63 The assessment evaluates how the operation of the existing dredger will affect the noise sensitive receptors within the limits of the Proposed Development.

15.4.64 The Proposed London Resort accommodation Developments are approximately 1200m from the Dredger position. As can be seen from Diagram 15.4.16, the Kent Project site is subject to moderate noise levels as a result of the dredger operation. .

Diagram 15.4.16. Acoustic Daytime (07:00-23:00) $L_{Aeq,T}$ dB(A) Dredger predicted noise levels at the Kent Project Site



15.4.65 The impact of the noise from the dredger operation is demonstrated in the model with the green (under $L_{Aeq,t}$ 40dB) and purple noise contours (maximum).

15.4.66 Whilst the acoustic noise model shows sound pressure levels at the eastern Kent Project Site boundary ranging from 61dB to 67dB. The hotels are predicted to experience levels up to 54 dB. The Proposed Development’s sensitive hotel and residential accommodation receptors benefit from the shielding provided by the attraction buildings to the north-east of the Kent Project Site.

15.4.67 It is considered likely that the low frequency noise from this operation will be a determining factor for the external glazing requirements of the residential London Resort NSRS.

Noise Impact and Limits for London Resort Helicopter Operations

15.4.68 The Proposed Development is required to incorporate a helicopter pad into the facility design with a primary purpose of providing life safety access for air ambulance landing events. Based on equivalent operations at Disneyland Paris the number of helicopter movements is expected to be limited to a maximum of eight per week, with 50% attributable to VIP / private transport methods.

15.4.69 Based on UK general aviation (although mostly fixed wing aircrafts) an $L_{Aeq,16hour}$ noise level of 54 dB(A) is considered to be the threshold of community annoyance due to aircraft movements. 63 dB(A) and 69 dB(A) $L_{Aeq,16hour}$ levels are respectively seen as the limits to moderate and high annoyance from aircraft movements. Adhering to the 54 dBA $L_{Aeq,16hour}$ level should reduce potential annoyance due to the use of the Resort Helicopter Pads at the nearby residential areas.

15.4.70 The European Union Aviation Safety Agency (EASA) publish a database of certified noise levels from rotary aircraft. Within the database, effective perceived noise levels (EPNdB's) provide a measure of relative noisiness from an aircraft, ranging from 80.2 to 100.4 EPNdB during take-off events. London Resort has been classified to be in a congested area based on the London Resort Helipad Evaluation (Issued by M Bowman, 5th October 2020. The twin-engine helicopters potentially landing at the Kent Project Site, are likely to produce noise levels with the EPNdB range above.

15.4.71 The stand-off distances (propagation distance for sound pressure decay below 35dB $L_{Aeq,T}$) for the different helicopter EPNdB levels were calculated to range from 0.2km (80EPNdB aircrafts) 1.2km (100EPNdB aircrafts).

15.4.72 To achieve the 54 dB(A) $L_{Aeq,16hour}$ threshold, the permissible number of helicopter take-offs within a 16-hour period is dependent on the types of helicopters entering the resort. In studying single event noise levels (SELs) from helicopter take-offs a 90 EPNdB helicopter would be limited to approximately 10 take-off events, whilst 30 take-off events would be permissible with the significantly Lower 80 EPNdB aircrafts.

15.4.73 Based on the expected number of flights per week and the daily 54 dB(A) $L_{Aeq,16hour}$ threshold for community annoyance. Landing events at the London Resort helicopter pad are not expected to create significant noise effects / annoyance at nearby residential areas.

CUMULATIVE EFFECT ASSESSMENT

15.4.74 A shortlist of schemes have been considered for the cumulative assessment. These are either those where traffic flows interact with the London Development being:

- Scheme 3. Lower Thames Crossing; and,
- Scheme 10. A2 Bean & Ebbsfleet Junction Improvement Works.

15.4.75 They are also chosen as those developments within sufficiently close proximity (taken to be 800 m distance from the London Resort site boundary where there is clear line of sight to noise sensitive receptors falling to 200m where the noise path is screened by topography or buildings) to consider the cumulative impact of either construction noise (and vibration) or the noise from fixed plant being:

- Scheme 9. Eastern Quarry, Swanscombe;
- Scheme 17. The Pier;
- Scheme 18, 19. Land West of Springfield Road;
- Scheme 29. Canning Town Area 8;
- Scheme 42. Land off Tillman Avenue;

15.4.76 They are also chosen as those within sufficiently close proximity likely to emit industrial noise being:

- Scheme 43. Bulk Aggregates impact terminal.

Demolition and Construction

15.4.77 Whilst it is not practical to undertake a quantitative assessment of the cumulative noise and vibration effects on this number of cumulative schemes, it is likely that cumulative noise and vibration levels will have an adverse effect. However, this is reliant on the location of the receptors relative to the Project Site and other developments.

15.4.78 It is not unusual for demolition and construction activities to take place on more than one development site in proximity to each other and the contractor(s) for the London Resort site should undertake regular liaison meetings and reviews with neighbouring sites to plan works so that they do not cause unnecessary disruption.

15.4.79 Additional noise impacts at the identified receptors may occur if demolition and construction activities take place simultaneously. The cumulative impact will be dependent on the exact activities taking place at each location; however, the introduction of site hoardings and compliance with the mitigation measures detailed in Appendix 15.3 will reduce these impacts as far as possible assuming that the other schemes will also incorporate best available mitigation measures during their demolition and construction phases.

15.4.80 Detailed assessments of construction noise are not available for all the cumulative schemes. Therefore, it is not possible to undertake a quantitative assessment of the cumulative noise impact. However, the close proximity of Schemes 9, 17, 18 & 19, 42 to receptors already deemed to be sensitive to noise from the construction of the London Resort means that cumulative effects are likely to occur at some of the construction phases of London Resort: particularly Gate 2 construction for Schemes 17,42 and the construction of the Access Road for Schemes 9, 18 & 19.

Fixed Plant Noise

15.4.81 Cumulative noise from fixed plant and equipment during the operational stage of these developments should follow the legislative requirements for fixed plant. It is assumed that the design of fixed plant and equipment at the developments mentioned above will follow the prevailing local authority policies as well, resulting in an overall negligible effect on the nearby receptors.

Industrial Noise

15.4.82 The Bulk Aggregates Import Terminal in Scheme 43 will have a temporal noise profile that is reliant on the tides. Therefore, its noise impact will vary depending on the time of day (or night) that vessels are unloaded, and the terminal operators will need an operational noise plan to take this into account. The movement of material from the Bulk Aggregates site by road will have additional impact. Good operational management by Bulk Aggregate employees will be required, routing vehicles out of the local area through a range of routes rather than one.

Road Traffic Noise

15.4.83 Intensification of traffic on local roads due to the cumulative effect of the London Resort, Scheme 3 and Scheme 10 will cause an increase in noise at noise sensitive receptors above the significance threshold of + 1dB.