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Portland Energy Recovery Facility

Assessment of the effect of the operation of a proposed waste incinerator on the sound character and tranquillity at Portland

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PROOF

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7th November 2023

1.0 Preamble, Qualifications and Experience

1.1 This proof has been written by me, Clive Frederick Bentley. I am an Acoustic Consultant and Partner at Sharps Acoustics LLP (SAL), a specialist acoustic consultancy with offices in Ipswich, Oxfordshire, and Cheltenham.

1.2 I hold two Bachelor of Science (Honours) degrees: one in Combined Studies in Science and one in Environmental Health; and a Diploma in Acoustics and Noise Control. I am a Member of the Institute of Acoustics, a Member of the Chartered Institute of Environmental Health, and a Member of the Institute of Environmental Science. I am also a Chartered Environmentalist and a Chartered Scientist.

1.3 I was employed at SAL position in March 2021 and became a Partner in January 2022. Prior to that I worked as an acoustic consultant at Sharps Redmore Partnership between January 2006 and February 2021. During that time, I was the project lead for nine years for the team providing acoustics input for the Sizewell C Power Station project and I also led a team within the company which produced environmental noise and vibration assessments for other projects.

1.4 Prior to 2006, I was a Senior Environmental Health Officer for Ipswich Borough Council, where I was responsible for the day to day running of the noise control team in the Environmental Protection Service. I worked in the Environmental Protection service at this Council continuously from 1992, investigating complaints of statutory nuisance and taking enforcement action in relation to them and advising on noise issues relating to planning matters.

1.5 I specialise in environmental noise and routinely deal with noise control in relation to planning (residential, commercial, industrial, and mixed-use applications), licensed premises, noise nuisance, road traffic noise, shooting noise, wind turbines and construction noise. I have considerable experience as an expert witness (at planning appeals, licensing hearings and court work), and routinely produce technical noise assessment reports and Environmental Statements.

1.6 I peer review the work of other consultancies; provide support and training for junior members of staff and from time to time carry out interviews for candidates seeking Chartered Environmentalist status with the Institution of Environmental Sciences. I also have specialist knowledge of noise effects on bats and co-authored a paper on this for "In Practice", the Bulletin of the Chartered Institute of Ecology and Environmental Management in 2020. I invented the Natural Tranquillity Method (United Kingdom Patent Number: 2582058, Acoustic Methods and Systems); which enables the assessment of the tranquillity found in outdoor spaces (and how this would be affected by proposed developments). I am the author of "Tranquil Spaces", a book which contains details and applications of this method.

1.7 I confirm that the content of my proof of evidence, which I have prepared and provide to this inquiry, is true and has been prepared and given in accordance with the guidance of my professional Institution and Institute. I confirm that the opinions expressed are my true and professional opinions.

2.0 Proof

2.1 I have been instructed by Stop Portland Waste Incinerator (SPWI) to provide an acoustic assessment of the change in sound character and the effect on tranquillity on the Isle of Portland as a result of the operation of a proposed Energy Recovery Facility (ERF) (an industrial scale waste incinerator).

2.2 I was asked to consider a study area comprising:

- the Royal Naval Cemetery;
- on the footpath which heads south from the cemetery before stopping at a gate to Port owned land (path number S3/72); and
- on the permissive footpath which is proposed to be opened as a result of the ERF further south which would join path S3/72 to the path to the south (path number s3/81) .

2.3 I have carried out this assessment and produced a report which sets out details relevant policy requirements; details of site survey work which I carried out; the methodology which I used; and my findings and conclusions dated 6th November which I append to this proof.

2.4 I carried out all work for this assessment myself, other than the noise prediction modelling work which was carried out my Ian Sharps MIOA, a Partner at Sharps Acoustics who specialises in noise modelling. The modelling work was carried out under my supervision.

2.5 I found that there would be a loss of tranquillity within the study area as a result of the operation of the proposed incinerator. The degree of this loss would depend on whether one considers the it against the baseline conditions when the port below the study area is busy (and noisy) or whether it is not busy and on where within the study area one is situated. The changes in tranquillity experienced across the study area under different port operational modes is probably best illustrated in Figures A4, A5, A6 and A7 in my report.

2.6 Specifically, I found that the sound emitted from the proposed ERF would result in:

- A negligible effect on tranquillity at the northern end of the path and in the Royal Naval Cemetery, mainly due to the presence of existing sounds from the port in these locations.
- a significant loss of tranquillity along the southern parts of path S3/72 and a small but potentially important loss (a reduction from "excellent" to "good" tranquillity) at the northern end of footpath S3/81.
- users of the proposed permissive path not experiencing the excellent tranquillity which would otherwise be present for much of its length.

2.7 The question of whether these paths may be prized for their recreation and amenity value due to their tranquillity is not something I am qualified to comment on. However, in my opinion, there would be a clear and perceptible loss of tranquillity in the study area due to the proposed operation of the incinerator, especially during periods when there is less activity at the port.

Appendix to proof: Tranquillity assessment report of 6th November 2023

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Portland Energy Recovery Facility

Assessment of the effect of the operation of a proposed waste incinerator on the sound character and tranquillity at Portland

REPORT

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6th November 2023

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1.0 Introduction

1.1 Sharps Acoustics LLP (SAL) has been commissioned by Stop Portland Waste Incinerator (SPWI) to provide an acoustic assessment of the change in sound character and the effect on tranquillity on the Isle of Portland as a result of the operation of a proposed Energy Recovery Facility (ERF) (an industrial scale waste incinerator).

1.2 SPWI raised a concern that the noise from the proposed ERF would have an adverse effect on the tranquillity currently experienced at:

- the Royal Naval Cemetery;
- on the footpath which heads south from the cemetery before stopping at a gate to Port owned land (path number s3/72); and
- on the permissive footpath which is proposed to be opened as a result of the ERF further south which would join path s3/72 to the path to the south (path number s3/81) .

1.3 SAL understand that these areas are used (or, in the case of the proposed path, are intended to be used) for recreational activity.

1.4 These three locations are marked on Figure A1 in Appendix A. In order to assess the tranquillity in these areas, survey work was carried out (as discussed in detail in Section 3.0 below) at five locations, as shown in Figure A2 in Appendix A. One location was within the Royal Naval Cemetery, three were on path S3/72 and the fifth was on path S3/81.

1.5 This report provides details of the work carried out to evaluate the differences in noise level predicted to arise as a result of the operation of the ERF and considers what effect this would have on the likely perception of tranquillity of people who use it.

1.6 Section 2.0 provides an overview of planning and noise policy relating to sound character and tranquillity and sets out details of the way in which tranquillity has been assessed for this study: the Natural Tranquillity Method (NTM).

1.7 A survey of existing noise levels and sound character was carried out in October 2023. Details of this survey are presented in Section 3.0.

1.8 The prediction of likely noise levels from the proposed ERF were made using 3D noise modelling software based on source levels and descriptions provided in the noise assessment report carried out for the ERF by the applicant. Details of how the modelling was carried out and input parameters are provided in Section 4.0.

1.9 The predicted noise levels and the resultant effects on tranquillity are presented in Section 5.0.

1.10 The tranquillity scores are interpreted and conclusions are presented in Section 6.0.

2.0 Methodology for the Assessment of Tranquillity

What is tranquillity?

2.1 The Oxford English Dictionary defines tranquillity as: 'The quality or state of being tranquil; freedom from disturbance or agitation; serenity, calmness; quietness, peacefulness, and this can relate to states of mind and landscapes.'

2.2 The Campaign to Protect Rural England (CPRE) describes tranquillity as: '… the quality of calm experiences in places with mainly natural features, free from disturbance from man-made ones.'

2.3 The UK Government's National Planning Practice Guidance (Noise Section) states, under the heading 'What factors are relevant if seeking to identify areas of tranquillity?':

> *'For an area to justify being protected for its tranquillity, it is likely to be relatively undisturbed by noise from human sources that undermine the intrinsic character of the area. It may, for example, provide a sense of peace and quiet or a positive soundscape where natural sounds such as birdsong or flowing water are more prominent than background noise, e.g., from transport.*
>
> *Consideration may be given to how existing areas of tranquillity could be further enhanced through specific improvements in soundscape, landscape design (e.g., through the provision of green infrastructure) and/or access.'*

2.4 In general tranquillity is experienced in places where there are:

- low noise levels;
- natural sounds rather than man-made sounds; and
- natural features in the area.

2.5 A place which is perceived to be natural and relatively quiet engenders a calmer, more serene, state of mind. It follows that people will respond to places differently dependent on how they are feeling or what expectations they have, or even on their cultural background.

Planning Policy relating to tranquillity

2.6 In England, Government policy relating to tranquillity and planning is found in the National Planning Policy Framework (NPPF). Paragraph 185 of the NPPF requires that:

> *'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*
>
> *… identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'*

2.7 Local Policy is found in the West Dorset, Weymouth & Portland Local Plan. Policy ENV1, "Landscape, seascape and sites of geological interest" which states:

> *"The plan area's exceptional landscapes and seascapes and geological interest will be protected, taking into account the objectives of the Dorset AONB Management Plan and World Heritage Site Management Plan. Development which would harm the character, special qualities or natural beauty of the Dorset Area of Outstanding Beauty or Heritage Coast, including their characteristic landscape quality and diversity, uninterrupted panoramic views, individual landmarks, and sense of tranquillity and remoteness, will not be permitted."*

2.8 In the Dorset Waste Plan, under Landscape and quality design, it states:

> *"12.50 Proposals within an AONB should therefore meet a local need and should enable waste to be managed proximate to its source. Any development within the AONB or its setting, should be sited and designed to minimise landscape and visual impact, through appropriate site selection, site planning and detailed site and building design. Development should not result in unacceptable landscape and visual impacts, or unacceptable impacts upon the special qualities that underpin the AONB designation, including aspects such as tranquillity and remoteness, an undeveloped rural character, dark skies and panoramic open views. Waste development proposals will need to demonstrate how they take account of the relevant AONB Management Plan objectives and policies."*

2.9 The following factors have been found to influence public perception of tranquillity in a location:

Environmental factors

- Sound – levels and types of sounds
- Visual appearance – landscape
- The character of the area immediately outside of the site of interest – the 'neighbourhood tranquillity'
- Presence of water (river, lake, waterfall, fountain, sea)
- Perceived safety (e.g., people, biting insects, birdsong)
- Comfort (e.g., somewhere to rest, weather conditions)
- Smells
- Textures

Personal factors

- Current psychological and /or emotional state

- Past experience / feelings / expectations about a site

2.10 Factors other than noise influence perceptions of tranquillity but a reliable prediction of how people rate the degree of tranquillity for most locations can be made by considering only sounds using the Natural Tranquillity Method (NTM). A detailed description of how this method and the terms it uses is applied is set out in Appendix B. Further detail on the research which led to the production of the method and its application can also be found in "Tranquil Spaces" https://naturaltranquillity.com/product/tranquil-spaces-book/ by Clive Bentley (the author of this report).

2.11 The NTM considers the existing and predicted noise levels and the character of the sound. In considering effects on tranquillity, the Natural Tranquillity Method considers four factors:

- the overall level of sound (how loud or quiet it is), described by the L_{AT} parameter;
- the relative levels of man-made and natural sounds, described using the NAMM parameter;
- the proportion of the time during which only natural sounds are present, described using the PONS parameter; and
- the amount of road traffic and rail noise, described using the L_{RR} parameter.

2.12 These parameters are assessed partially by survey and partially by prediction, as described in the following sections using the NTM to provide a tranquillity score for existing (baseline) conditions and for the situation where the ERF is in operation. Surveyed parameters are adjusted to take account of various rules set out in the NTM and moderated using any other relevant information.

