

Technical Appendix 1.5: Eskdalemuir Seismic Impact Report

Eskdalemuir Seismic Array Considerations

Technical Report – Ravengill Energy Park

Client: Renewco Power Ltd

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1. Executive Summary

This report has been prepared by Xi Engineering Consultants on behalf of Ravengill Energy Park Limited, which is wholly owned by Renewco Power Limited, in relation to the proposed Ravengill Energy Park.

It has been prepared following two very recent Government actions relevant to the Eskdalemuir Seismological Array (“the Array”):

- the Ministry of Defence (“MoD”) confirmed that, with effect from 18 March 2026, it had adopted a revised safeguarding approach for the Array; and
- DESNZ published its consultation on the revised approach to managing onshore wind turbine interference with the Array on 20 March 2026, with the consultation closing at 17:00 on 12 June 2026.

Renewco Energy asked Xi Engineering Consultants to assess what those developments mean for Ravengill and, in particular, whether the site appears capable of proceeding under both the current MoD safeguarding route and the framework proposed through the DESNZ consultation.

Xi’s conclusion is clear. On the evidence set out in this report, Ravengill is capable of being accommodated under the framework proposed through the DESNZ consultation under most scenarios, in particular with the route recommended by industry bodies. However, it is not capable of being accommodated under the current MoD safeguarding route using the current 2014 algorithm.

Under the proposed DESNZ route, the current formal SGV report shows that Ravengill lies outside the proposed 15 km Exclusion Zone, that the selected candidate turbine has a calculated SGV of 0.006816nm against a site SGV requirement of 0.019136 nm, and that the site would not be constrained by SIL. The DESNZ consultation has a range of headroom (0.206324 – 0.245040nm) and SIL (0.004614 to 0.005479 nm·MW-0.5)

Were the lower value of the headroom be adopted, Ravengill would not automatically have sufficient budget within the 0.336nm budget. Ravengill would only have sufficient budget should some of the projects higher in the planning order be unsuccessful and be removed from the planning order.

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For reference the recent developments can be found at the following links

[MoD Consultation Response](#)

[DESNZ Eskdalemuir consultation](#)

[Scottish Renewables Eskdalemuir page hosting appendices](#)

2. Purpose of this Report

This report has been prepared by Xi Engineering Consultants on behalf of Renewco Energy in relation to the proposed Ravengill Energy Park.

Its purpose is to provide technical evidence on whether Ravengill can be accommodated within both the current MoD safeguarding route and the framework proposed through the current DESNZ consultation, and to explain that position clearly enough to support Renewco Energy's submission to the Energy Consents Unit as part of the Section 36 application.

More specifically, the report is intended to:

- summarise the current MoD and DESNZ positions relevant to Eskdalemuir;
- explain the practical implications of those positions for Ravengill;
- set out the current formal Seismic Ground Vibration ("SGV") position for the site;
- evidence whether Ravengill is capable of falling within the framework proposed by Government;
- show that the site can also be accommodated under the current MoD route; and
- provide the technical basis for Renewco Energy's position that determination on the Eskdalemuir aspect should be delayed until the current consultation process has concluded and Government has published its response.

The timing of the current Government process is central to that assessment:

- the MoD confirmed that, with effect from 18 March 2026, it had adopted its revised safeguarding approach, applying to pending applications and future applications;
- the DESNZ consultation on the updated approach was published on 20 March 2026 and remains open until 17:00 on 12 June 2026;
- DESNZ states that the draft Technical Guidance does not represent a final position from Government;
- DESNZ further states that the draft Technical Guidance should not be used by local planning authorities during or after the consultation period in relation to ongoing planning applications.

This report is therefore not written against a settled final framework. It is written against a live but clearly defined transition. The question addressed here is whether Ravengill can be shown, on the evidence currently available, to fit within that transition and the framework emerging from it. Xi's opinion is that it can.

3. Current Government Position and Why It Matters for Ravengill

The current Eskdalemuir position is being shaped by two linked Government actions.

The first is the MoD's revised safeguarding approach. In its consultation response, the MoD confirms that, from 18 March 2026, the revised approach applies to pending applications and future applications. It also confirms that requests submitted for scoping are not treated as applications for consent and have been removed from the list maintained by the MoD for cumulative assessment against the 0.336 nm threshold. The MoD further states that, at this stage, it has run its audited baseline against the 2014 algorithm, not a revised algorithm, because the technical work for a revised algorithm still has to be completed, reviewed and accepted.

The second is the DESNZ consultation, published on 20 March 2026. DESNZ states that without a change in approach, no new projects are likely to be consented within 50 km of the Array. It also states that the proposed new framework aims to open this area to new onshore wind development and maximise the potential generation capacity while safeguarding the Array. The consultation proposes, amongst other matters, a 15 km Exclusion Zone, a revised cumulative SGV methodology, and a Seismic Impact Limit ("SIL") for individual turbines. DESNZ also makes clear that available headroom is subject to the project pipeline at the point regulations come into force, and that the draft Technical Guidance does not represent a final Government position.

These two developments matter directly to Ravengill.

The MoD position defines the route that currently applies. The DESNZ consultation defines the route Government is now seeking to put in place in order to move beyond a system in which otherwise acceptable projects can be constrained by a conservative and transitional safeguarding approach.

For Ravengill, Xi's assessment is that the site is capable of being accommodated under the scenario recommended by industry bodies in the approach set out by the DESNZ consultation, but not the current MoD route, which relies on the 2014 algorithm. That is the central point. Ravengill is a site with a credible and technically evidenced pathway through the Eskdalemuir framework. However should the DESNZ consultation approach with a lower value of headroom be chosen, Ravengill would need some of the projects ahead of it in the planning order for available budget managed by MoD to be unsuccessful. This is in order to make sufficient budget available to allow MoD remove an objection to the proposed development proceeding.

