Noise Disturbance – Baseline Noise Level Monitoring in the Solent

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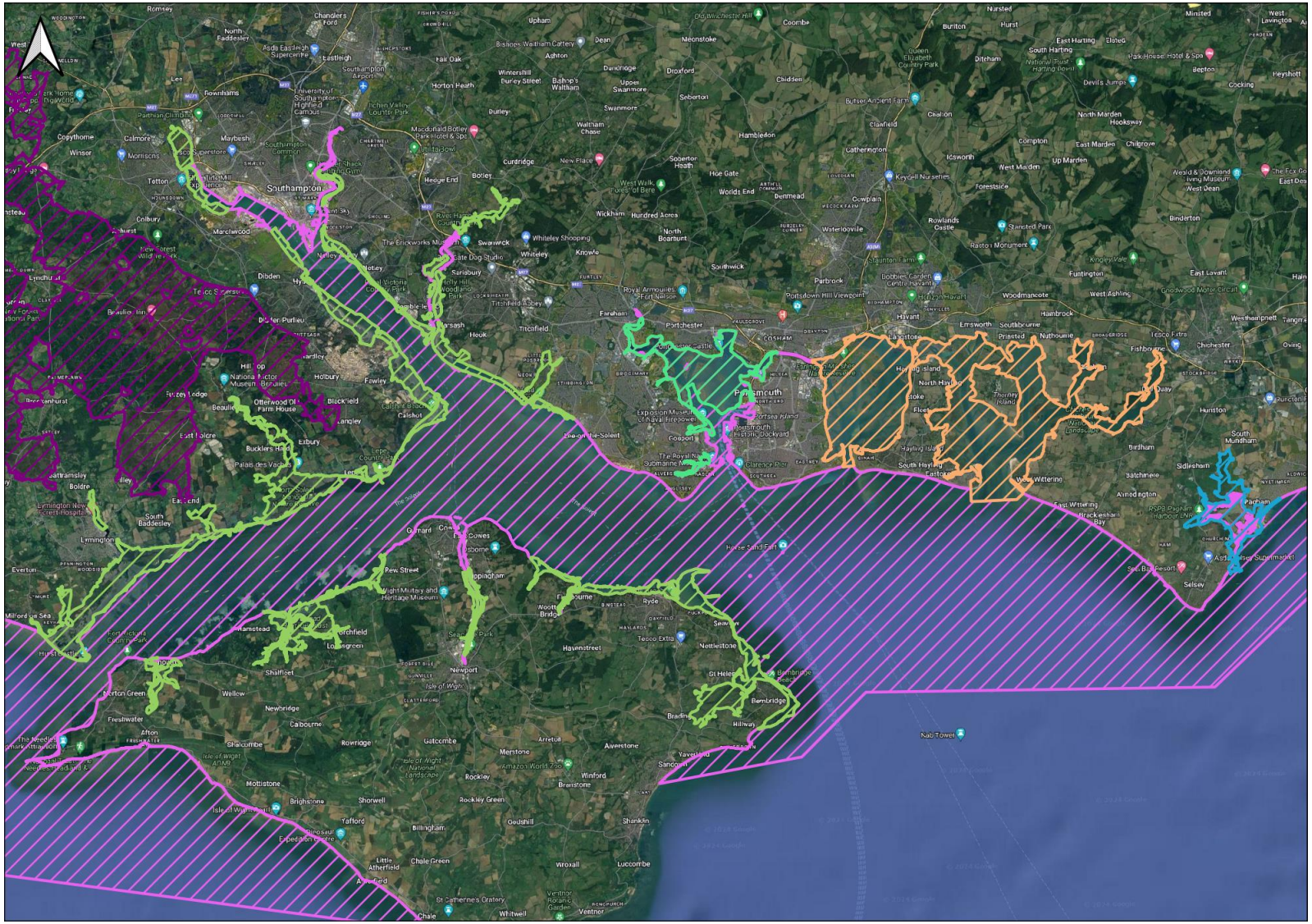
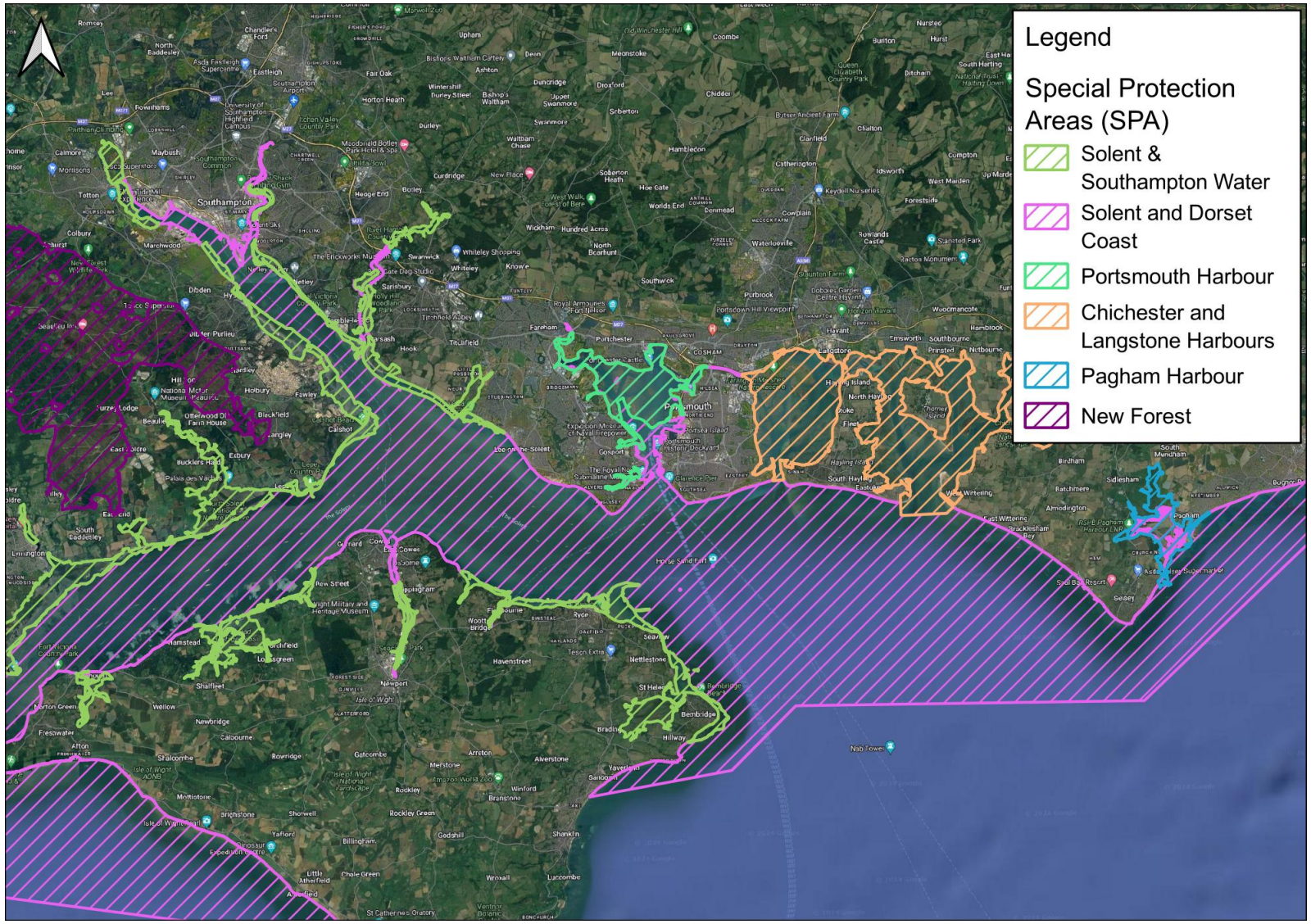
(Tetra Tech)