2.13 The NTM uses an eight-point tranquillity score from 1 (frantic / chaotic / harsh) to 8 (excellent tranquillity) as shown in Table 2.1 below. Since the release of the method, field tests have shown that the distinction between tranquillity scores 4 and 5 are hard to distinguish for many rural environments and that a description of "neutral tranquillity" better covers these two situations. Also, scores in the range 1 to 3 can be more simply described as "not tranquil" for most purposes.

2.14 The simplified scoring system still uses the same underlying NTM scores (1 to 8). The two "just tranquil" and "not quite tranquil" designations have been combined into one "neutral" and all three of the "not tranquil" designations are reported as "not tranquil". Thus, there is no change to the approach resulting from this simplified approach to reporting.

2.15 Hence, (baseline) tranquillity and predicted tranquillity as a result of the proposed development are summarised below using a simplified, five-level descriptive scale: not tranquil; neutral tranquillity; fairly tranquil; good tranquillity; and excellent tranquillity shown in the right hand column of Table 2.1.

Table 2.1: Tranquillity score descriptors

NTM Score	Original NTM Description	Simplified Tranquillity Description
1	Frantic / chaotic / harsh	Not tranquil
2	Busy / noisy	
3	Unsettled / slightly busy	
4	Not quite tranquil	Neutral
5	Just tranquil	
6	Fairly tranquil	Fair tranquillity
7	Good tranquillity	Good tranquillity
8	Excellent tranquillity	Excellent tranquillity

2.16 Potential impacts on tranquillity can be evaluated by predicting the changes to NAMM, PONS, L_{RR} and L_{AT} which would result from the proposals to enable a comparison to be made of existing and predicted tranquillity with the development in place.

2.17 The character and level of existing sounds are recorded using these four parameters and, from these, the tranquillity scores at each survey location are recorded. These can then be combined to create a description (or map, if desired) of the baseline tranquillity along a path (or in an area). The character and level of the sounds which would be present in the event that a particular development was to go ahead would then be predicted and these could be combined with existing characters and levels (in the manner described in detail in Appendix B) to generate "with development" tranquillity scores.

2.18 The baseline and "with development" tranquillity scores can then be used to determine:

a) how the tranquil the location currently is and
b) how the tranquillity score would be affected by the proposed development.

2.19 The NTM has been found to provide a very good prediction of perceived tranquillity in most situations. When comparing subjective assessments made by a wide range of assessors with the results of the NTM, the scores match exactly 65% of the time, and are within one score either way 98% of the time. Given that tranquillity is a subjective assessment and perceptions (and therefore scores) will inevitably vary between people, the NTM can be considered a reliable measure of perceived tranquillity.

2.20 There are other methods which are sometimes used to assess tranquillity. The two most commonly referred to approaches are the University of Bradford method and the CPRE method. The limitations and reliability of these approaches is discussed in detail in Appendix C (which is an extract from the book, "Tranquil Spaces"). There are significant inherent flaws in both approaches; neither is capable of providing a reliable assessment tool for planning purposes.

2.21 The NTM, on the other hand, has provided a successful tool for the assessment of tranquillity. It has been used, for example, in a number of cases where landowners have used it to improve tranquillity within private garden areas and to apply for compensation for the effect of road traffic noise from a new road scheme on tranquillity.

2.22 It has also been used as the basis for expert evidence given to a number of significant planning decisions. These include its use in evidence at a Public Inquiry in relation to Daw Mill Colliery in North Warwickshire; at the DCO examination for the A303 Stonehenge bypass scheme and to underpin the amenity and recreation assessment of the effects of tranquillity resulting from the construction of Sizewell C nuclear power station. In each of these cases, the evidence on tranquillity was found to be reliable and the NTM findings have been referred to and endorsed in the planning decisions. Appendix D provides further details of these cases, for information.

3.0 Survey of baseline tranquillity

3.1 In discussion with the client, it was decided that the paths would be likely to be most used during weekends. For this reason, the survey of baseline tranquillity was carried out over a weekend.

3.2 An environmental noise survey was carried out by SAL on 14th and 15th October 2023. Measurements were taken at locations shown in Figure A2 in Appendix A between 1550 hours and 1700 hours on the 14th and between 0930 and 1630 hours on the 15th. The microphone was fitted with an integrated wind-shield. Measurements were conducted at 1.5m above ground level in free-field conditions. The meter used was a Class 1 integrating sound level meter (an 01dB Fusion) and it was field checked for calibration before and after the measurements. No significant drift was noted.

3.3 All measurements were made for periods between 5 minutes and 20 minutes. In general, the measurement period was 15 minutes but shorter, spot checks were also made where such additional information was deemed to be of use.

3.4 The weather was dry with wind speed below 5m/s throughout. The surveyor was present for all survey work and a note was made of meteorological conditions during each measurement. Observations were also made of the contribution to the overall measured level from different sources of noise and the NTM parameters were recorded.

3.5 The area of interest is relatively close to the port at Castletown and sounds from ships in the port (at a distance of approximately 600m away from the area of interest) affected readings. At times, when a noisy pump or other mechanical system was in operation onboard a ship, this produced a pronounced, tonal sound which reduced the tranquillity score significantly. At other times, although some sound from the port was present, this had far less of an effect on tranquillity. The effect of the presence of ships is therefore an important feature of the assessment and so the assessment has been divided into periods when ship noise is significant and periods when it is not.

3.6 Table 3.1 below summarises the measured levels at each location when the port was noisy, Table 3.2 summarises the measured levels at each location when the port was not noisy. Based on observations made during the survey, the port appeared to be noisy for about 50% of the time. SAL understand from discussions with the client that this is reasonably typical. (The terms NAMM, PONS and so on in the tables are explained in Appendix B).

Table 3.1: Summary of survey results when port is noisy

Location	NAMM	PONS	L_{RR}, dB	L_{AT}, dB	Observations
1	2	5	15	45	Tonal whine from port dominant for much of the time. Birdsong and leaves also present.
2	3	5	15	38	
3	3	5	15	38	
4	5	95	15	35	Leaf rustle and birdsong. Port inaudible.
5	5	95	15	37	

Table 3.2: Summary of survey results when port is not noisy

Location	NAMM	PONS	L_{RR}, dB	L_{AT}, dB	Observations
1	5	85	29*	39	Birdsong, leaves in trees, hum from port audible at low level.
2	5	90	29*	39	Distant sound of the sea, occasional port noise audible, natural sounds dominate (birdsong and leaf rustle). Hum from port just audible.
3	5	95	28*	38	Leaf rustle and birdsong. Hum from port just audible.
4	5	95	15	35	Leaf rustle and birdsong. Port inaudible.
5	5	95	15	37	

* Port hum included as road traffic, see Rule NP7 in Table B2 in Appendix B

4.0 Prediction of noise from ERF by computer modelling

4.1 To enable the effect of the proposed development to be determined, the propagation of noise from the proposal (ie. what the noise levels from the ERF would be around the area) needs to be predicted. This section describes how this was done using computer noise modelling. Computer noise modelling allows the modeller to input information about the noise levels from the proposed operations and plant items, along with information about the buildings that they are housed in and other relevant information about the operational site to predict how much sound would be present at the boundary of the site and beyond. The data used in this case was taken directly from the BS4142 Noise Impact Assessment produced for Powerfuel Portland by Arup (reference number AAc/267701/R03a, Issue 2, dated 21st May 2021).

4.2 This data was input into a 3D computer noise model of the proposed development site and surroundings, along with topographical data and information about ground conditions. Using this model, SAL were able to predict noise propagation in the area and predict broadly the same noise levels as the levels reported in Powerfuel's submission.

4.3 The model was run using the ISO 9613 noise propagation methodology and levels were predicted as contours around the area of interest. A comparison of SAL and Powerfuel's predicted levels, using their reported predictions in the Table 4 of their report is shown in Table 4.1 below. This provides a way to check that the noise levels predicted by SAL are similar to those predicted by Powerfuel's consultants.

Table 4.1: Comparison of noise levels predicted from ERF operation

Location	Predicted level, dB, including "contingency" as explained in Arup report, Section 4.3		
	Arup	**SAL**	**Difference**
Ayton Drive	30	31	-1
Castle town	34	35	-1
Coronation Road	27	26	1
Crabbers' Wharf holiday apartments	36	36	0
East Weare Drive	33	35	-2
HMP the Verne	39	40	-1
Portland Hospital	27	25	2
Portland marina (moorings)	34	34	0

4.4 As can be seen, there is good agreement between the two sets of predictions which suggests that the SAL model predicts levels which are similar to those predicted by the developer's consultant.

5.0 Predicted Noise Levels from ERF and tranquillity Scores

5.1 Predicted noise level contours from the modelling described in Section 3.0 above are presented in Figure A3 in Appendix A.

5.2 Predicted levels at each survey location, taken from the noise contours in Figure A3 in Appendix A are shown in Table 5.1 below.

Table 5.1: Predicted noise levels from ERF at each measurement location

Location	Predicted noise level from incinerator, dB,
1	34
2	37
3	39
4	41
5	30

5.3 The baseline NAMM, PONS, L_{RR} and L_{AT} values in Tables 3.1 and 3.2 above were used to predict baseline tranquillity in each location. These values were then adjusted to take account of the presence of incinerator noise, using the incinerator levels predicted in Table 5.1. The resultant "with development" NAMM, PONS, L_{RR} and L_{AT} values were then calculated to predict the "with development" tranquillity scores.

5.4 Tables E1, E2, E3 and E4 in Appendix E show both the baseline and predicted NAMM, PONS, L_{RR} and L_{AT} values for both "port busy" and "port not busy" situations and the corresponding tranquillity scores, calculated using the approach and formulae set out in Appendix B. A summary of the resultant baseline and "with development" tranquillity scores is shown in Table 5.2 below.

5.5 The predicted "with ERF" scenarios have been colour-coded to indicate the magnitude of the change, based on the degree of change of tranquillity. Green indicates that there would be no change in the tranquillity score, yellow indicates a change in one score, orange a change in two scores and red a change in three scores. The greater the change, the greater the impact on tranquillity.

Table 5.2: Predicted tranquillity scores

Location	When existing port activity is noisy		When existing port activity is not noisy	
	Without ERF	With ERF	Without ERF	With ERF
1	Neutral	Neutral	Good	Good
2	Fair	Fair	Good	Fair
3	Fair	Fair	Excellent	Fair
4	Excellent	Neutral	Excellent	Neutral
5	Excellent	Good	Excellent	Good

5.6 Further interpretation is required to understand what these changes in tranquillity mean and to consider what the likely tranquillity score along the proposed new permissive path would be.

6.0 Interpretation of Tranquillity Scores and Conclusions

6.1 Location 1 is within the Royal Naval Cemetery. Existing tranquillity here is either neutral or good, depending on the activity at the port. This would not be affected by the operation of the ERF as the noise from the incinerator operation would be lower here.

6.2 Locations 2, 3 and 4 are on the footpath which currently runs from the eastern end of the cemetery to a dead end. As one walks along this footpath, at present, the tranquillity of the sounds present gradually improves as the sounds from the port are reduced. When the port is busy at present, the operation of the ERF would have a negligible effect on the first 100-150 metres south from the southern tip of the cemetery. After this point, the path turns slightly and the intervening topography screens the port noise quite effectively, meaning that beyond this point the good and then excellent tranquillity (at the dead end, location 4) currently experienced, even when the port is busy and noisy would be reduced by the operation of the ERF, which would produce higher noise levels in this area, to neutral.

6.3 When the port is not so busy and noisy, the footpath between the southern end of the cemetery and the dead end (locations 2, 3 and 4) is currently good to excellent. Noise levels from the operation of the ERF would be at their highest in this area, resulting in a drop in tranquillity score from good to fair at the northern end and excellent to neutral at location 4. This would be experienced as a significant detrimental change to the soundscape along this path. The good to excellent tranquillity currently experienced would be lost.