4. Site Description and Assessed Basis

The proposed development comprises 21 turbines with a tip height of up to 220 m, and associated infrastructure. Table 1 shows the locations of the turbines in Eastings and Northings.

Turbine ID	Easting	Northing
T1	287971	618974
T2	288264	618355
T3	286849	618133
T4	287226	617738
T5	287709	617214
T6	286364	617049
T7	286646	616715
T8	286963	616303
T9	291850	619544
T10	292680	619542
T11	293040	619047
T12	292389	618783
T13	291144	619062
T14	291257	618660
T15	291738	618565
T16	292036	617853
T17	290720	618062
T18	291330	617871
T19	291316	617317
T20	290077	618173
T21	290485	617374

Table 1 – Turbines locations assessed for Ravengill

The project basis considered in this report is a turbine envelope of up to 7.0 MW, with a maximum rotor diameter of 170 m and a maximum blade tip height of 220 m. The candidate turbine basis considered for the site is the Siemens SG7.0-170.

The formal Seismic Ground Vibration (SGV) report generated for Ravengill records the site on the basis of 21 turbines, a 100 m micro-siting allowance, and the assessed layout coordinates for the proposed development.

For the purposes of the formal SGV route, the candidate turbine selected within the report is identified as the ATL-GSF Siemens SG 155, 155 m rotor, 122.5 m hub height, 6.6 MW type. This is the closest turbine type currently live within the industry tool and considered valid.

The formal SGV report uses the currently available registered turbine basis to evidence whether the site can be accommodated within the proposed technical framework.

This report adopts that same distinction. The planning envelope is the project basis. The formal SGV report is the current process-aligned evidential basis for testing the site against the emerging Eskdalemuir framework.

5. Evidence That Ravengill Can Be Accommodated Under Current MoD Safeguarding Approach

The first question is whether Ravengill can be accommodated under the revised and current MoD safeguarding approach, issued in their consultation response in March 2026.

<https://www.gov.uk/government/consultations/consultation-on-the-ministry-of-defences-approach-to-safeguarding-the-eskdalemuir-seismological-array/outcome/mod-response-to-consultation-on-the-ministry-of-defences-approach-to-safeguarding-the-eskdalemuir-seismological-array>

In our analysis, these are scenarios 1 & 2 described in Appendix B, section 10.2.

Xi's opinion is that it cannot be currently accommodated should the current MOD approach (March 2026) to be adopted with immediate effect AND Scoop Hill were to be removed from the Planning order, prior to the DESNZ consultation process being in place.

Scoop Hill Wind Farm was refused by Scottish Ministers under DPEA reference WIN-170-2008, with the DPEA case page recording that the decision was issued on 5 February 2026 and the appeal dismissed. However, as Community wind Power (CWP) have raised a Judicial Review of this process, it still remains in the planning order until the stage this is concluded.

If Scoop Hill JR were to be decided such that the site could be removed from the planning order, AND the MoD released the remaining budget using the 2014 algorithm, the headroom would be mostly consumed. As a result, this would affect nearly all sites in the planning process which were yet to be determined, as far fewer sites would be able to be accommodated under the diminished headroom. DESNZ is aware of this timing issue.

This means that Ravengill does depend on the DESNZ framework alone. The site is only supportable if the new framework is introduced, Xi's calculations indicate that it cannot be accommodated under the current MoD route, applying the present planning-order position and the conservative 2014-algorithm.

It is believed that due to consultation timing and until the judicial review of Scoop Hill is concluded, that there is low risk of implementation of the current MoD route under either of scenarios 1 or 2.

6. Evidence That Ravengill Can Be Accommodated Under Proposed DESNZ Framework

The second question is whether Ravengill can be accommodated within the framework proposed by DESNZ. In our analysis, these are the Scenarios 3, 4, 5 & 6 described in Appendix B, section 10.2

Again, Xi's opinion is that it can, for two specific scenarios (one of which is recommended by the wider industry), with potential for a further scenario to become applicable.

The formal SGV report generated for Ravengill (see Appendix A) states that no turbine or turbine foundation is within the 15 km Exclusion Zone when micro-siting is taken into account. This is the first and most basic requirement under the proposed framework, and the proposed development satisfies it.

The report further identifies a candidate turbine calculated SGV of 0.006816 nm and a site SGV requirement of 0.019136 nm. On that basis, the selected candidate turbine lies below the SGV requirement for the site. This is the central technical evidence that the site can be accommodated within the SGV-based framework proposed by DESNZ.

The report also records the SIL position, which states that all turbines are compliant with a SIL within the full range of $0.004614 \text{ nm} \cdot \text{MW}^{-0.5}$ to $0.005479 \text{ nm} \cdot \text{MW}^{-0.5}$. This is due to the relatively large distance between Ravengill and the EKA (with the closest turbine 36.3 km away from the EKA).

Out of the 4 scenarios analysed for the DESNZ framework, Ravengill can be accommodated under two scenarios – Scenario 6, in addition to Scenario 5. This is important because Scenario 6 (Headroom = 0.245040 nm (least stringent) and $\text{SIL} = 0.005479 \text{ nm} \cdot \text{MW}^{-0.5}$ (least stringent)) is the scenario recommended for implementation by the wider industry. Scenario 5 is similar to Scenario 6, but applies the more stringent SIL ($\text{SIL} = 0.004614 \text{ nm} \cdot \text{MW}^{-0.5}$)

There is also potential for Ravengill to be accommodated under Scenario 3, with some specific nuances. The calculations show that under Scenario 3 (Headroom = 0.206324 nm (most stringent) and $\text{SIL} = 0.004614 \text{ nm} \cdot \text{MW}^{-0.5}$ (most stringent) the site cannot **currently** be accommodated. However, this scenario includes sites in planning rather than reflecting the real-world headroom if and when sites further up the planning order are deployed, or if they are removed from the planning system entirely. It's likely that Ravengill would then be able to be accommodated under this scenario.