This project was commissioned and funded by Natural England



Background

- The Solent coastline hosts thriving harbours, ports and other coastal industry
- High volume of activity interacting with the marine environment in the area
- Noise causing disturbance and displacement of birds within the Special Protection Area (SPA)



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Special Protection Areas (SP

Special Protection Areas (SPAs) are protected areas for birds in the UK classified under[1]:

- the Conservation of Habitats and Species Regulations 2017 in England and Wales and to a limited extent in Scotland and Northern Ireland
- the Conservation (Natural Habitats &c.) Regulations 1994 in Scotland
- the Conservation (Natural Habitats &c.) Regulations 1995 in Northern Ireland
- the Conservation of Offshore Marine Habitats and Species Regulations 2017 in the UK offshore area

SPA	Overwintering Period	
	Breeding birds	Non-breeding birds
Solent and Southampton Water SPA	• Common tern • Little tern • Mediterranean gull • Roseate tern • Sandwich tern	• Black-tailed godwit • Dark-bellied brent goose • Ringed Plover • Teal • Waterbird assemblage
Solent and Dorset Coast SPA	• Common tern • Little tern • Sandwich tern	
Portsmouth Harbour SPA		• Black-tailed godwit • Dark-bellied brent goose • Dunlin • Red-breasted merganser
Chichester and Langstone Harbours SPA	• Common tern • Little tern • Sandwich tern	• Bar-tailed godwit • Curlew • Dark-bellied brent goose • Dunlin • Grey plover • Pintail • Red-breasted merganser • Redshank • Ringed plover • Sanderling • Shelduck • Shoveler • Teal • Turnstone • Waterbird assemblage • Wigeon

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Background

- Disturbance from anthropogenic noise in the areas coul reduce time spent in feeding or breeding areas
- Lack of data on what background noise levels are in the area makes it difficult to assess the risk of an activity disturbing birds through the introduction of above water noise
- The objective of the project is to provide data on background noise levels in order to more accurately determine the likely significant effect on birds when responding to anthropogenic noise
- This was done through noise monitoring in key areas across SPA sites in the Solent