6.4 Beyond location 4 (the dead end of footpath S3/72), and on to location 5 (footpath S3/81), interpolating from survey data at locations 4 and 5, the proposed route of the permissive path would be likely to experience excellent tranquillity if the ERF were not operating but would be neutral at its northern end, gradually improving to become good (where it is currently excellent) by its southern end, as the ERF noise drops off with distance and screening due to local topography.

Summary

6.5 Sound from current operations at the port effects the degree of tranquillity along the footpath S3/72 and in the Royal Naval Cemetery. This can be either a small effect or can produce quite a significant effect, when a noisy ship is docked. According to local residents, the noisy condition is present for roughly 50% of the time.

6.6 During the quieter periods, the Royal Naval Cemetery experiences good tranquillity and footpath S3/72 beyond the cemetery to the south currently experiences excellent tranquillity.

6.7 If the ERF were operational at the same time as the port is noisy, this would have little effect on the tranquillity within the Cemetery or along the first 150m of the path south of the cemetery but would reduce tranquillity further down the path from either good or excellent to neutral.

6.8 When the port is not noisy, if the ERF were operational, this would have little effect on the good tranquillity found at the cemetery but would have a significant detrimental effect on the good or excellent tranquillity currently found on footpath S3/72 south of the cemetery.

6.9 Since access is not currently permitted, no survey was possible of the existing tranquillity along the route of the proposed new permissive path which would join S3/72 and S3/81. However, it is reasonable to assume that tranquillity along this would be excellent as the baseline tranquillity score at either end of the path is excellent. With the ERF operational, this tranquillity would be lost or reduced along the proposed permissive path since noise from the incinerator noise would be relatively high at the northern end and would remain audible at the southern end at a level which would affect the excellent tranquillity present as the baseline there.

6.10 This information is shown graphically in Figures A4 to A7 in Appendix A. These show the tranquillity scores along the paths under different conditions using coloured squares to indicate the scores: blue being excellent, green being good, yellow being fair and grey being neutral.

6.11 The requirement set out in paragraph 185 of the NPPF is to protect locations where these are prized for their recreational and amenity value due to their tranquillity.

6.12 In summary, the sound emitted from the proposed ERF would result in:

- A negligible effect on tranquillity at the northern end of the path and in the Royal Naval Cemetery, , mainly due to the presence of existing sounds from the port in these locations.
- A significant loss of tranquillity along the southern parts of path S3/72 and a small but potentially important loss (from excellent down to good tranquillity) at the northern end of footpath S3/81.
- Users of the proposed permissive path not experiencing the excellent tranquillity which would otherwise be present for much of its length.

6.13 The question of whether these paths may be prized for their recreation and amenity value is for others to comment on; however the existing tranquillity found on these paths (and which would otherwise be found on the permissive path) would be reduced or lost (depending on the location) due to the operation of the proposed incinerator.

Appendix A: Figures

Figure A1: Plan showing receptor locations adjacent to the proposed ERF

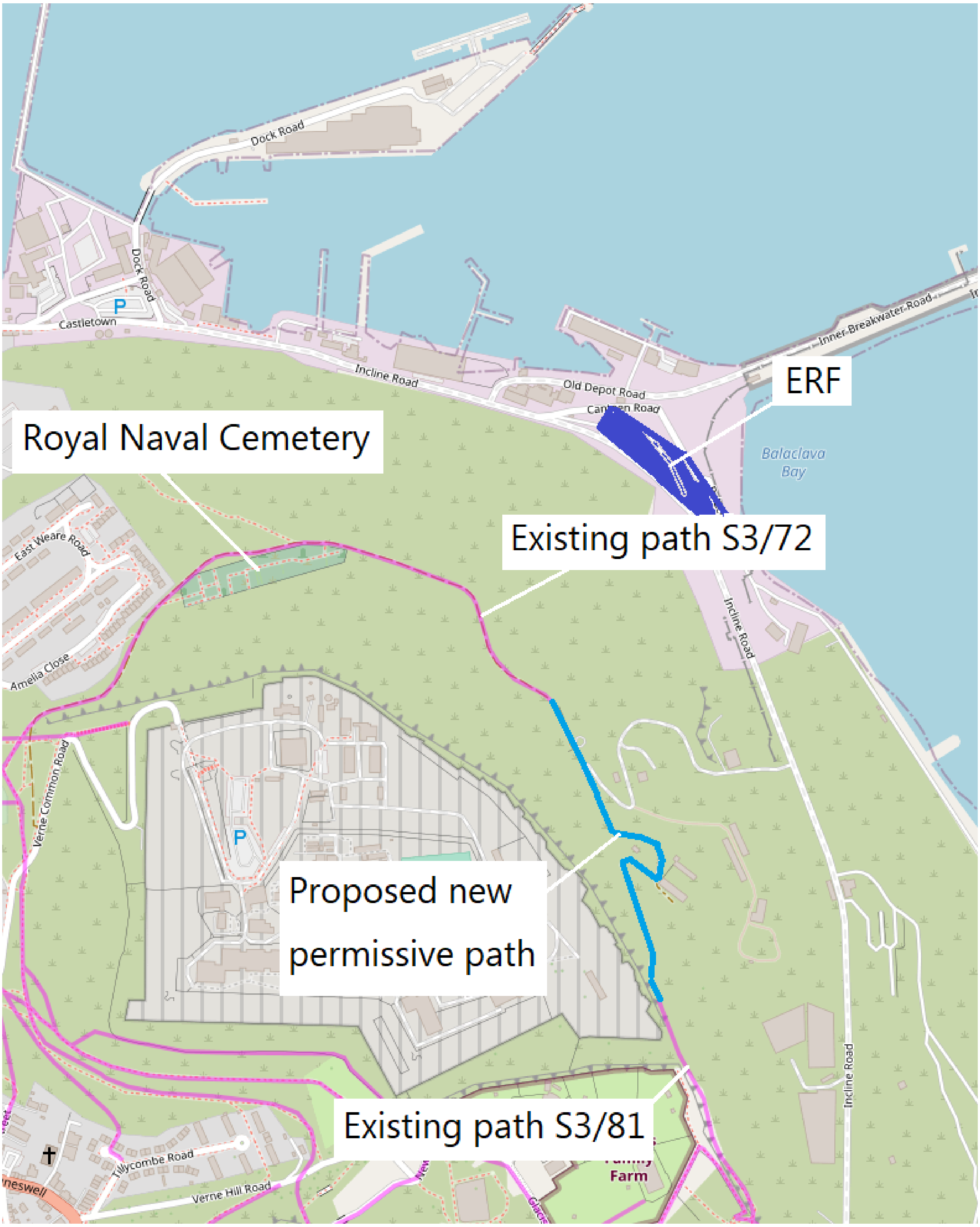


Figure A2: Plan showing survey locations

Figure A3: Predicted noise contours from ERF operation shown at 1.5m above ground level