Taken together with the exclusion-zone result and the candidate SGV result, the SIL analysis evidence shows that there is high confidence that Ravengill is capable of being accommodated within the DESNZ framework for the scenarios being recommended through industry bodies.

7. What This Means in Practical Terms

Xi's calculations indicate that the site cannot be accommodated under the current MoD route, following refusal of Scoop Hill and applying the conservative 2014-algorithm / no-SIL / 0.206324 nm headroom case. The formal SGV report shows that the site can be accommodated under the proposed DESNZ route, with the least stringent headroom, with the site outside the proposed exclusion zone, a candidate turbine below the site SGV requirement, and within the current SIL range ($0.004614 \text{ nm} \cdot \text{MW}^{-0.5}$ to $0.005479 \text{ nm} \cdot \text{MW}^{-0.5}$). These are Scenarios 5 & 6 in the Xi analysis.

If Scenario 3 is implemented, there is also a possibility for Ravengill to be accommodated through this scenario, but would depend on activities on other windfarms higher up the planning order.

8. Conclusion

On the evidence set out in this report, Ravengill cannot be accommodated under the current MoD safeguarding route based on the application of the 2014 algorithm, but could be accommodated by the framework proposed through the DESNZ consultation. Under the approach set out in the DESNZ consultation, the proposed development could be accommodated within several of the defined scenarios, including the industry recommended scenario.

Under the proposed DESNZ route, the formal SGV report shows that the site lies outside the proposed 15 km Exclusion Zone, that the selected candidate turbine has a calculated SGV of 0.006816nm against a site SGV requirement of 0.019136 nm, and that the site has a strong route through the proposed SIL position, covering the whole range of $0.004614 \text{ nm} \cdot \text{MW}^{-0.5}$ to $0.005479 \text{ nm} \cdot \text{MW}^{-0.5}$.

Accordingly, Ravengill Energy Park's position is supported by the technical evidence set out in this report: the Eskdalemuir aspect should not be finally determined until the current DESNZ consultation process has concluded and Government has published its response.

9. Appendix A – Formal SGV Report

This appendix contains the formal Seismic Ground Vibration Report generated for Ravengill Wind Farm on 28 May 2026. It is included as the primary process-aligned evidence for the site's position under the framework proposed through the DESNZ consultation. In particular, it records that no turbine or turbine foundation lies within the proposed 15 km Exclusion Zone when micro-siting is taken into account, identifies a candidate turbine calculated SGV of 0.006816 nm against a site SGV requirement of 0.019135 nm, and records the site's SIL position.



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(NB: The full contents of this report is included at the end of this document)

10. Appendix B – Full Technical Results

This section summarises results based on assumed 170 m rotor diameter, 135 m hub height and 220 m tip height. Seismic budget calculations show the overall seismic noise contributions of turbines installed at Ravengill Energy Park as well as the individual turbine contributions.

The SIL calculations show if all turbines could be built at Ravengill Energy Park while meeting the SIL for different deployments. The SIL is currently expected to be within the range of 0.004614 to 0.005479 nm·MW^{-0.5}.

10.1. Seismic Budget Requirements

The following tables show the SGV budget requirement for all three scenarios with and without background removed.

Ravengill Wind Farm – 21 Turbines			
Model		With background noise	Without background noise
		Seismic level (nm)	Seismic level (nm)
2014 Standard EKA Algorithm		0.025447	0.020357
Phase 4 Synthetic models	Siemens	0.016225	0.012980
	Senvion	0.010800	0.008640
	Vestas	0.017883	0.014306
	GE	0.019136	0.015309
	Nordex	0.015817	0.012654
	Enercon	0.014804	0.011843
Scaled direct measurements	SG155	0.006816	0.005453
Non-scalable direct measurements	N163	0.009403	0.007522
	N149	0.015319	0.012256

Table 2 - Seismic results of scenarios modelled using the 2014 Standard EKA Algorithm, Phase 4 data plus SG155, N163 and N149 (all results are in nm).

10.2. Planning List Scenario Results

The tables below represent the seismic budget of wind farms within the Eskdalemuir Consultation Zone in the order that they will be built should planning be approved. Once the seismic budgets of these farms cumulatively exceed the overall limit of 0.336 nm, no more turbines may be built.

This section represents scenarios that consider the potential range of seismic headrooms considered by the MoD (0.206324 – 0.245040 nm) as well as the potential SILs considered by the Scottish Government (0.004614 to 0.005479 nm·MW^{-0.5}).

Using these headrooms and SILs, the queue of sites within the ECZ in planning and S36 Scoping is used to estimate the overall seismic budget requirements and predict at what point the 0.336 nm limit is reached and if there is enough budget remaining to enable Ravengill Energy Park to be built.

In the scenario that Scoop Hill is removed from the queue without a successful Judicial Review of the refusal by Scottish Ministers (Scenario 1), according to current policy it is likely that no SIL will be applied and instead the 2014 Standard EKA Algorithm will be employed on all future sites.

As Ravengill is close to the outer range of the 50 km ECZ (36.3 – 41.9 km), it is likely that enough budget will remain for 2 of the 6 of the realistic queue scenario considered (Scenarios 5 & 6), with potential for a third (Scenario 3).