October 2023 9Emsworth

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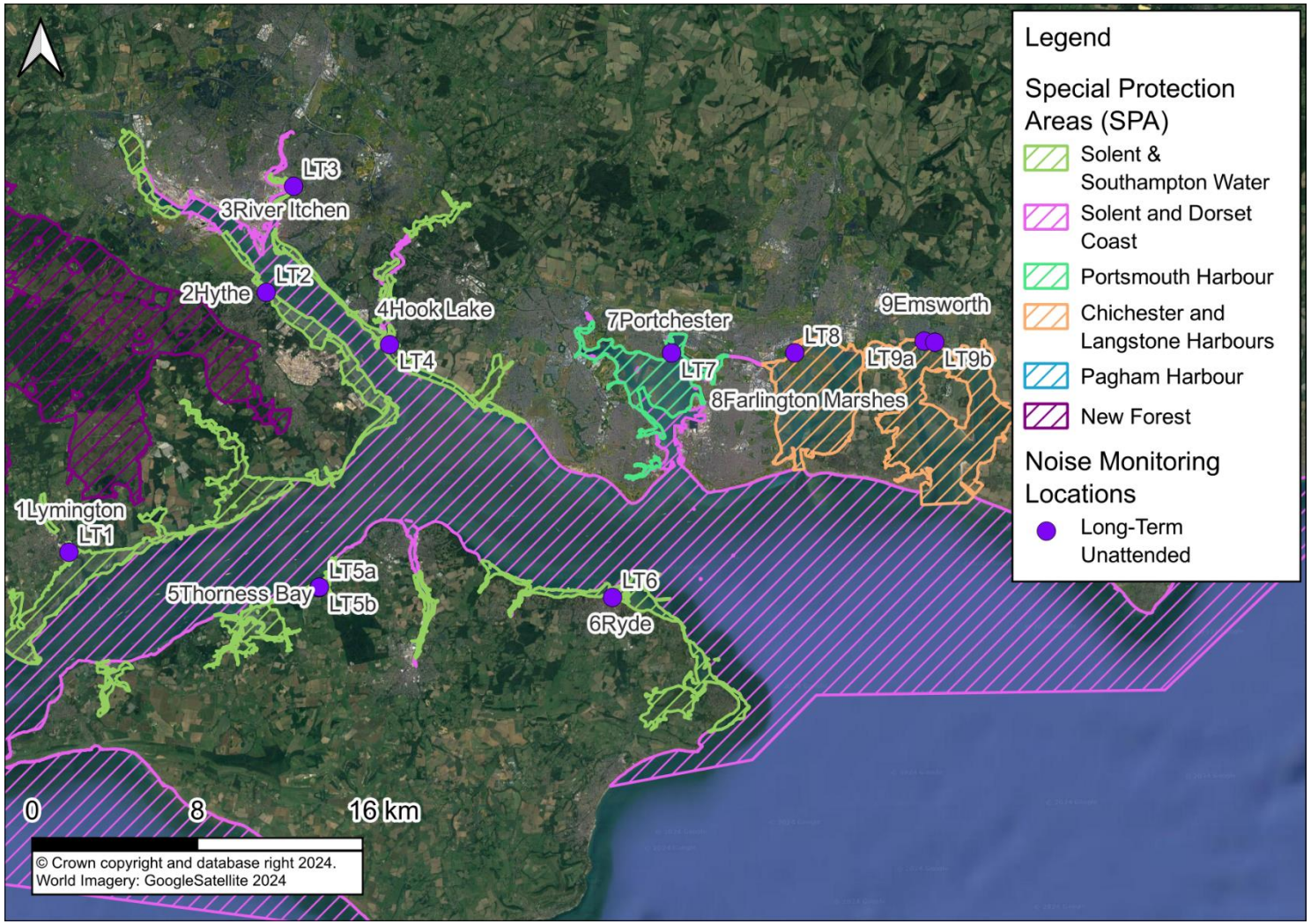
Long-term Baseline Noise Monitoring

- Nine areas of the Solent with high activity have been chosen as representative of the Solent for monitoring
- These areas are hotspots for anthropogenic activity and cross over with key areas of designated SPAs



Unattended monitoring undertaken from October 2023 to February 2024 with 1 week monitoring period per month

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Short-term Noise Monitoring

- Attended daytime short-term (2 hours) undertaken each month to coincide with long-term monitoring
- Bird count and species ID within an approximate range of 500m undertaken during the observation period
- Bird responses due to noise events observed were recorded (location of bird and noise source, time, noise source, type of response)