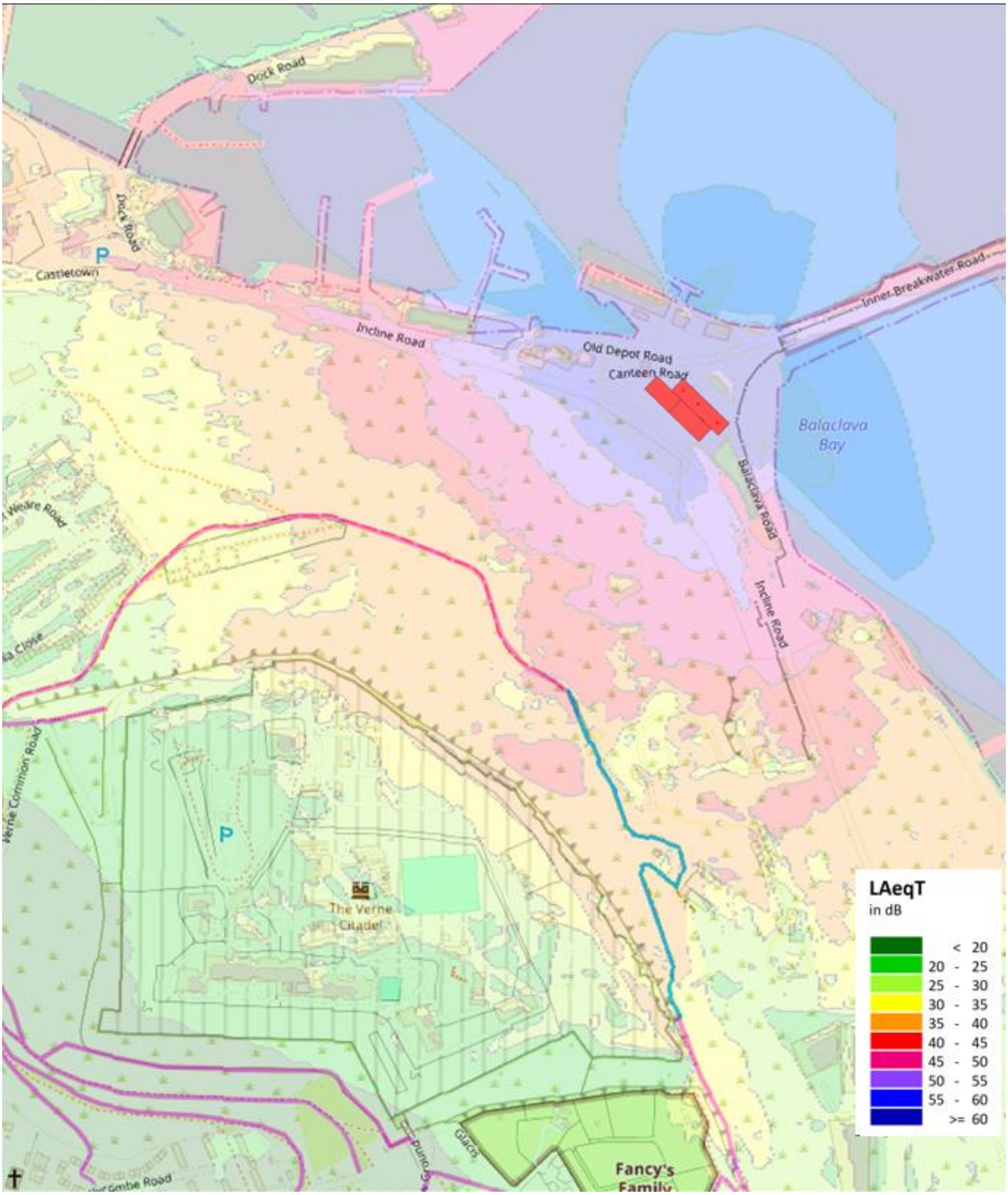


Figure A4: Tranquillity scores along paths – baseline, port is noisy

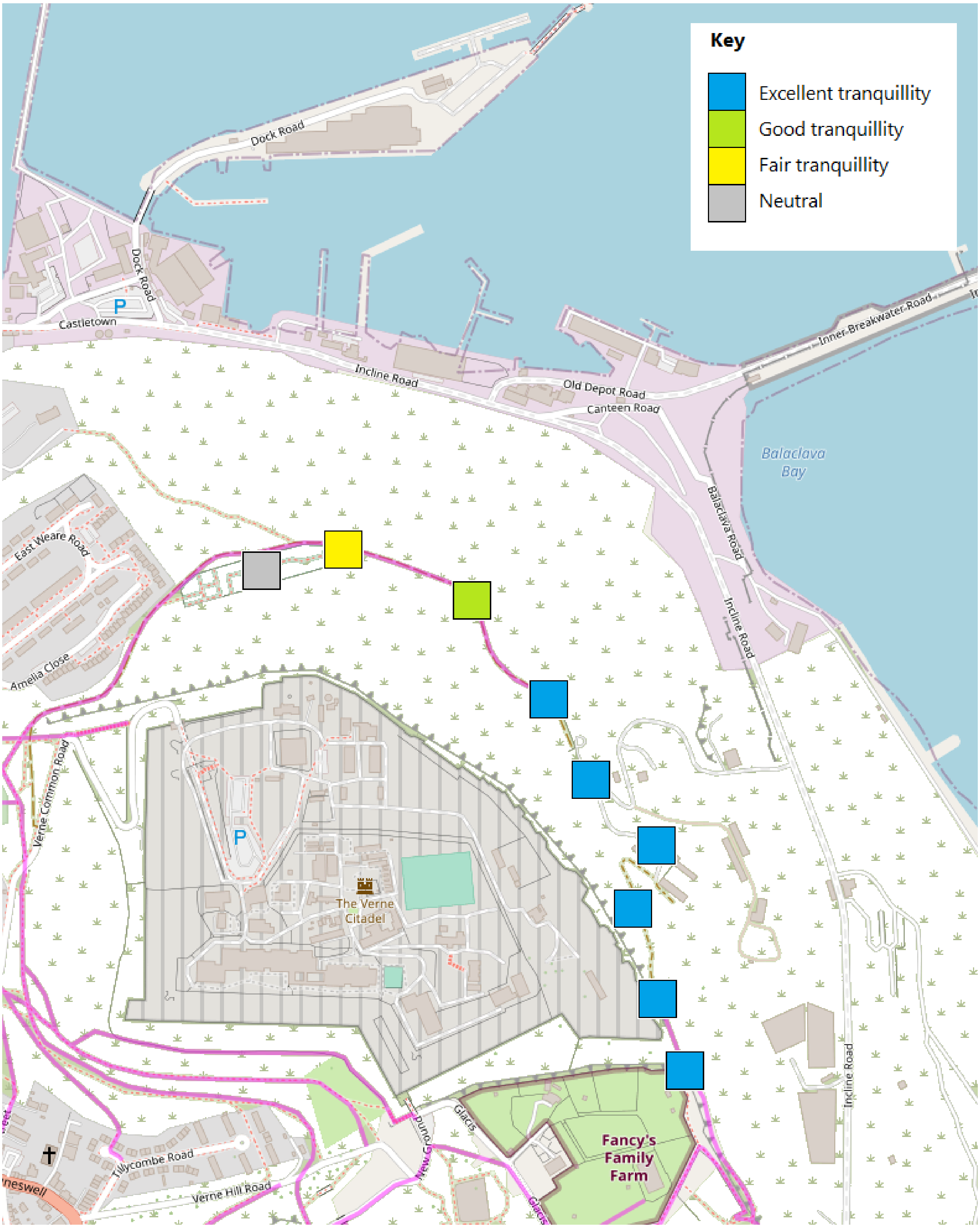


Figure A5: Tranquillity scores along paths – baseline, port not busy

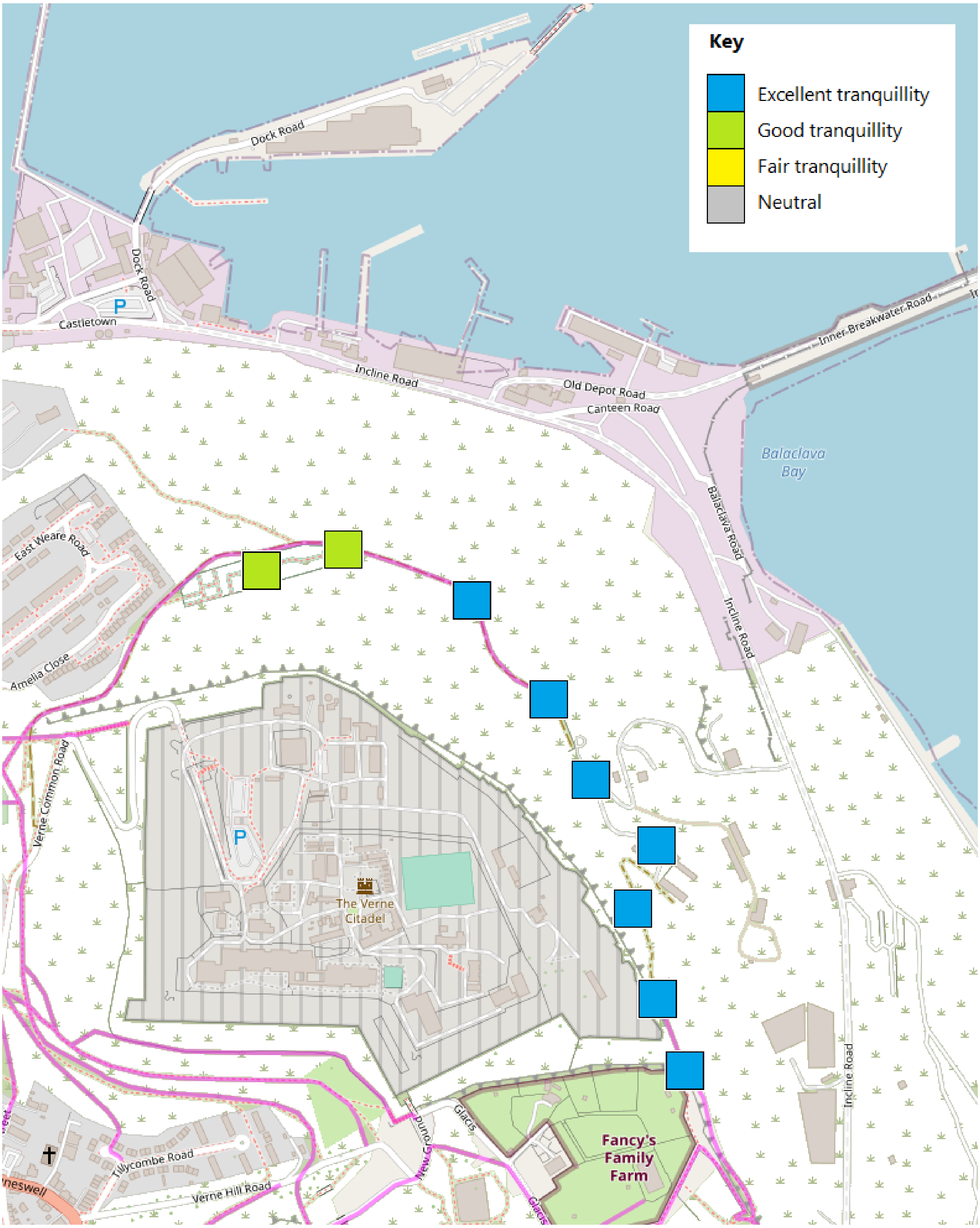


Figure A6: Tranquillity scores along paths – with ERF, port is noisy

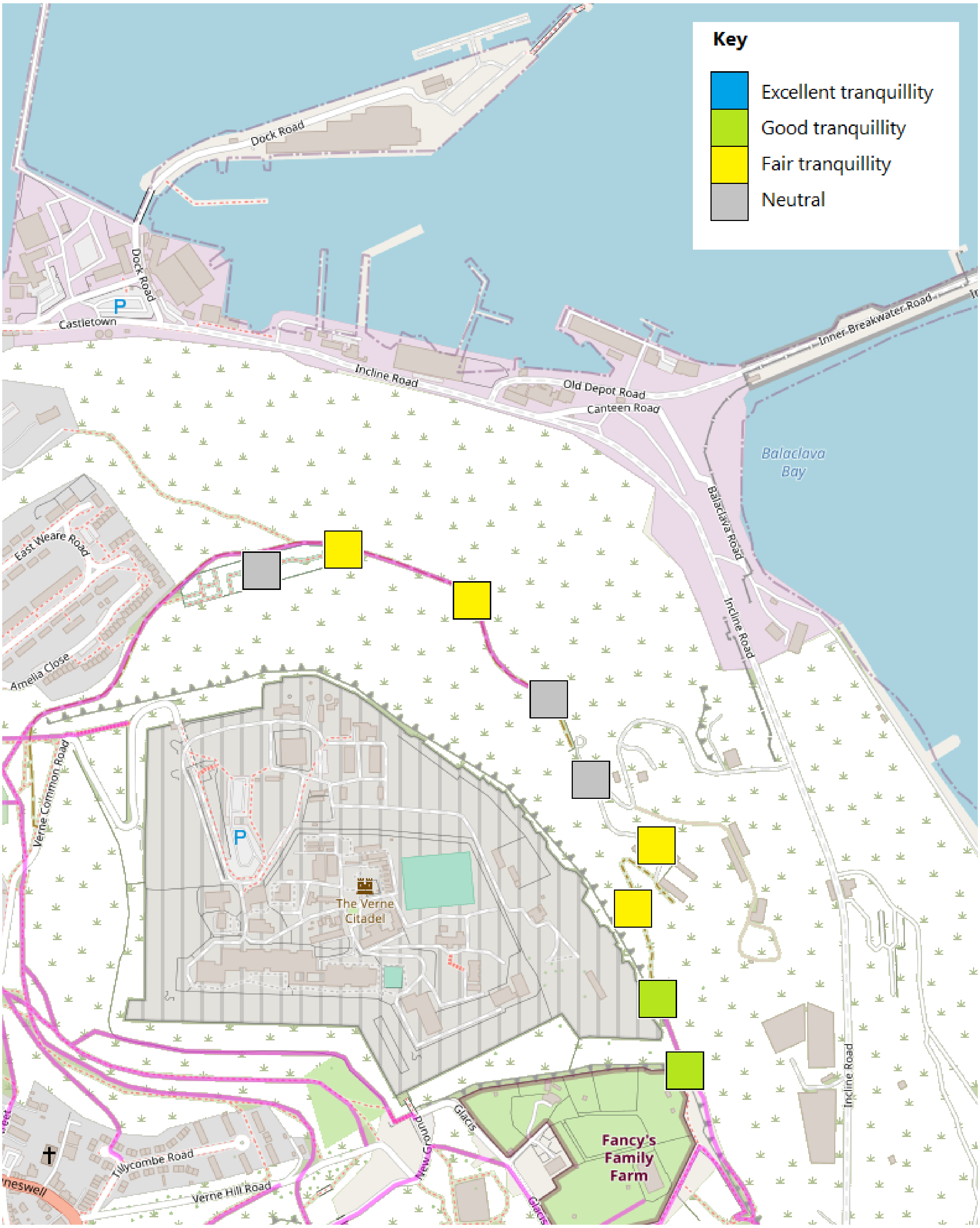
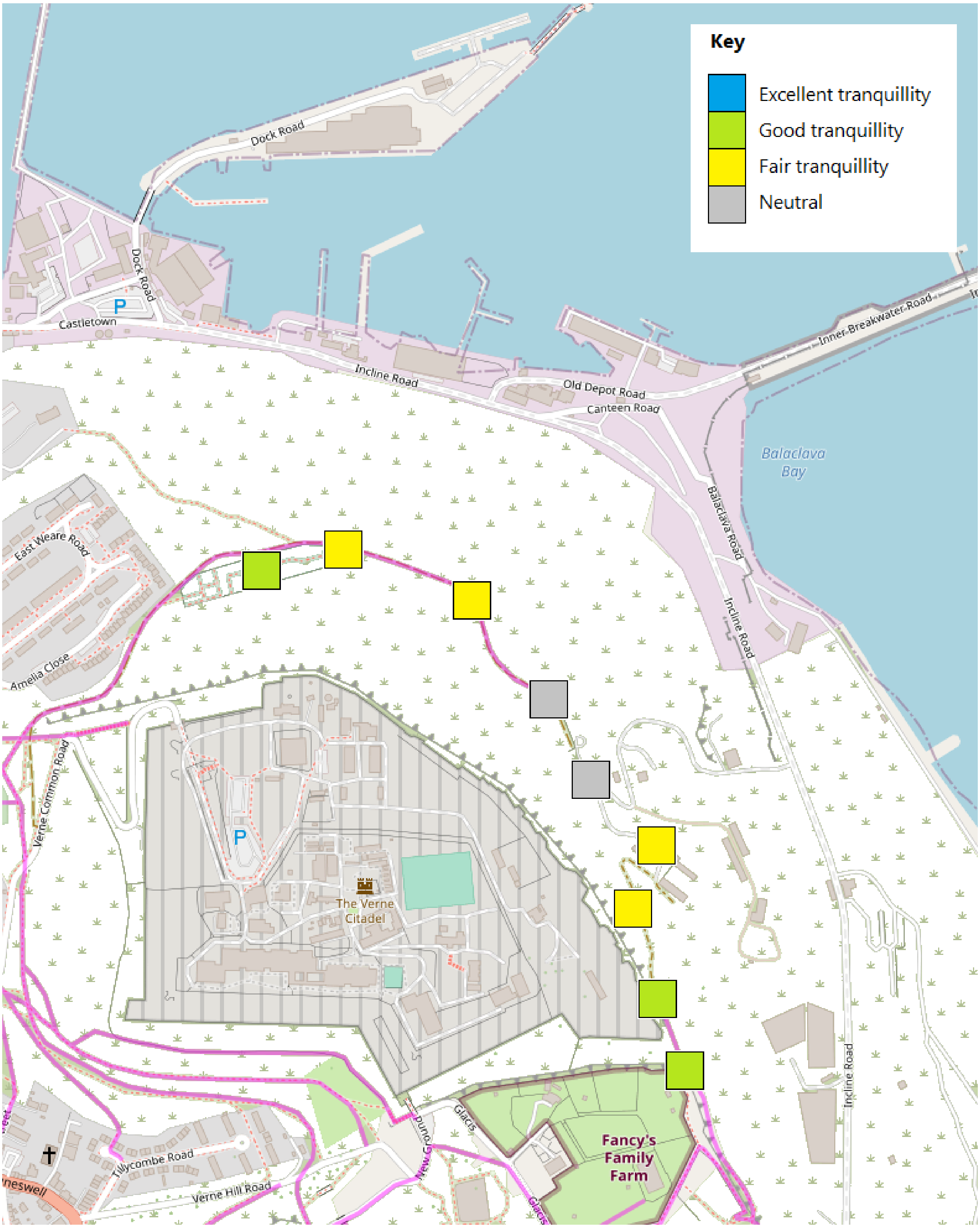