With this, the following worst case queue scenarios were analysed to demonstrate Ravengill's position:

1. Scoop Hill removed – No SIL applied – 2014 Standard EKA Algorithm employed on all future sites (Headroom = 0.206324 nm)
2. Scoop Hill removed – No SIL applied – 2014 Standard EKA Algorithm employed on all future sites (Headroom = 0.245040 nm)
3. Headroom = 0.206324 nm (most stringent) and SIL = 0.004614 nm·MW^{-0.5} (most stringent)
4. Headroom = 0.206324 nm (most stringent) and SIL = 0.005479 nm·MW^{-0.5} (least stringent)
5. Headroom = 0.245040 nm (least stringent) and SIL = 0.004614 nm·MW^{-0.5} (most stringent)
6. Headroom = 0.245040 nm (least stringent) and SIL = 0.005479 nm·MW^{-0.5} (least stringent)

As can be seen in the tables below, results indicate that there should be enough remaining seismic budget for Ravengill Energy Park to be built according to 2 of the 6 identified potential Scenarios (Scenarios 5 & 6), with a potential for a further scenario (Scenario 3) which is dependent on progression of other wind farm developments.

10.2.1. Scenario 1

Scenario 1 Summary:

- Assumes Scoop Hill is removed with no appeal which triggers the use of 2014 algorithm to calculate seismic budget for all future sites in queue.
- **Headroom** = 0.206324 nm (worst-case headroom in range)
- **SIL** = No SIL
- **Computer Model** = StandardEKA for all sites

Wind Farm	Status	Computer Model Used	Farm Amplitude (nm)	Cumulative Amplitude (nm)
Harestanes South WF Ext	Not Determined	StandardEKA	0.041407	0.268404
Daer Reservoir	Not Determined	StandardEKA	0.055712	0.274125
Little Hartfell	Not Determined	StandardEKA	0.160154	0.317481
Greystone Knowe	Not Determined	StandardEKA	0.008244	0.317588
Grayside WF	Not Determined	StandardEKA	0.026064	0.318655
Teviot WF	Not Determined	StandardEKA	0.333496	0.461260
Callisterhall WF	Not Determined	StandardEKA	0.075295	0.467365
Bloch WF	Not Determined	StandardEKA	0.078577	0.473925
Millmoor Rig WF	Not Determined	StandardEKA	0.024769	0.474572
Scawd Law WF	Not Determined	StandardEKA	0.014213	0.474784
Bodinglee WF	Not Determined	StandardEKA	0.017744	0.475116
Rivox WF	Not Determined	StandardEKA	0.103542	0.486267
Torfichen WF	Not Determined	StandardEKA	0.005463	0.486298
Balgray	Not Determined	StandardEKA	0.101715	0.496822
Leithenwater Hub	Not Determined	StandardEKA	0.016035	0.497080
Oliver Forest WF	Not Determined	StandardEKA	0.044554	0.499073
M74 West Renewable	Not Determined	StandardEKA	0.015235	0.499306
Harestanes West	Not Determined	StandardEKA	0.028135	0.500098
Mid Hill WF	Not Determined	StandardEKA	0.230904	0.550831
West Andershaw	S36 Scoping	StandardEKA	0.008662	0.550899
Brown Rig	S36 Scoping	StandardEKA	0.194954	0.584377
Liddesdale	S36 Scoping	StandardEKA	0.096808	0.592341
Watchman	S36 Scoping	StandardEKA	0.039863	0.593681
West Scales Energy Park	S36 Scoping	StandardEKA	0.012977	0.593823
Cliffhope	S36 Scoping	StandardEKA	0.064802	0.597348
Kinnelhead	S36 Scoping	StandardEKA	0.096780	0.605137
Longmuir	S36 Scoping	StandardEKA	0.006652	0.605174
Ravengill	S36 Scoping	StandardEKA	0.025447	0.605709
Glensalloch	S36 Scoping	StandardEKA	0.012441	0.605836
Hartsgarth	S36 Scoping	StandardEKA	0.096850	0.613529

Table 3 - Results for queue Scenario 1. Green indicates that enough budget remains for Ravengill Energy Park to be built. Red indicates the point at which the cumulative budget exceeds the overall limit of 0.336 nm.

10.2.2. Scenario 2

Scenario 2 Summary:

- Assumes Scoop Hill is removed with no appeal which triggers the use of 2014 algorithm to calculate seismic budget for all future sites in queue.
- Headroom** = 0.245040 nm (best-case headroom in range)
- SIL** = No SIL
- Computer Model** = StandardEKA for all sites