October 2023 4Hook Lake

0 – no response

1 – freeze/stress response

2 – staying at site but moving away from noise

3 – flight response with settlement within 100m

4 – flight response with settlement beyond 100m

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Short-term Noise Monitoring

October 2023 1Lymington

October 2023 2Hythe

October 2023 3River Itchen

October 2023 4Hook Lake

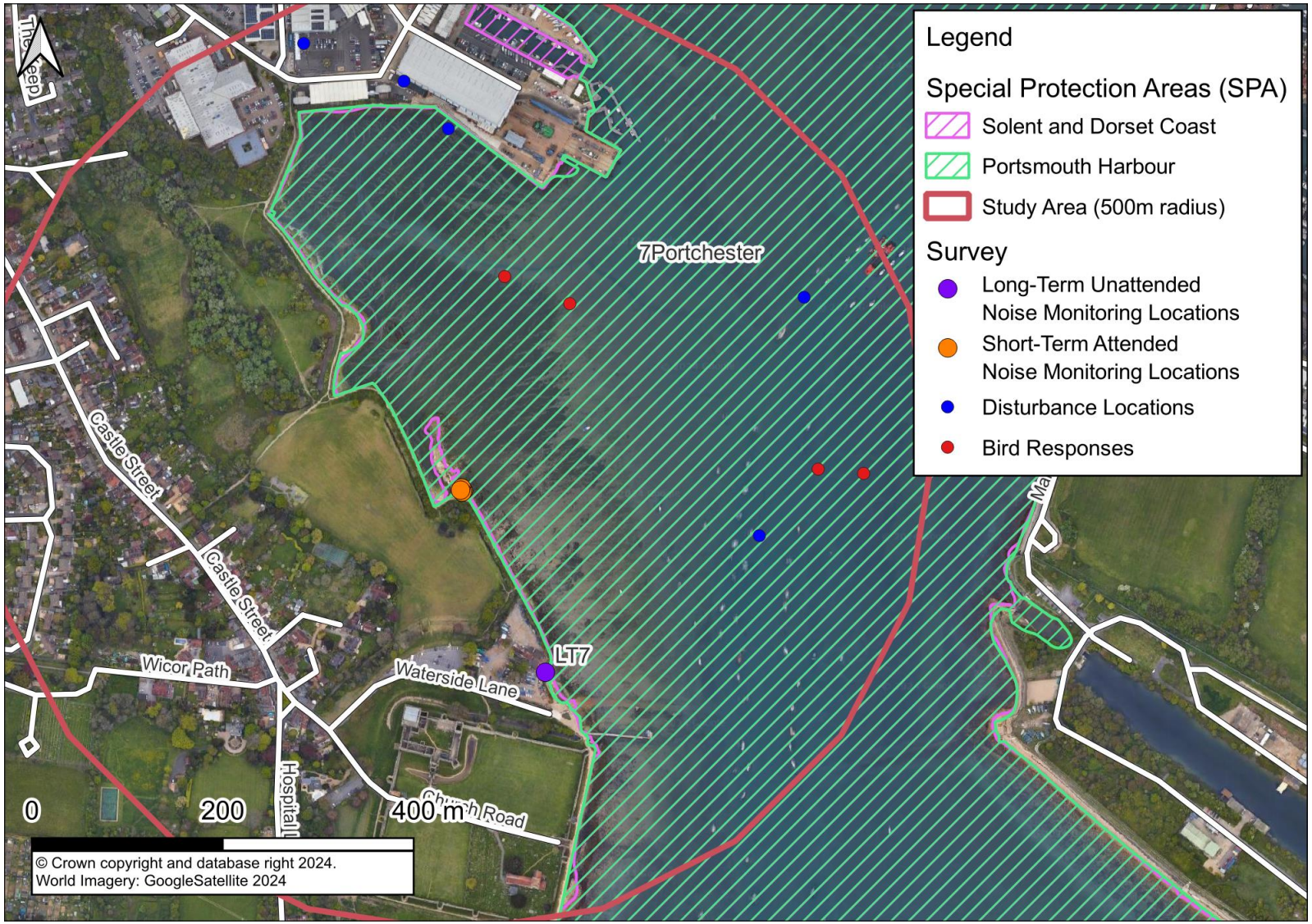
October 2023 7Portchester

Short-term Noise Monitoring

- For any bird responses recorded, the sound pressure level at the bird location was estimated using the inverse square law