Figure A7: Tranquillity scores along paths – with ERF, port not busy



Appendix B: Overview of the Natural Tranquillity Method

Assessment of Tranquillity using the Natural Tranquillity Method

The impact of the proposed development on tranquillity has been considered using the Natural Tranquillity Method (NTM) which is a method described in *'Tranquil Spaces'*, published in 2019. This method reviews previously published approaches to the assessment of tranquillity and concludes that they are not capable of providing a reliable assessment of tranquillity for planning purposes. Probably the best known of these, is the approach published by Campaign to Protect Rural England (CPRE) in 2006, *'Tranquillity Mapping: Developing a Robust Methodology for Planning Support in 2008'* is considered in detail and a number of key problems identified if the approach were to be used to carry out an assessment for planning purposes. Tranquil Spaces describes research involving the measurement and recording of sound character and level and simultaneous scoring of tranquillity at thousands of locations around the UK over a four year period and how this led to the derivation of a evidence based method for converting details about the sound level and character into a tranquillity score.

As well as dealing with key the shortcomings of other methods, such as the fact that people's response to road traffic noise is not linear, the fact that the CPRE method uses low resolution 500m by 500m grid sizes so that all tranquillity within each 500m square has the same score and that fact that the presence of natural sound is not properly considered in other methods, the NTM provides a reliable way to assess existing tranquillity and the tranquillity which would be present as a result of proposed changes.

In summary, the NTM involves surveying the area, noting sound character and level, according to a number of defined rules and recording results in terms of four parameters: NAMM, PONS, L_{RR} and L_{AT} (as described below). These parameters enable a record to be made of the relative level and degree of presence of natural sounds and man-made sounds, sounds from transportation sources and the overall level of sound. These parameters and the rules for assessing them are described below.

NAMM is the relative levels of natural and man-made sound recorded according to Table B1 below:

Table B1: NAMM values

NAMM parameter value	Description
1	All or virtually all sound is from man-made sources
2	Sounds are mainly man-made but natural sounds are also present
3	Natural and man-made noise contributes equally
4	Sounds are mainly natural but man-made sounds are also present
5	All or virtually all sound is from natural sources

Note: 'man-made' sounds include noise from items or animals brought to (or near to) the location by people so would, for example, include noise from machinery, dogs, and radios.

PONS is recorded as the percentage of time when you can only hear natural sound. Silence (or absence of man-made and natural sounds, as defined here) is considered a 'natural sound' contributing to the PONS value.

The values assessed for both PONS and NAMM should reflect conditions on a typical busy or quiet day. This presents a problem when survey time at any given location is limited as will often be the case. It is therefore important that the values observed are considered alongside other information about the pattern of noise source occurrence.

The NAMM and PONS indices are complementary; both provide a way of assessing the amount of natural and man-made sound experienced at each survey location. The more time spent making these observations, the more reliable the results. When scoring NAMM and PONS, follow the additional rules set out in Table B2 and estimate the value over a 12-hour day (from 07:00 to 19:00 hours). Atypical events should be excluded from results.

Table B2: NAMM and PONS rules

Rule	Topic / situation	Rule
NP1	Road traffic and rail noise	Other than where rules NP2, NP3 or NP4 below apply, when assessing PONS and NAMM values, noise from road traffic and rail must be disregarded*.
NP2	Road traffic noise continuous** and dominant, defined as: where RTN is greater than or equal to 50dB **and** RTN is greater than or equal to (all other sources + 4dB)	Score NAMM = 1 and PONS = 0
NP3	Road traffic is continuous** and significant, defined as: where RTN is not dominant (defined as in NP2) **and** RTN is equal to or between 3dB below the overall measured level and the overall measured level	Record PONS as 0 **and** if NAMM would be 5, record NAMM as 4, otherwise record NAMM as normal.
NP4	Rail noise dominant, defined as: where rail noise > 56dB **and** (rail noise – 6) > (all other sources + 4)	Score NAMM = 1 and PONS = 0
NP5	When recording sound from aircraft or boats	For all such events, record using NAMM and PONS.
NP6	Where the overall background noise level is relatively low, distant sounds are more readily audible. In such circumstances, where one can clearly hear a distant man-made sound (such as children playing, dogs barking or aircraft flying over) but where these sounds do not affect the overall L_{AT} by more than 1dB	Record NAMM = 5 and reduce PONS by the amount necessary to account for proportion of time for which the source is present.
NP7	Continuous, low noise level man-made sound (such as a fan or motor in the distance running continuously but which is only noticeable when listening carefully)	Ignore for the purposes of NAMM and PONS and include as part of the L_{RR}.

Rule	Topic / situation	Rule
NP8	Where there is very little man-made or natural sound (such as may be found within a courtyard area)	Record the percentage of time when there is 'silence' (i.e. the absence of sounds other than road traffic or rail noise) as a 'natural sound' within PONS.
NP9	Where man-made sounds are intermittent, sudden sounds but occurring repeatedly such as hammering or dog barking	Whenever a non-natural sound of this type occurs repeatedly in any given minute, then the PONS value for that minute should be 0%.

* Disregarded means treating it as if it does not exist at all. Other than for rules NP2, NP3 and NP4, road traffic (and rail) noise is effectively considered to be inaudible when assessing NAMM and PONS.

** Continuous means present all or virtually all the time. Even busy roads can have brief lulls in traffic flow occasionally; where these occur, the flow may still be considered continuous if it is audible most of the time.

L_{RR} is the parameter used of the assessment of the contribution of road and rail noise. Ideally, road traffic levels around a site should be predicted using road traffic flow information (number, type and speed of vehicles) and a computer model used to predict noise propagation taking account of local topography, screening, wind conditions based on the prevailing wind for the area in question, ground and air absorption of sound. However, this is not always possible in practice. It is important to assess the contribution of road traffic noise by measurement, either to validate the model or because no modelled values are available. When it is not possible to predict road traffic levels by modelling or calculation, the rules in Table B3 below should be followed.

Table B3: L_{RR} rules

Rule	Situation	Rule
RR1	Road traffic noise levels can be heard clearly without interference from other sounds for much of the time	Measure directly, removing any other sounds from the measurement.
RR2	Road traffic noise levels are fairly steady but can only be heard when other sounds are not present (which may only occur occasionally)	Measure directly with care – noting the road traffic noise level when no other sounds are present.
RR3	Where there is a continuous flow of traffic on a road more than 100 metres away	It is particularly important to model RTN (if possible) for typical conditions, bearing in mind the prevailing wind. If not possible, then measurements must be made with a range of wind conditions and typical levels established with reference to this information.
RR4	Road traffic noise cannot be heard due to masking by other sounds (e.g., in a busy pedestrianised town centre or a park where there are sounds from other sources)	Either use a value which is 10dB below the minimum measured noise or 40dB, whichever is the lower.

Rule	Situation	Rule
RR5	Where road traffic noise is inaudible due to being too far away, very well screened, or due to low flows of vehicles	Use 15dB as value for RTN.
RR6	Where the local road has a low flow of traffic	See 'Dealing with roads with low vehicle flows and more complex road traffic conditions' below.
RR7	If the level of road traffic or railway noise is determined (by calculation) to be below 15dB	Record L_{RR} as 15dB.

Rail noise can be predicted by modelling using information about train and wagon types, numbers, speeds and so on. In practice, however, specific data about train and carriage/wagon types may be difficult to access/utilise. Rail noise is therefore often calculated by measuring the level of noise from different train types as the single event level, L_{AE}, at a particular distance, adding up the contribution from each type depending on the number of trains which run in a typical day, then correcting for attenuation with distance and other factors which affect sound propagation, as appropriate to calculate an average level for the period of interest; in this case, generally, a 12-hour day.

To obtain a value for L_{RR} for sites where both road and rail noise is present, the road traffic noise (RTN) should be logarithmically added to the level of rail noise (RN) – 6dB over a 12-hour day between 07:00 and 19:00 hours using formula:

$$L_{RR} = 10 \times \log [10^{(RTN/10)} + 10^{((RN-6)/10)}]$$

Using the L_{RR} parameter for other sound sources

The L_{RR} parameter was designed for assessing the contribution of road and rail noise, but it has been also found to be useful for one additional type of sound source. Occasionally, where there is a continuous, distant man-made sound such as a fan or motor which is only noticeable when listening carefully, this should be logarithmically added to the L_{RR} parameter without the application of any correction.

L_{AT} – the corrected overall measured level

This is derived from the measured L_{Aeq}, which may be modified according to certain rules in certain conditions. The L_{Aeq} should be measured using a type 1 sound level meter, calibrated, with an appropriate wind shield. All measurements should be taken in a free field location at a height of around 1.5 metres above ground. Meteorological conditions should be suitable for the measurement of environmental sound.

The L_{AT} value used will, in general, be an estimate of the L_{Aeq} value which would be measured over a typical 12-hour day at each location. Reliable spot checks will normally suffice and the value to use for L_{AT} will simply be the measured L_{Aeq}, with two exceptions.

Exception 1

When train noise is present, this needs to be removed from the measurement (as explained below) and then added back in. When adding its contribution back into the assessment to obtain the effective 'with train' L_{AT} value, the corrected train noise must be used rather than the actual train noise.

$$L_{AT} = \text{Measured } L_{Aeq} \text{ (without trains)} + (\text{Train level} - 6).$$

The subtraction is arithmetic, but the addition of levels is logarithmic.