Wind Farm	Status	Computer Model Used	Farm Amplitude (nm)	Cumulative Amplitude (nm)
Harestanes South WF Ext	Not Determined	StandardEKA	0.041407	0.233593
Daer Reservoir	Not Determined	StandardEKA	0.055712	0.240145
Little Hartfell	Not Determined	StandardEKA	0.160154	0.288650
Greystone Knowe	Not Determined	StandardEKA	0.008244	0.288768
Grayside WF	Not Determined	StandardEKA	0.026064	0.289942
Teviot WF	Not Determined	StandardEKA	0.333496	0.441912
Callisterhall WF	Not Determined	StandardEKA	0.075295	0.448280
Bloch WF	Not Determined	StandardEKA	0.078577	0.455115
Millmoor Rig WF	Not Determined	StandardEKA	0.024769	0.455789
Scawd Law WF	Not Determined	StandardEKA	0.014213	0.456010
Bodinglee WF	Not Determined	StandardEKA	0.017744	0.456355
Rivox WF	Not Determined	StandardEKA	0.103542	0.467954
Torfichen WF	Not Determined	StandardEKA	0.005463	0.467986
Balgray	Not Determined	StandardEKA	0.101715	0.478912
Leithenwater Hub	Not Determined	StandardEKA	0.016035	0.479180
Cliver Forest WF	Not Determined	StandardEKA	0.044554	0.481247
M74 West Renewable	Not Determined	StandardEKA	0.015235	0.481488
Harestanes West	Not Determined	StandardEKA	0.028135	0.482310
Mid Hill WF	Not Determined	StandardEKA	0.230904	0.534733
West Andershaw	S36 Scoping	StandardEKA	0.008662	0.534803
Brown Rig	S36 Scoping	StandardEKA	0.194954	0.569229
Liddesdale	S36 Scoping	StandardEKA	0.096808	0.577402
Watchman	S36 Scoping	StandardEKA	0.039863	0.578776
West Scales Energy Park	S36 Scoping	StandardEKA	0.012977	0.578922
Cliffhope	S36 Scoping	StandardEKA	0.064802	0.582537
Kinnelhead	S36 Scoping	StandardEKA	0.096780	0.590522
Longmuir	S36 Scoping	StandardEKA	0.006652	0.590559
Ravengill	S36 Scoping	StandardEKA	0.025447	0.591107
Glensalloch	S36 Scoping	StandardEKA	0.012441	0.591238
Hartsgarth	S36 Scoping	StandardEKA	0.096850	0.599118

Table 4 – Results for queue Scenario 2. Green indicates that enough budget remains for Ravengill Energy Park to be built. Red indicates the point at which the cumulative budget exceeds the overall limit of 0.336 nm.

10.2.3. Scenario 3

Scenario 3 Summary:

- Assumes normal queue with all sites included (Not Determined and S36 Scoping)
- Headroom** = 0.206324 nm (worst-case headroom in range)
- SIL** = 0.004614 nm·MW^{-0.5} (most stringent SIL in range)
- Computer Model** = Worst-case LATT

Wind Farm	Status	Computer Model Used	Farm Amplitude (nm)	Cumulative Amplitude (nm)
Scoop Hill	Not Determined	Vestas	0.095900	0.281999
Harestanes South WF Ext	Not Determined	GE	0.029259	0.283513
Daer Reservoir	Not Determined	GE	0.041081	0.286473
Little Hartfell	Not Determined	Vestas	0.032756	0.288340
Greystone Knowe	Not Determined	GE	0.006390	0.288411
Grayside WF	Not Determined	GE	0.019757	0.289087
Teviot WF	Not Determined	GE	0.090133	0.302812
Callisterhall WF	Not Determined	GE	0.028888	0.304187
Bloch WF	Not Determined	GE	0.047950	0.307943
Millmoor Rig WF	Not Determined	GE	0.018599	0.308504
Scawd Law WF	Not Determined	GE	0.010815	0.308693
Bodinglee WF	Not Determined	GE	0.013482	0.308988
Rivox WF	Not Determined	GE	0.066672	0.316099
Torfichen WF	Not Determined	GE	0.004243	0.316127
Balgray	Not Determined	GE	0.028142	0.317378
Leithenwater Hub	Not Determined	GE	0.012245	0.317614
Oliver Forest WF	Not Determined	GE	0.031918	0.319214
M74 West Renewable	Not Determined	GE	0.011705	0.319428
Harestanes West	Not Determined	GE	0.021089	0.320123
Mid Hill WF	Not Determined	Vestas	0.044639	0.323221
West Andershaw	S36 Scoping	GE	0.006608	0.323288
Brown Rig	S36 Scoping	Vestas	0.033906	0.325061
Liddesdale	S36 Scoping	GE	0.068997	0.332303
Watchman	S36 Scoping	GE	0.029393	0.333601
West Scales Energy Park	S36 Scoping	GE	0.009719	0.333742
Cliffhope	S36 Scoping	GE	0.047927	0.337166
Kinnelhead	S36 Scoping	GE	0.059885	0.342443
Longmuir	S36 Scoping	GE	0.005076	0.342480
Ravengill	S36 Scoping	GE	0.019136	0.343015
Glensalloch	S36 Scoping	GE	0.009449	0.343145
Hartsgarth	S36 Scoping	GE	0.052527	0.347142

Table 5 - Results for queue Scenario 3. Green indicates that enough budget remains for Ravengill Energy Park to be built. Red indicates the point at which the cumulative budget exceeds the overall limit of 0.336 nm.

10.2.4. Scenario 4

Scenario 4 Summary:

- Assumes normal queue with all sites included (Not Determined and S36 Scoping)
- Headroom** = 0.206324 nm (worst-case headroom in range)
- SIL** = 0.005479 nm·MW^{-0.5} (least stringent SIL in range)
- Computer Model** = Worst-case LATT