$$L_{bird} = L_{meter} - 20 \log_{10} (r_{bird}/r_{meter})$$

- Similarly for the instantaneous noise level L_{AFmax}



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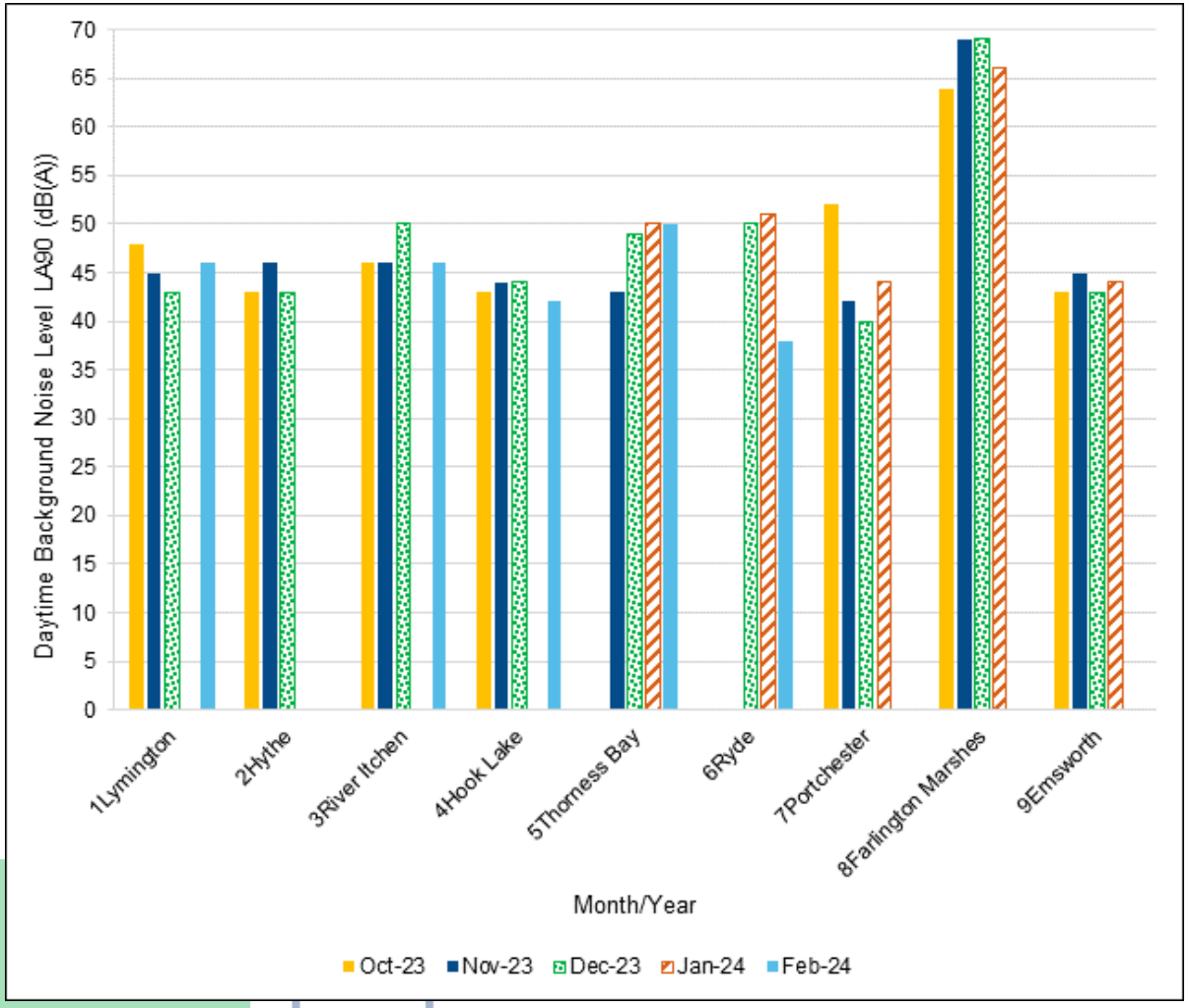
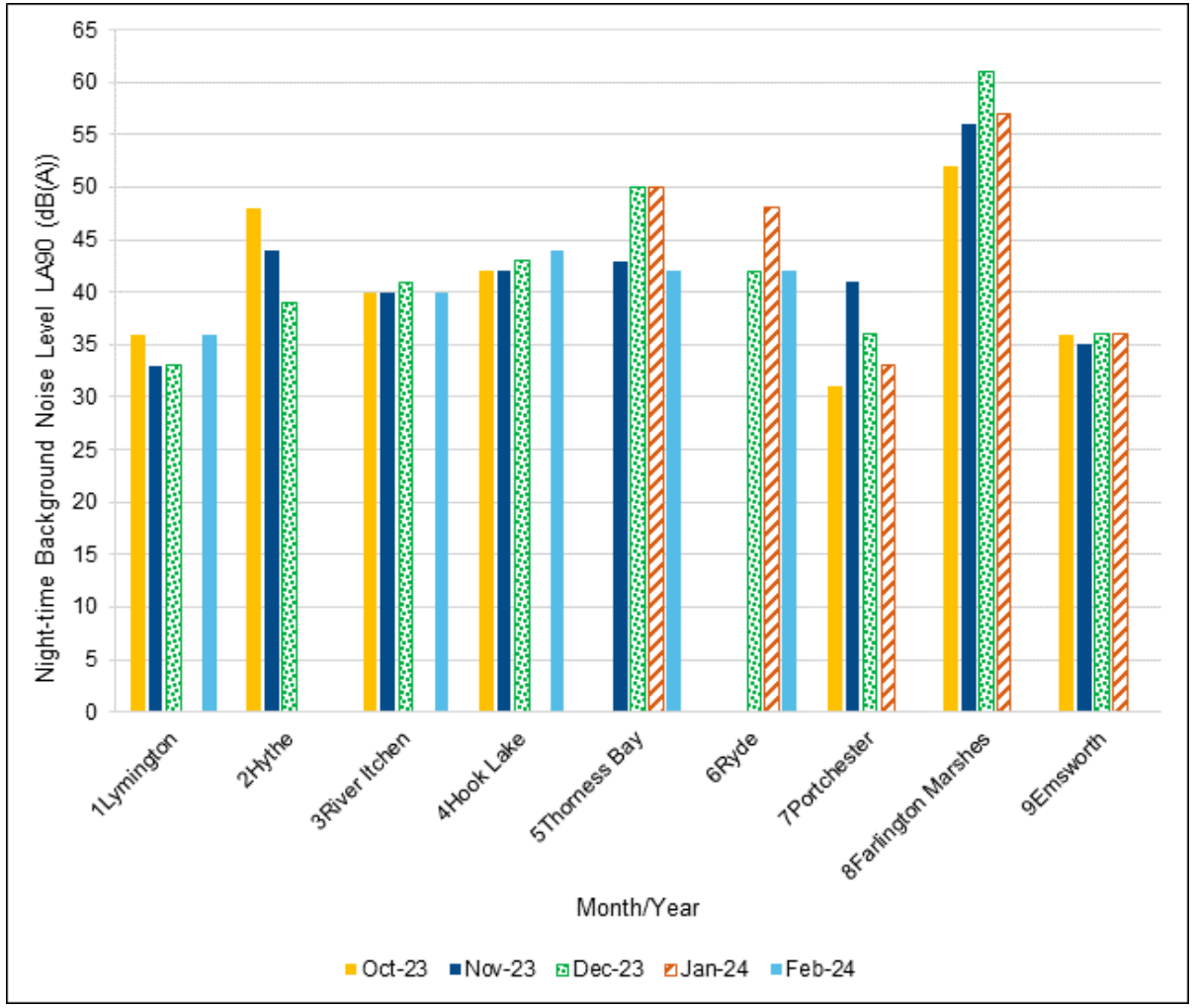
Results – Background Noise Levels

Daytime (07:00 – 23:00)



Night-time (07:00 – 23:00)