Exception 2

If the survey location is within 25 metres of an active playground regularly containing children shouting and screaming, then a 5dB penalty should be added (arithmetically) to the measured L_{Aeq} value to account for the impact of this type of sound. In these circumstances,

L_{AT} = Measured L_{Aeq} + 5dB (arithmetic addition).

If a location has both an active playground and train noise present, then both corrections would need to be applied, with the playground correction being applied first.

Dealing with roads with low vehicle flows and more complex road traffic conditions

In rural locations, there is often less than one vehicle passing every minute and, although this can mean that the values of L_{RR} (and therefore L_{AT}) can be quite high, the tranquillity score is often still reasonably good since, for much of the time, there are no vehicles present. According to rules NP2 and NP3, if the sound of road traffic is not continuous (not audible for all or virtually all of the day), the NAMM and PONS scores should not be modified. NAMM and PONS only need to be modified to take account of this when vehicle numbers rise to the point where road traffic noise is continuous. For a country road a continuous flow might occur when vehicle numbers rise to approximately 200 – 300 vehicles per hour, for example, although this depends on the road layout and level of other ambient sounds. If other ambient sounds are lower and the stretch of road audible is long, then RTN may be continuously audible with lower flows than this.

Occasionally, one will encounter a more complex situation where there is a local road with low flows and continuous road noise from further away. In this situation, the value of L_{RR} is quite likely to be primarily affected by road traffic on the local low-flow road but the continuous sound of traffic on the more distant road(s) would also need to be considered.

To determine whether to correct the NAMM and PONS scores, one must first consider only the distant continuous road traffic noise, ignoring any noise from the local road. This approach would be important when considering the potential impact that a new road scheme might have on a rural location which may currently experience good or excellent tranquillity, and which could result in a noticeable drop in tranquillity as a result of the scheme.

Predicting tranquillity score using the NTM formulae

This can be done by processing the NAMM, PONS, L_{RR} and L_{AT} scores using the formulae in Table B4 below. This will return the relative probability of each tranquillity score according to the codes in Table B5 and from these select the score which has the highest probability.

Table B4: Formulae for predicting tranquillity scores

Tranquillity score	Relative probability of this score being chosen
1 Chaotic / frantic / harsh	0.00
2 Busy / noisy	74.17398+(NAMMx9.57158)+(PONSx5.32434) +(L_{RR}x0.08640)-(L_{AT}x1.21115)
3 Unsettled / slightly busy	114.46581+(NAMMx10.93007)+(PONSx5.27272) +(L_{RR}x0.08981)-(L_{AT}x1.85779)

Tranquillity score	Relative probability of this score being chosen
4 Not quite tranquil	$129.58104+(NAMMx11.55970)+(PONSx5.33385)+(L_{RR}x0.13029)-(L_{AT}x2.17490)$
5 Just tranquil	$133.98827+(NAMMx12.81092)+(PONSx5.35484)+(L_{RR}x0.12512)-(L_{AT}x2.32374)$
6 Fairly tranquil	$136.05294+(NAMMx14.11910)+(PONSx5.37543)+(L_{RR}x0.11841)-(L_{AT}x2.46001)$
7 Good tranquillity	$132.75350+(NAMMx16.44831)+(PONSx5.38689)+(L_{RR}x0.05909)-(L_{AT}x2.56049)$
8 Excellent tranquillity	$116.06068+(NAMMx19.41205)+(PONSx5.45928)-(L_{RR}x0.08844)-(L_{AT}x2.57928)$

The relative probabilities are calculated as follows:

The relative probability, P_1 of the tranquillity score 1 (corresponding to the tranquillity score of 1, described as shown in Table B4 below) is always zero:

$$P_1 = 0.00$$

… and the relative probability of each other tranquillity score, P_n (where n is a value between 2 and 8, corresponding to the tranquillity scores of 2 to 8, as shown in Table 24) is given by;

$$P_n = A_{an} + A_{bn} \text{ x NAMM} + A_{cn} \text{ x PONS} + A_{dn} \text{ x } L_{RR} + A_{en} \text{ x } L_{AT}$$

Where:

A_{an}, A_{bn}, A_{cn}, A_{dn} and A_{en} are five different numbers (constants) for each value of n, such that there are in total of 35 different constants (five constants per tranquillity score and seven tranquillity scores) in total.

Table B5: Tranquillity scores and descriptions

Tranquillity score	Description
1	Frantic / chaotic / harsh
2	Busy / noisy
3	Unsettled / slightly busy
4	Not quite tranquil
5	Just tranquil
6	Fairly tranquil
7	Good tranquillity
8	Excellent tranquillity

Appendix C: Extract from “Tranquil Spaces” – discussion of other methods for the assessment of tranquillity

THREE ▪ PREVIOUS MEASURES OF TRANQUILLITY

Look deep into nature, and then you will understand everything better

Albert Einstein

Tranquillity has become something we need to assess, measure, and quantify yet the methodology for doing so has only begun to develop recently. The first published method of measuring tranquillity in public places appeared in 2004. Of many methods, two stand out as contributing to the development of a standard approach: the CPRE method, and the University of Bradford method. The pros and cons of these approaches are reviewed below.

UNIVERSITY OF BRADFORD METHOD

The method developed by the University of Bradford considers road traffic noise levels, landscape features, and moderating factors to predict the perception of tranquillity in an area. The importance of separating man-made and natural noise is highlighted. [1, 2, 3, 4]

Their research concluded that a good assessment can be made using just **two factors**: **noise level (determined from road traffic) and the visual appearance of surroundings**. In their words, 'Statistically significant factors that have been identified are the noise level (L_{Aeq} or L_{Amax}) and the percentage of natural and contextual features in the landscape.'

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[1] Watts G, and Pheasant R (2013), Towards quantifying the quality of tranquil areas with reference to the National Planning Policy Framework. *Proceedings of the Institute of Acoustics* Vol. 35 (1).

[2] Watts G, and Pheasant R (2015), Identifying tranquil environments and quantifying impacts. *Applied Acoustics* Vol. 89, pp. 122–127.

[3] Watts G, and Pheasant R (2015) Factors affecting tranquillity in the countryside. *Applied Acoustics* Vol. 74(9), pp. 1094-1103.

[4] Pheasant R, Horoshenkov K, and Watts G (2010), Tranquillity rating prediction tool (TRAPT). *Acoustics Bulletin* 35(6), November/December, pp.18–24.

They produced the Tranquillity Rating Prediction Tool or TRAPT from which a Tranquillity Rating (TR) for a study site can be determined on a scale of 0–10 (0 = not tranquil, 10 = most tranquil) using this formula:

$$TR = 9.68 + 0.041\ NCF - 0.146\ L_{Aeq} + MF$$

where

NCF = Natural and Contextual Features (this includes natural and man-made features) calculated as a percentage of natural and contextual features in a 360° view from the location using continuous photographs taken at a height of 1.5 metres sweeping a horizontal plane.

If 'N' is the area with natural features and 'M' is the total area of man-made features, then NCF is given by:

$$NCF = 100\ N/(N+M)$$

L_{Aeq} = the A-weighted equivalent sound level of road traffic noise (although it is understood that this could be adapted to take account of other noise sources) in decibels and expressed with a time reference period. The reference period is daytime (defined as the 12-hour period between 07:00 and 19:00 hours).

MF = Moderating Factors: these were added to the formula during development and designed to take into account litter and graffiti that would depress the rating, or natural water sounds that would improve it. A value of 1 or -1 is assigned to enhancing or detracting features, respectively.

Photo 3.1 Panoramic photos in a wood, ready for an assessment of NCF

Using their formula, they suggested the following scale and descriptors of the calculated Tranquillity Rating:

<5	unacceptable
5.0 – 5.9	just acceptable
6.0 – 6.9	fairly good
7.0 – 7.9	good
≥ 8.0	excellent

Limitations of this method

There are several important limitations to the University of Bradford method.

1. It takes no account of the presence and behaviour of people.
2. It takes no account of noise sources other than road traffic.
3. The equation gives roughly equal weight to road traffic noise level and visual appearance whereas in the development of the Natural Tranquillity Method it was found that, in the field, visual appearance assessed using the NCF parameter has a relatively weak correlation with most people's perceptions of tranquillity compared to sound.
4. It assumes that the relationship between the independent variables and tranquillity is linear and that tranquillity is an ordinal variable. In fact, this relationship is not linear and tranquillity scores are better treated as nominal.
5. The method can be tricked, for example, by choosing where to sample the visual measures to deliberately include or remove factors such as litter which would affect the score.
6. The method assumes that people's response to road traffic noise is linear. However, this is not the case. People tend to filter out noise from road traffic so that it has less impact as levels drop below about 50dB and are more conscious of, and feel a greater intrusion from, road traffic noise at higher levels (above about 58dB). In addition, the intrusion of road noise is relative. The relationship between road traffic and reduction in tranquillity scores is not linear, as illustrated in Figure 3.1, which shows the relationship found during research for the Natural Tranquillity Method.

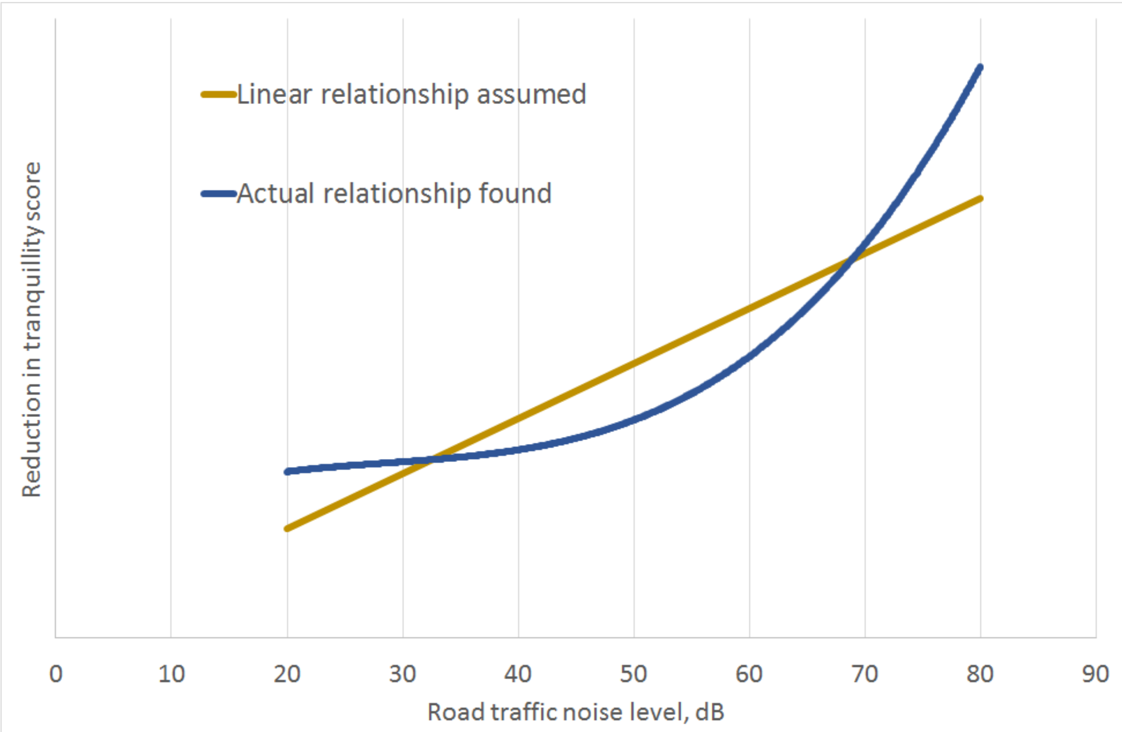

Figure 3.1 Graph illustrating relationships between road traffic noise impact and reduction tranquillity scores using different methods (the curve is indicative only: where ambient levels are very low, road traffic can have a greater effect between 30 and 40dB than shown here)

Although the University of Bradford method (as we shall see) provides a less reliable assessment than the Natural Tranquillity Method, it is still useful in some circumstances. It is not affected by seasonal variations or differences in weather conditions and may prove valuable in an area without people; where natural sounds are not high enough to mask road traffic; or where there are no aircraft or trains. However, given the complexity of most locations and the lack of reproducible findings to support some of the theoretical assumptions of the method, it does not provide a robust assessment of the sort which would be required when producing expert evidence for a legal case or a planning appeal. It also appears to provide better tranquillity scores in many situations than those reported by subjective observers; possibly because it does not take account of the activities of people who may be present.