Wind Farm	Status	Computer Model Used	Farm Amplitude (nm)	Cumulative Amplitude (nm)
Scoop Hill	Not Determined	Vestas	0.113879	0.288608
Harestanes South WF Ext	Not Determined	GE	0.030484	0.290214
Daer Reservoir	Not Determined	GE	0.041134	0.293114
Little Hartfell	Not Determined	Vestas	0.038897	0.295684
Greystone Knowe	Not Determined	GE	0.00639	0.295753
Grayside WF	Not Determined	GE	0.019757	0.296412
Teviot WF	Not Determined	GE	0.10703	0.315144
Callisterhall WF	Not Determined	GE	0.034304	0.317005
Bloch WF	Not Determined	GE	0.055494	0.321826
Millmoor Rig WF	Not Determined	GE	0.018599	0.322363
Scawd Law WF	Not Determined	GE	0.010815	0.322544
Bodinglee WF	Not Determined	GE	0.013482	0.322826
Rivox WF	Not Determined	GE	0.074215	0.331247
Torfichen WF	Not Determined	GE	0.004243	0.331274
Balgray	Not Determined	GE	0.033417	0.332956
Leithenwater Hub	Not Determined	GE	0.012245	0.333181
Oliver Forest WF	Not Determined	GE	0.032372	0.33475
M74 West Renewable	Not Determined	GE	0.011705	0.334954
Harestanes West	Not Determined	GE	0.021089	0.335617
Mid Hill WF	Not Determined	Vestas	0.053008	0.339778
West Andershaw	S36 Scoping	GE	0.006608	0.339842
Brown Rig	S36 Scoping	Vestas	0.040262	0.342219
Liddesdale	S36 Scoping	GE	0.071093	0.349525
Watchman	S36 Scoping	GE	0.029393	0.350759
West Scales Energy Park	S36 Scoping	GE	0.009719	0.350893
Cliffhope	S36 Scoping	GE	0.047927	0.354151
Kinnelhead	S36 Scoping	GE	0.066709	0.360379
Longmuir	S36 Scoping	GE	0.005076	0.360415
Ravengill	S36 Scoping	GE	0.019136	0.360923
Glensalloch	S36 Scoping	GE	0.009449	0.361046
Hartsgarth	S36 Scoping	GE	0.062273	0.366377

Table 6 – Results for queue Scenario 4. Green indicates that enough budget remains for Ravengill Energy Park to be built. Red indicates the point at which the cumulative budget exceeds the overall limit of 0.336 nm.

10.2.5. Scenario 5

Scenario 5 Summary:

- Assumes normal queue with all sites included (Not Determined and S36 Scoping)
- Headroom** = 0.245040 nm (best-case headroom in range)
- SIL** = 0.004614 nm·MW^{-0.5} (most stringent SIL in range)
- Computer Model** = Worst-case LATT

Wind Farm	Status	Computer Model Used	Farm Amplitude (nm)	Cumulative Amplitude (nm)
Scoop Hill	Not Determined	Vestas	0.0959	0.249095
Harestanes South WF Ext	Not Determined	GE	0.029259	0.250807
Daer Reservoir	Not Determined	GE	0.041081	0.25415
Little Hartfell	Not Determined	Vestas	0.032756	0.256252
Greystone Knowe	Not Determined	GE	0.00639	0.256331
Grayside WF	Not Determined	GE	0.019757	0.257092
Teviot WF	Not Determined	GE	0.090133	0.272434
Callisterhall WF	Not Determined	GE	0.028888	0.273961
Bloch WF	Not Determined	GE	0.04795	0.278125
Millmoor Rig WF	Not Determined	GE	0.018599	0.278747
Scawd Law WF	Not Determined	GE	0.010815	0.278956
Bodinglee WF	Not Determined	GE	0.013482	0.279282
Rivox WF	Not Determined	GE	0.066672	0.28713
Torfichen WF	Not Determined	GE	0.004243	0.287161
Balgray	Not Determined	GE	0.028142	0.288537
Leithenwater Hub	Not Determined	GE	0.012245	0.288797
Oliver Forest WF	Not Determined	GE	0.031918	0.290555
M74 West Renewable	Not Determined	GE	0.011705	0.290791
Harestanes West	Not Determined	GE	0.021089	0.291554
Mid Hill WF	Not Determined	Vestas	0.044639	0.294952
West Andershaw	S36 Scoping	GE	0.006608	0.295026
Brown Rig	S36 Scoping	Vestas	0.033906	0.296968
Liddesdale	S36 Scoping	GE	0.068997	0.304878
Watchman	S36 Scoping	GE	0.029393	0.306291
West Scales Energy Park	S36 Scoping	GE	0.009719	0.306446
Cliffhope	S36 Scoping	GE	0.047927	0.310171
Kinnelhead	S36 Scoping	GE	0.059885	0.315899
Longmuir	S36 Scoping	GE	0.005076	0.31594
Ravengill	S36 Scoping	GE	0.019136	0.316519
Glensalloch	S36 Scoping	GE	0.009449	0.31666
Hartsgarth	S36 Scoping	GE	0.052527	0.320987

Table 7 – Results for queue Scenario 5. Green indicates that enough budget remains for Ravengill Energy Park to be built. Red indicates the point at which the cumulative budget exceeds the overall limit of 0.336 nm.

10.2.6. Scenario 6

Scenario 6 Summary:

- Assumes normal queue with all sites included (Not Determined and S36 Scoping)
- Headroom = 0.245040 nm (best-case headroom in range)
- SIL = 0.005479 nm·MW^{-0.5} (least stringent SIL in range)
- Computer Model = Worst-case LAT T