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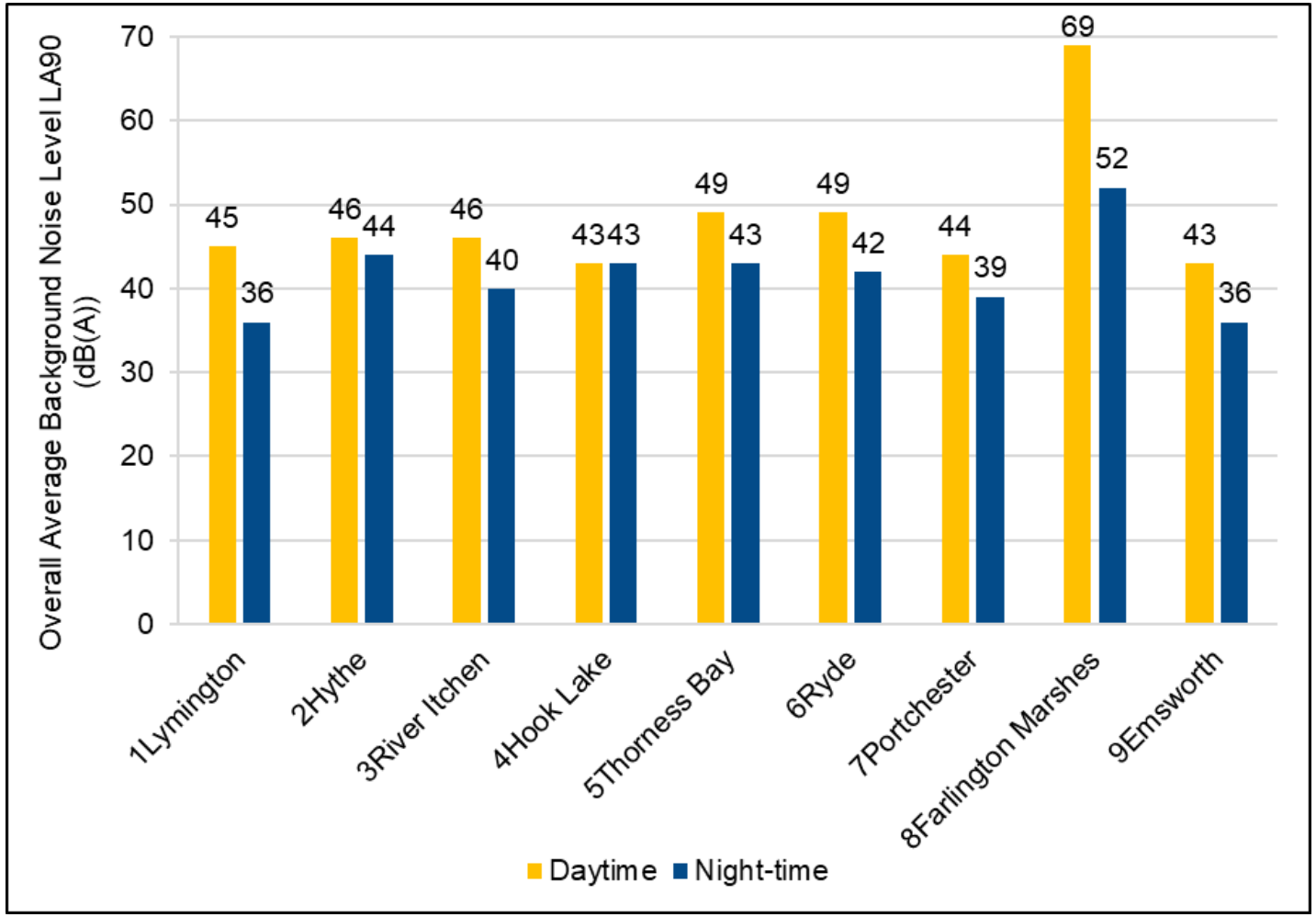
Results – Background Noise Levels

Overall average background noise level L_{A90}



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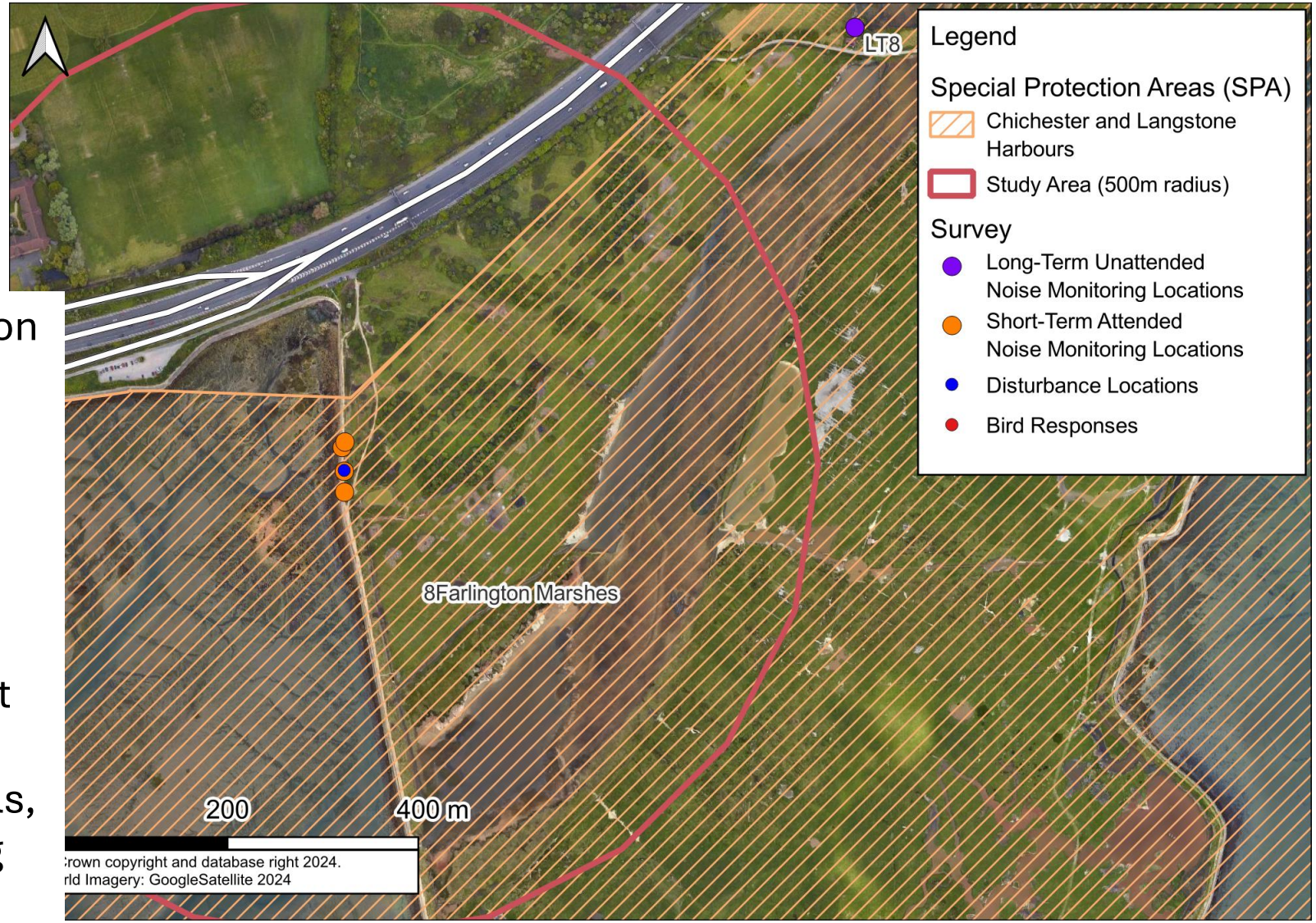
Discussion – Background Noise Levels