THE CPRE METHOD

The Campaign to Protect Rural England (CPRE) produced a *Tranquillity Map for England* in 2006 and *Tranquillity Mapping: Developing a Robust Methodology for Planning Support* in 2008.[5, 6] This built on an earlier assessment of tranquillity within the Chilterns Area of Outstanding Natural Beauty (AONB) which involved a participatory appraisal of the views of people in the Northumberland National Park and West Durham Coalfield in County Durham.

The work to develop the CPRE method was extensive and provided a valuable database of information about the factors which influence perception of tranquillity in a location. The *Tranquillity Map for England* (updated in 2011) is an impressive achievement and has led to the UK Government revising its Planning Policy in 2012 to include tranquillity in the planning process for the first time.

Their tranquillity mapping is produced using a Geographical Information System (GIS); a computer-based system for the integration, analysis, modelling and mapping of geographical data. It uses the Participatory Appraisal (PA) results to identify the significance of different features and then associates these features with nationally available datasets. Predictions are made of the presence, level or amount of each feature based on information within the GIS dataset and these values are then weighted in the analysis (dependent on the PA survey results) to provide a tranquillity score for each 500 x 500 metre square grid.

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[5] The research was carried out by the Centre for Environmental and Spatial Analysis (CESA) and PEANuT (Participatory Evaluation and Appraisal in Newcastle upon Tyne) project at Northumbria University, in collaboration with Bluespace Environments, Durham and Newcastle Universities.
[6] Jackson S, Fuller D, Dunsford H, and Mowbray R (2008), *Tranquillity Mapping: Developing a Robust Methodology for Planning Support*. Report to the Campaign to Protect Rural England, Centre for Environmental and Spatial Analysis, Northumbria University, Bluespace environments and the University of Newcastle upon on Tyne.

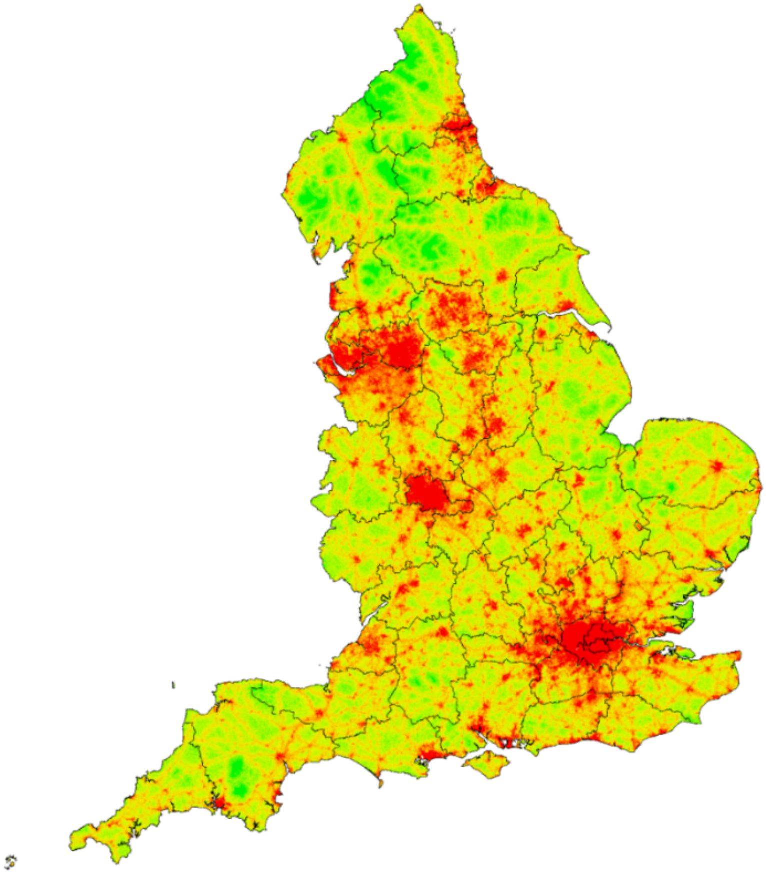
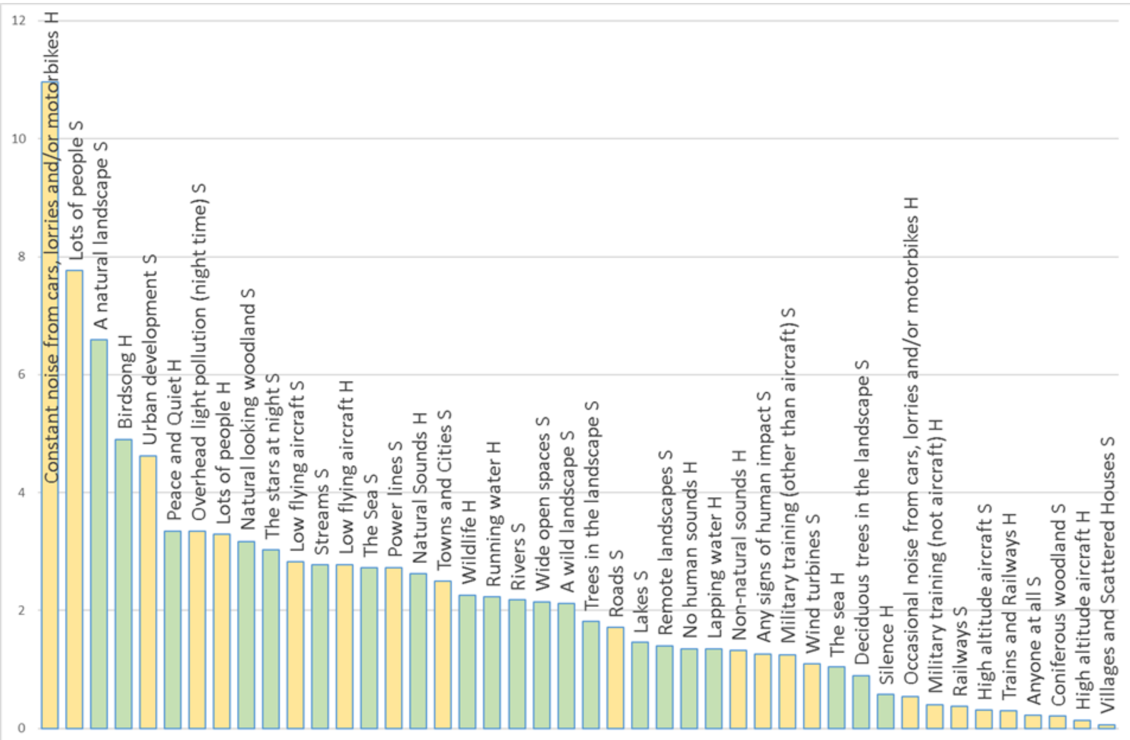


Figure 3.2 CPRE National Tranquillity Mapping Data 2007 developed for the Campaign to Protect Rural England and Natural England by Northumbria University. © Crown Copyright and database rights 2019. Ordnance Survey licence number 100022021. See Appendix C for credits and data sources.

The features and weightings given in the GIS system are shown in Figure 3.3 (yellow indicates a negative effect on tranquillity, green indicates a positive effect). The weightings, which indicate the relative importance of each factor are shown on the y axis. The designation 'H' refers to factors which affect 'Hearing', and 'S' refers to 'Seeing'.

Without doubt, this research was incredibly important and led to the policy requirement to protect tranquillity. The following discussion of its limitations do not detract from this important innovation.

Figure 3.3 Graphical representation of weightings given to features, based on CPRE research



Limitations of the CPRE method

1. Any area less than 500 x 500 metres is given a single tranquillity value. In fact, noise levels vary significantly over such a distance and, since tranquillity is largely a function of noise, such a low resolution renders the method of little practical use for the consideration of most situations for planning or design purposes.

2. People's response to road traffic noise is assumed to be linear but this is not so (as discussed above).

3. The only non-natural sounds considered are those from transportation sources. This means that a location exposed to significant industrial noise would be considered tranquil if it was screened visually so that you could not see it (by a natural tree belt, for example). In fact, of course, such noise could significantly detract from tranquillity.

4. The approach assumes that birdsong, wildlife and other natural sounds (excluding the sounds of water and the sea) would only be present where noise from transportation is low and considers that this would occur when the level is less than 25dB. The method assumes that such low noise areas are places where:

   > '… there is an opportunity to hear non-human sounds that would otherwise be drowned out.'[7]

   However, natural sounds are not only present in areas with very low transportation noise. For example, a country park might provide noise from birdsong and leaf rustle at a level of 48dB, with distant road traffic at a level of 36dB. The CPRE method would predict that natural sound would be 'drowned out' and the area would have relatively poor tranquillity; however, the location may feel quite tranquil since the natural sounds would dominate. This may be the biggest limitation of the CPRE method because the balance between man-made and natural sounds has been found to be a crucial factor affecting how tranquil a location is likely to be perceived to be.

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[7] Jackson, S., et al., op. cit.

5. The predictions of noise levels from road traffic are unreliable. Sound attenuation due to distance, air and ground absorption are considered but no account is taken of local topography or the presence of any structures which might provide screening or reflection of sound. The calculations also assume certain flows and speeds for road traffic. These are likely to overestimate the noise levels from smaller rural roads as it is assumed that such roads have 1000 vehicles per day, travelling at 60 miles per hour. In many rural areas, flows are lower than this and speeds on smaller country roads will often not reach 60 mph.

6. The methods for assessing the contribution of rail and aircraft noise are unreliable. First, it is assumed that these two sources can be treated in the same way. In fact, it is generally agreed that rail noise is considerably less annoying than road traffic or aircraft noise. Second, the impact assessment for these sources assumes that all aircraft produce the same noise level and are audible for two minutes when flying over and that all trains produce the same noise level and take 30 seconds to pass a point. In fact, experience shows that the trains having the greatest impact on tranquillity are freight trains, which often take 75 to 90 seconds to pass a point; and that aircraft may have little impact if at high altitude but may have a significant effect at low altitude. Also, using a single value for source noise level is unreliable, since there is considerable variation between noise levels from, for example, a three-carriage suburban passenger train and a fast, inter-city train with 12 carriages. The same is true for aircraft.

The CPRE research states the assumption that, when modelling noise from transportation sources:

> 'The cut off figure for noise attenuation is 25dB, when noise diffusion of a given source has reached ambient noise levels, giving the maximum distance away from which the original noise cannot be heard.'[8]

This assumption is incorrect since, in the majority of outdoor locations around England, daytime ambient noise levels are considerably above 25dB (See Figure 6.1).

[8] Jackson, S., et al., op. cit.

7. The approach assumes that it is the number of other people which is intrusive. However, people do not always detract from reported experiences of tranquillity. A group of students quietly studying in an urban park would have a different impact on tranquillity from the same group playing football. It is not the simple presence of other people which affects tranquillity, but their behaviour.

   Urban parks, country parks and woodlands that are full of people, including noisy family groups, are often considered ‘fairly tranquil’. The work of Liz O’Brien and others (described in Chapter 2) shows that some people need to see others around them to feel secure before they are able to experience tranquillity.

   The CPRE method over-emphasises the importance of the presence of others as a detractor from tranquillity in some situations.