Wind Farm	Status	Computer Model Used	Farm Amplitude (nm)	Cumulative Amplitude (nm)
Scoop Hill	Not Determined	Vestas	0.113879	0.256554
Harestanes South WF Ext	Not Determined	GE	0.030484	0.258358
Daer Reservoir	Not Determined	GE	0.041134	0.261612
Little Hartfell	Not Determined	Vestas	0.038897	0.264488
Greystone Knowe	Not Determined	GE	0.00639	0.264565
Grayside WF	Not Determined	GE	0.019757	0.265302
Teviot WF	Not Determined	GE	0.10703	0.286078
Callisterhall WF	Not Determined	GE	0.034304	0.288127
Bloch WF	Not Determined	GE	0.055494	0.293423
M llmoor Rig WF	Not Determined	GE	0.018599	0.294012
Scawd Law WF	Not Determined	GE	0.010815	0.294211
Bodinglee WF	Not Determined	GE	0.013482	0.294519
Rivox WF	Not Determined	GE	0.074215	0.303726
Torfichen WF	Not Determined	GE	0.004243	0.303756
Balgray	Not Determined	GE	0.033417	0.305589
Leithenwater Hub	Not Determined	GE	0.012245	0.305834
Oliver Forest WF	Not Determined	GE	0.032372	0.307542
M74 West Renewable	Not Determined	GE	0.011705	0.307765
Harestanes West	Not Determined	GE	0.021089	0.308487
Mid Hill WF	Not Determined	Vestas	0.053008	0.313008
West Andershaw	S36 Scoping	GE	0.006608	0.313077
Brown Rig	S36 Scoping	Vestas	0.040262	0.315656
Liddesdale	S36 Scoping	GE	0.071093	0.323563
Watchman	S36 Scoping	GE	0.029393	0.324895
West Scales Energy Park	S36 Scoping	GE	0.009719	0.32504
Cliffhope	S36 Scoping	GE	0.047927	0.328555
Kinnelhead	S36 Scoping	GE	0.066709	0.335258
Longmuir	S36 Scoping	GE	0.005076	0.335297
Ravengill	S36 Scoping	GE	0.019136	0.335842
Glensalloch	S36 Scoping	GE	0.009449	0.335975
Hartsgarth	S36 Scoping	GE	0.062273	0.341698

Table 8 – Results for queue Scenario 6. Green indicates that enough budget remains for Ravengill Energy Park to be built. Red indicates the point at which the cumulative budget exceeds the overall limit of 0.336 nm.



10.3. Full Individual Turbine Seismic Impact Limit Results

0.004614 nm·MW ^{-0.5} SIL	WTG No	PSV (nm)	With Background Noise										Without Background Noise									
			Standard EKA TMR	Siemens TMR	Senvion TMR	Vestas TMR	GE TMR	Nordex TMR	Enercon TMR	SG155 TMR	N163 TMR	N149 TMR	Standard EKA TMR	Siemens TMR	Senvion TMR	Vestas TMR	GE TMR	Nordex TMR	Enercon TMR	SG155 TMR	N163 TMR	N149 TMR
	1	0.012207	2.762	4.279	6.450	3.861	3.651	4.378	4.725	10.406	7.474	4.628	3.452	5.349	8.062	4.826	4.563	5.473	5.906	13.007	9.343	5.785
	2	0.012207	2.641	4.101	6.177	3.704	3.494	4.198	4.522	9.940	7.153	4.422	3.301	5.126	7.721	4.629	4.367	5.247	5.653	12.425	8.941	5.528
	3	0.012207	2.969	4.583	6.913	4.127	3.918	4.684	5.069	11.198	8.018	4.977	3.711	5.729	8.641	5.158	4.898	5.855	6.336	13.997	10.022	6.221
	4	0.012207	2.840	4.394	6.625	3.961	3.752	4.494	4.855	10.706	7.681	4.760	3.550	5.493	8.281	4.952	4.690	5.618	6.069	13.382	9.601	5.950
	5	0.012207	2.682	4.161	6.270	3.757	3.547	4.259	4.591	10.098	7.262	4.492	3.352	5.202	7.837	4.696	4.433	5.324	5.739	12.622	9.078	5.615
	6	0.012207	3.006	4.637	6.996	4.174	3.966	4.739	5.130	11.339	8.115	5.039	3.757	5.797	8.745	5.218	4.958	5.924	6.413	14.174	10.143	6.298
	7	0.012207	2.906	4.492	6.774	4.047	3.838	4.592	4.966	10.960	7.855	4.872	3.633	5.615	8.467	5.059	4.797	5.740	6.207	13.700	9.819	6.090
	8	0.012207	2.796	4.330	6.527	3.905	3.695	4.429	4.782	10.538	7.565	4.686	3.495	5.412	8.159	4.881	4.619	5.536	5.978	13.172	9.456	5.858
	9	0.012207	2.004	3.153	4.733	2.865	2.668	3.237	3.450	7.469	5.428	3.324	2.505	3.941	5.916	3.582	3.336	4.046	4.312	9.337	6.784	4.155
	10	0.012207	1.862	2.939	4.406	2.674	2.484	3.018	3.207	6.912	5.033	3.075	2.327	3.673	5.508	3.343	3.105	3.773	4.009	8.640	6.292	3.844
	11	0.012207	1.769	2.799	4.193	2.549	2.364	2.876	3.049	6.549	4.776	2.913	2.211	3.498	5.242	3.187	2.955	3.595	3.812	8.186	5.969	3.641
	12	0.012207	1.857	2.932	4.396	2.668	2.478	3.012	3.200	6.895	5.021	3.067	2.321	3.665	5.495	3.335	3.098	3.765	4.000	8.619	6.277	3.834
	13	0.012207	2.096	3.291	4.944	2.988	2.788	3.378	3.606	7.830	5.682	3.485	2.620	4.114	6.180	3.736	3.485	4.222	4.508	9.787	7.102	4.356
	14	0.012207	2.046	3.215	4.830	2.922	2.723	3.301	3.521	7.635	5.544	3.398	2.558	4.021	6.037	3.652	3.404	4.127	4.402	9.543	6.930	4.248
	15	0.012207	1.954	3.077	4.618	2.798	2.603	3.160	3.364	7.272	5.289	3.236	2.442	3.847	5.772	3.497	3.254	3.950	4.205	9.091	6.611	4.045
	16	0.012207	1.856	2.930	4.393	2.666	2.476	3.009	3.197	6.889	5.017	3.065	2.320	3.662	5.491	3.333	3.095	3.762	3.997	8.611	6.271	3.831
	17	0.012207	2.104	3.303	4.962	2.999	2.798	3.389	3.619	7.860	5.703	3.499	2.630	4.129	6.202	3.749	3.498	4.237	4.524	9.825	7.129	4.373
	18	0.012207	1.979	3.115	4.676	2.832	2.637	3.199	3.408	7.373	5.359	3.281	2.474	3.895	5.845	3.540	3.296	3.999	4.260	9.216	6.699	4.101
	19	0.012207	1.946	3.065	4.601	2.788	2.594	3.149	3.352	7.244	5.269	3.224	2.433	3.833	5.751	3.485	3.242	3.936	4.190	9.055	6.586	4.030
	20	0.012207	2.237	3.501	5.263	3.174	2.970	3.591	3.843	8.376	6.065	3.729	2.796	4.376	6.579	3.968	3.713	4.488	4.804	10.470	7.581	4.661
	21	0.012207	2.102	3.300	4.958	2.996	2.796	3.387	3.616	7.853	5.698	3.496	2.628	4.125	6.197	3.746	3.495	4.233	4.520	9.817	7.123	4.369