- The long-term noise monitoring location 8 Farlington is approximately 120m south of the major road, A27
- Noise contribution from road traffic is highly likely to be the reason for the higher background noise levels measured at this location
- Other monitoring locations are at least 500m from any major, noisy roads
- Despite higher background noise levels, at least 29 bird species, both breeding and non-breeding, were observed at location 8



Further and/or longer monitoring is likely required to determine if the birds are affected by the anthropogenic noise in the area at location 8.

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Results – Bird Responses

- 20 bird responses were observed from 11 bird species out of 51 species observed

Brent Goose.
From: Steve Young (www.birdsonfilm.com)

Bird species	Number of events responded to
Coot	1
Curlew	1
Grey Heron	1
Herring Gull	1
Mute Swan	1
Black Headed Gull	3
Dunlin	1
Brent Goose	8
Redshank	1
Turnstone	1
Oystercatcher	1

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Results – Bird Responses

- Audible and visible
- Audible but not visible

Location	Nature of disturbance	SPL at bird location (dBA)	Background Noise Level (dBA)	Type of response
2 Hythe	• Loud horn	67.5	46.0	4 - Flight response with settlement beyond 100m
3 River Itchen	• Airplane passing overhead	76.5	46.0	1 - Freeze/stress response
	• Train passing	73.1		3 - Flight response with settlement within 100m
6 Ryde	• Hovercrafts	73.1 – 85.4	49.0	3/4 - Flight response with settlement within and beyond 100m
7 Portchester	• Boat leaving harbour	58.3 – 68.9	44.0	3/4 - Flight response with settlement within and beyond 100m
	• Metal works	65.7		4 - Flight response with settlement beyond 100m
9 Emsworth	• People walking into the beach	46.9 – 54.3	43.0	3/4 - Flight response with settlement within and beyond 100m
	• Small motorboat in the channel	67.6		3 - Flight response with settlement within 100m
	• Airplane passing overhead	52.0		1 - Freeze/stress response

Location	Number observed	Bird species	% of birds which showed a response from the species	Noise event
6 Ryde	75	Brent Goose	20%	Hovercraft
	65		17%	Hovercraft
	40		38%	Hovercraft
	5		8%	Hovercraft
	9		15%	Hovercraft
	35		60%	Hovercraft
7 Portchester	200		91%	Boat leaving the harbour
9 Emsworth	3		1%	Small motorboat in the channel
6 Ryde	2	Black Headed Gull	3%	Hovercraft
7 Portchester	2		66%	Boat leaving the harbour
9 Emsworth	22		23%	People walking into the beach
7 Portchester	75	Turnstone	75%	Boat leaving the harbour
7 Portchester	1	Curlew	33%	Metal works
9 Emsworth	6	Redshank	15%	People walking into the beach
9 Emsworth	8	Oystercatcher	57%	People walking into the beach
9 Emsworth	2	Dunlin	4%	People walking into the beach
9 Emsworth	1	Coot	11%	Airplane passing overhead
2 Hythe	1	Herring Gull	25%	Loud horn
3 River Itchen	1	Mute Swan	5%	Airplane passing overhead
3 River Itchen	1	Grey Heron	100%	Train passing

Thresholds for Bird Responses	Our Findings	Other Literature
Background noise levels		

Discussion – Bird Responses: Frequency Specific

The effects of highway and urban noise on birds by R. J. Dooling et al. (2019)

Anthropogenic noise can affect birds' abilities to detect prey, assess their acoustic environments and communicate with other birds

If there is enough energy in the bird's region of **best** hearing or dominant frequency, the noise can have a significant impact on how well the birds can hear their species-specific vocalisations

Therefore, may cause behavioural and/or physiological responses from the birds

Most bird vocalisations are in the range of 2 kHz to 9 kHz

A study by Rheindt (2003) which consisted of population assessments in an oak-beech forest close to a motorway

Concluded that bird species with higher-pitched vocalisations or songs with dominant frequencies well above the typical frequencies of traffic noise (up to 1 kHz) were **less susceptible** to noise pollution