The Participatory Appraisals (conducted 2004 – 2006), from which the importance of tranquillity factors was developed, were carried out in rural areas meaning that the results are not representative of the UK population.[9] Although CPRE research provides a reliable survey of the opinions of people who live in or visit the countryside, they do not necessarily reflect the views of the wider population.

This may mean that the CPRE method cannot be applied reliably in urban areas because most of the factors people said they needed to be present for a location to be described as tranquil are not present in a city. Also, in cities there is almost always some road traffic noise and people are present; there is, by definition, ‘urban development’ all around and many other features which detract from tranquillity according to the views of those participating in the study. Nevertheless, you can visit many locations within cities and busier country parks which people say they value for their tranquillity.

Thus, although the CPRE approach has provided a very effective way of highlighting the importance of tranquillity in rural areas across England, it does not provide us with a way to identify how individuals will experience places.

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[9] Jackson, S., et al., op. cit.

Applying the CPRE method

In 2010, the method was assessed at Cranborne Chase and West Wiltshire Downs Area of Outstanding Natural Beauty (AONB).[10, 11] It was found that there were significant discrepancies; the CPRE method did not match what was found on the ground.

By far the greatest difference between predicted tranquillity and surveyors' observations was found in relation to low noise areas: the CPRE method gave zero scores but surveyors found them to be tranquil. This occurred where there was an abundance of natural sounds but the method was unable to identify these due to its limitations (see number 4, above).

In relation to non-natural sounds, the surveyors noted a wide variety of man-made sounds which they felt affected tranquillity (e.g., agricultural sounds, lawn mowers, distant artillery and low flying military aircraft from nearby Salisbury Plain) but which the method failed to properly account for.

Overall, the study concluded that the CPRE method gave the following factors too much weight:

> seeing the stars at night, seeing a natural landscape, hearing running water, seeing streams and rivers, and seeing and hearing lots of people.

At the same time, the method gave the following factors insufficient weight:

> hearing low noise areas, seeing urban development, and seeing overhead pollution.

Scoring 'seeing a natural landscape, hearing and seeing running water, streams and lots of people' too highly is a common error corrected by the Natural Tranquillity Method (see later).

The New Forest National Park commissioned a mapping exercise in 2014, which included ground truthing (checking figures on the ground) and did not use the CPRE method published in 2006, preferring instead to use the CPRE's 1996

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[10] Ground truthing. According to Wikipedia, "The collection of ground-truth data enables calibration of remote sensing data, and aids in the interpretation and analysis of what is being sensed."

[11] Cranborne Chase and West Wiltshire Downs Area of Outstanding Natural Beauty. *Tranquillity Mapping Ground Truthing Methodology and Interim Report*, July 2010

approach, despite acknowledged criticisms. In relation to the more recent CPRE method the National Park felt that:

> '… these new maps of tranquillity failed to capture some local significant effects on tranquillity, and in the New Forest the positive effects of the natural land cover 'dilute' the negative effects from significant roads (particularly the A31 which cuts through the National Park) making the resulting map less meaningful on a local scale.'[12]

The fact that the CPRE method is unable to capture the positive effect of natural sounds is likely to be the main cause of this.

In 2017, the South Downs National Park Authority mapped relative tranquillity within the national park using the CPRE method. Their report describes the difficulty of assessing 'the view' at a location in which the view is partially obscured. They concluded that areas that are most susceptible to change are to a degree more tranquil than the original CPRE desk-based study suggests. [13]

Again, since the CPRE method is not able to take account of the positive effects of natural sounds on perceptions of tranquillity it is to be expected that it will underestimate the tranquillity in many circumstances, particularly in areas where natural sounds are dominant and high levels of tranquillity may be present.

CPRE method in summary

The CPRE maps for relative tranquillity across England have provided a helpful tool for comparing how some of the factors which affect tranquillity have changed over the years and to help to identify areas which may be tranquil as part of the campaign to protect these places. However, the process of turning a vast amount of data into maps necessitated some significant assumptions and generalisations that do not—and, in fairness, do not claim to—give a great deal of information about specific locations. As a result, all cities and larger towns are uniformly classified as 'not at all tranquil' and all areas which are remote from urban development and roads and which have pleasant views are classified as having 'relatively good' tranquillity. Tranquillity maps provide a useful rough guide but are not reliable for specific locations.

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[12] *New Forest Park Tranquil Area Mapping*. Report prepared by LUC London for New Forest National Park, 2015

[13] South Downs National Park Authority. *Tranquillity Study 2017*

OTHER METHODS

There are a few other approaches which have tried to assess tranquillity for one-off projects such as that used by Red Kite Environment when considering tranquillity in Cannock Chase Area of Outstanding Natural Beauty, and that used by consultants at Scott Wilson when considering tranquillity in Westminster Parks in the Westminster Open Spaces Noise Study in 2008. It is interesting to note comparisons. Both approaches found that the presence of nature enhanced tranquillity and that man-made sound detracted from it. Both also found lower noise levels were beneficial for tranquillity.

However, there were some differences between the factors these two studies rank as most and least important for the assessment of tranquillity. Whereas the AONB study (conducted in a rural area) reports that the presence of people contributed negatively to tranquillity (and that solitude was desirable), the central London study did not identify presence of people as a negative factor unless those people were asking for money or using mobile phones. Also, in the rural location, people ranked 'quiet' as the single most important beneficial factor, whereas in central London 'hearing complete silence' featured as a negative factor.

THE NEW METHOD

The fact that planning guidance now specifically mentions tranquillity is a considerable achievement resulting from the CPRE method and tranquillity maps. However, none of the other approaches provides reliable, high resolution information or maps to show how tranquil a location is felt to be.

The need for an empirical, evidence-based formula which accounts for sound level and character, as well as other factors has led to the evolution of new methodology based on the work of these pioneers.

I have called this the **NATURAL TRANQUILLITY METHOD**; it is presented and explained in the following chapters.

Appendix D: Use of the Natural Tranquillity Method in other significant planning decisions

Daw Mill Colliery: North Warwickshire

In January 2017 the NTM was used to assist a public inquiry considering an appeal against the refusal of planning permission for development at this former colliery site. The proposed scheme would have provided general industrial use (likely involving locomotive maintenance or similar) and permission was refused in part, due to concerns about potential noise impact. Local people appreciated the site and surroundings for its 'quiet, rural character.'

The Natural Tranquillity Method was used to assess the potential impact on tranquillity from the proposal to develop the land for industrial use at the former colliery site.

The site is in a shallow valley with a small stream (the River Bourne) in the centre. The area around the site was found to be overgrown and supported a range of wildlife. There were footpaths running along the edge of the former colliery up to and across the valley.

The Birmingham to Leicester railway runs along the southern boundary and trains are audible for about 7% of the time between 0700 and 1900 hours. Throughout the site there was little man made sound. Non-natural sounds detected were from rail, road and occasional light aircraft. Natural sounds comprised birdsong (which was significant) and some water noise. The assessment found that the site and the immediate surroundings could be considered to have fair or good tranquillity.

It was found that the proposed development would result in a reduction in tranquillity to the key features of the site and surroundings (such as the footpath network). This conclusion, along with supporting data and tranquillity maps were given in evidence to the inquiry.

In March 2018, the Secretary of State issued a decision to refuse the appeal against the refusal of planning permission.

Under the heading "Tranquillity" the decision stated:

> *"… the Secretary of State agrees with the Inspector that there can be no surety that the noise from the rail-related uses would not give rise to significant adverse impacts on the long term health and quality of life of residents and those who enjoy the countryside, which would be conflict with CS Policy NW12 [which is a North Warwickshire Local Plan Policy]. The Secretary of State gives significant weight to this against the proposal."*

A303 Stonehenge bypass

In January 2017, the UK Government announced its intention to commission a £1.6 billion highways project to develop a 2.9km tunnel under the Stonehenge site. The main reasons given were to ease traffic congestion on the nearby A303 and improve tranquillity and visitor experience by removing the sight and sound of traffic.

The NTM was used to assess whether the removal of the A303 would, in fact, have a positive beneficial effect on tranquillity at the henge.

A survey of existing tranquillity was carried out at the site. It was found that due to the way the site is accessed (with visitors restricted to a designated route), there were two areas where visitor density was particularly high — the two narrow pathways to the north of the stones, and the west. These paths were noisy and congested during busy periods.

Although road traffic noise from the A303 could be heard across the Stonehenge site, the most significant source of noise on site came from human voices and audio guides.

It was found that the removal of the road would result in a considerable improvement in tranquillity in the wider area around the henge but that, since the main detriment to tranquillity at the site was due to noise from tourists, removing the road would have a negligible effect on a visitor's experience of tranquillity at this site.

The busy areas would remain busy and the rest of the site would still be 'not quite tranquil'.

In summary, the site was found to be not tranquil and removing the A303 would result in no noticeable improvement in tranquillity experienced by visitors to Stonehenge. This finding was found to be valid by the Examining Authority in their decision.

Sizewell C nuclear power station

The NTM was used to underpin the submitted amenity and recreation assessment to the DCO examination process for Sizewell C nuclear power station project. This large, nationally significant infrastructure project is planned to be constructed in an Area of Outstanding Natural Beauty (AoNB) on the Suffolk Coast.

To assess the likely impact on tranquillity of the 10-year construction project, a team of six surveyors spent six months surveying the Suffolk Coast and Heaths area that includes RSPB Minsmere and Thorpeness.

In addition to the impact of the construction work on tranquillity in the AoNB, the NTM was used to consider the impact of two new proposed road schemes (which would be an integral part of the project) on a number of villages in a rural part of Suffolk.

The Examining Authority's (ExA) report felt that the way that the potential impact had been considered was notable and helpful, stating, at para 5.18.160 to 5.18.162 of their report, in relation to tranquillity:

> *"The veracity of the assessment was accepted by all parties as a fair and reasonable portrayal of the current and likely future position through the construction phases of the Proposed Development. It describes the baseline sound environment in these areas and describes the likely sound effects from the likely construction activities. These descriptions from the ExA's experiences fairly reflect the current experiences that people have when visiting the AONB and the public Right of Way within this area.*
>
> *The ExA is appreciative that as a tranquillity assessment, this is an important piece of evidence which reflects the broader appreciation of the natural environment in a way which a more traditional noise assessment might do."*

Appendix E: Tranquillity score predictions

Table E1: Baseline results and tranquillity scores when port is noisy

Location	NAMM	PONS	L_{RR}, dB	L_{AT}, dB	Tranquillity scores
1	2	5	15	45	5 - neutral
2	3	5	15	38	6 – fairly tranquil
3	3	5	15	38	6 – fairly tranquil
4	5	95	15	35	8 – excellent tranquillity
5	5	95	15	37	8 – excellent tranquillity

Table E2: Baseline results and tranquillity scores when port is not busy

Location	NAMM	PONS	L_{RR}, dB	L_{AT}, dB	Tranquillity scores
1	5	85	29	39	7 – good tranquillity
2	5	90	29	39	7 – good tranquillity
3	5	95	28	38	8 – excellent tranquillity
4	5	95	15	35	8 – excellent tranquillity
5	5	95	15	37	8 – excellent tranquillity

Table E3: With development values and tranquillity scores when port is noisy

Location	NAMM	PONS	L_{RR}, dB	L_{AT}, dB	Tranquillity scores
1	2	0	15	45	5 - neutral
2	3	0	15	41	6 – fairly tranquil
3	3	0	15	42	6 – fairly tranquil
4	2	0	15	41	5 - neutral
5	5	95	30	38	7 – good tranquillity

Table E4: With development values and tranquillity scores when port is not busy

Location	NAMM	PONS	L_{RR}, dB	L_{AT}, dB	Tranquillity scores
1	4	0	15	34	7 – good tranquillity
2	3	0	15	41	6 – fairly tranquil
3	3	0	15	42	6 – fairly tranquil
4	2	0	15	41	5 - neutral
5	5	95	30	38	7 – good tranquillity