Discussion – Bird Responses: Frequency Specific

				Leq (dB)																															
Location	Species	% Disturbed*	Noise Event	12.5 Hz	16 Hz	20 Hz	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz	12.5 kHz	16 kHz	20 kHz
LT6	75 BG	20%	Hovercraft	59	59	56	57	58	56	56	57	56	53	50	54	56	50	51	53	53	54	54	53	53	52	49	47	46	45	43	41	37	34	28	21	12
LT6	65 BG	17%	Hovercraft	74	75	71	68	67	65	66	63	70	75	67	69	69	65	66	64	62	60	62	60	59	57	55	53	51	49	47	45	42	39	36	30	22
LT6	40 BG	38%	Hovercraft	60	64	62	63	69	67	63	66	69	62	67	69	70	69	72	68	66	65	63	59	55	55	54	52	49	47	44	43	39	34	31	26	18
LT6	5 BG	8%	Hovercraft	57	62	63	62	60	59	66	73	58	58	63	65	64	62	58	59	59	59	58	57	56	56	55	53	51	50	48	46	44	42	39	35	27
LT6	9 BG	15%	Hovercraft	77	74	68	69	69	71	68	69	71	75	70	72	71	69	74	69	65	63	60	61	58	56	56	56	52	49	45	41	38	36	32	28	20
LT6	35 BG	60%	Hovercraft	77	74	68	69	69	71	68	69	71	75	70	72	71	69	74	69	65	63	60	61	58	56	56	56	52	49	45	41	38	36	32	28	20
LT7	200 BG	91%	Boat leaving the harbour and noise from the industrial estate	47	49	45	46	49	49	48	51	50	53	50	47	44	44	44	48	50	50	50	50	51	54	53	52	54	49	45	37	25	18	15	12	8
LT9b	3 BG	1%	Small motor boat in the channel	50	55	52	54	53	54	61	56	56	53	51	50	44	44	45	43	39	41	41	40	36	32	27	22	16	13	12	13	10	9	10	8	6
LT6	2 BH	3%	Hovercraft	76	73	73	71	74	70	70	68	70	73	68	69	72	68	67	62	59	57	57	59	56	55	53	52	50	48	46	44	42	39	36	32	25
LT7	2 BH	66%	Boat leaving the harbour	45	53	48	50	55	61	58	51	53	50	48	50	47	42	41	41	41	41	41	38	35	28	25	21	17	12	9	8	8	9	9	8	6
LT9a	22 BH	23%	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT7	75 TT	75%	Boat leaving the harbour and noise from the industrial estate	47	49	45	46	49	49	48	51	50	53	50	47	44	44	44	48	50	50	50	50	51	54	53	52	54	49	45	37	25	18	15	12	8
LT7	1 CU	33%	Metal works	43	47	43	50	52	57	53	59	59	51	49	48	45	51	53	50	51	53	51	54	53	51	48	47	48	42	35	26	21	18	16	12	8
LT9a	6 RK	15%	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT9a	8 OC	57%	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT9a	2 DN	4%	People walking into the beach	63	53	54	56	55	53	46	45	43	43	40	35	34	33	31	31	32	33	34	35	33	31	29	26	22	20	18	16	14	12	11	9	7
LT9b	1 CO	11%	Airplane passing overhead	47	50	51	48	48	50	47	61	66	45	45	49	55	50	49	43	42	39	41	41	41	39	35	32	28	26	26	24	23	19	17	13	9
LT2	1 HG	25%	Loud horn from yard	51	46	47	51	53	54	51	50	49	49	51	52	45	53	51	52	50	52	48	49	47	44	37	35	31	26	19	16	14	14	11	9	6
LT3	1 MS	5%	Airplane passing overhead	61	59	61	62	65	62	61	59	56	61	68	70	68	61	69	64	66	64	62	65	64	63	65	66	70	62	59	64	48	34	21	13	8
LT3	1 H.	100%	Train passing	49	54	51	54	55	52	55	53	52	50	46	43	41	41	42	41	41	42	42	44	43	42	41	40	39	38	36	34	32	30	27	23	15

- it is unlikely that these bird responses were caused by any specific frequencies
- particularly as most bird vocalisations, and their dominant frequencies, are in the much higher frequency range

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Conclusions

- Typically, the daytime background noise levels $L_{A90,daytime}$ range between 43 dB to 49 dB at all monitoring locations
- With the exception of location 8 Farlington Marshes within the area of Chichester and Langstone Harbours SPA – where the daytime background noise level is 69 dB due to the location's proximity to a major road
- Birds are more likely to respond to noise disturbance when the sound pressure levels at the location of the birds are at least 20 dB above the typical background noise level
- However, the visual nature of any noise disturbance is also likely to cause responses from the birds
- The findings of this study will help to determine the impacts of anthropogenic noise on overwintering birds in the Solent; a key challenge given the national and international significance of these populations

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Recommendations for Future Studies

- A longer period of monitoring, both unattended long-term for background noise as well as attended short-term, is recommended to monitor any changes in background noise levels due to changing seasons (and therefore activities such as tourism) in order to provide a clearer conclusion to this study
- For Location 8 Farlington – longer monitoring and/or a different monitoring location which is further from the major road A27 may be beneficial to understand if birds in the area respond to noise disturbance in a similar way to the other locations within the Solent
- The species-specific vocalisations found in the SPA could be compared to the same species in other varied areas to determine if changes in the dominant frequencies have occurred as was shown in a study of nine tropical bird species in Brazil conducted by Tolentino et al. in 2018
- A study on visual disturbance may also be beneficial to understand the impact of human activities on the behaviour and responses from the SPA bird features, particularly during the hotter months where there is likely to be a higher level of tourism

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