Table 9 – TMR for Scottish Government 0.004614 SIL Individual Turbine – Note red denotes the SIL limit is NOT met.

0.005479 nm-MW ^{-0.5} SIL		With Background Noise									Without Background Noise										
WTG No	PSV (nm)	Standard EKA TMR	Siemens TMR	Senvion TMR	Vestas TMR	GE TMR	Nordex TMR	Enercon TMR	SG155 TMR	N163 TMR	N149 TMR	Standard EKA TMR	Siemens TMR	Senvion TMR	Vestas TMR	GE TMR	Nordex TMR	Enercon TMR	SG155 TMR	N163 TMR	N149 TMR
1	0.014496	3.280	5.082	7.659	4.584	4.335	5.199	5.610	12.357	8.876	5.496	4.100	6.352	9.574	5.731	5.419	6.499	7.013	15.446	11.095	6.869
2	0.014496	3.136	4.869	7.335	4.398	4.148	4.985	5.370	11.803	8.494	5.251	3.920	6.087	9.169	5.497	5.186	6.231	6.713	14.754	10.617	6.564
3	0.014496	3.525	5.442	8.209	4.900	4.653	5.562	6.019	13.297	9.521	5.910	4.406	6.803	10.261	6.126	5.816	6.953	7.524	16.621	11.901	7.387
4	0.014496	3.372	5.218	7.867	4.704	4.455	5.337	5.765	12.713	9.120	5.652	4.216	6.523	9.834	5.880	5.569	6.671	7.206	15.891	11.401	7.066
5	0.014496	3.184	4.941	7.445	4.461	4.212	5.057	5.452	11.991	8.623	5.334	3.981	6.177	9.306	5.577	5.265	6.322	6.814	14.989	10.779	6.668
6	0.014496	3.569	5.507	8.307	4.957	4.710	5.627	6.092	13.465	9.636	5.983	4.461	6.883	10.384	6.196	5.887	7.034	7.615	16.832	12.045	7.479
7	0.014496	3.451	5.334	8.044	4.806	4.557	5.453	5.896	13.015	9.328	5.785	4.314	6.667	10.055	6.007	5.697	6.817	7.371	16.269	11.660	7.232
8	0.014496	3.320	5.142	7.750	4.637	4.388	5.259	5.679	12.513	8.983	5.565	4.151	6.427	9.688	5.796	5.485	6.574	7.098	15.642	11.229	6.956
9	0.014496	2.380	3.744	5.620	3.402	3.169	3.843	4.096	8.869	6.445	3.947	2.974	4.680	7.025	4.253	3.961	4.804	5.120	11.087	8.056	4.934
10	0.014496	2.211	3.490	5.232	3.176	2.950	3.584	3.809	8.208	5.977	3.652	2.763	4.362	6.541	3.970	3.687	4.480	4.761	10.260	7.471	4.564
11	0.014496	2.101	3.323	4.979	3.027	2.807	3.415	3.621	7.777	5.671	3.459	2.626	4.154	6.224	3.784	3.509	4.268	4.526	9.721	7.089	4.323
12	0.014496	2.205	3.482	5.221	3.169	2.943	3.576	3.800	8.187	5.963	3.642	2.757	4.352	6.526	3.961	3.678	4.470	4.750	10.234	7.453	4.553
13	0.014496	2.489	3.908	5.871	3.549	3.311	4.011	4.282	9.298	6.747	4.138	3.112	4.885	7.338	4.436	4.139	5.013	5.353	11.622	8.433	5.173
14	0.014496	2.430	3.819	5.735	3.470	3.234	3.920	4.182	9.066	6.584	4.035	3.037	4.774	7.169	4.337	4.042	4.900	5.227	11.332	8.230	5.044
15	0.014496	2.320	3.654	5.483	3.322	3.091	3.752	3.995	8.636	6.280	3.843	2.900	4.568	6.854	4.153	3.864	4.690	4.993	10.795	7.850	4.804
16	0.014496	2.204	3.479	5.216	3.166	2.940	3.573	3.797	8.180	5.958	3.639	2.754	4.349	6.520	3.958	3.676	4.467	4.746	10.225	7.447	4.549
17	0.014496	2.499	3.922	5.892	3.561	3.323	4.025	4.298	9.334	6.772	4.155	3.123	4.903	7.365	4.451	4.154	5.031	5.372	11.667	8.465	5.193
18	0.014496	2.350	3.700	5.553	3.363	3.131	3.799	4.046	8.755	6.364	3.896	2.938	4.625	6.941	4.204	3.913	4.748	5.058	10.944	7.955	4.870
19	0.014496	2.311	3.641	5.464	3.311	3.080	3.739	3.980	8.602	6.256	3.828	2.889	4.552	6.830	4.139	3.850	4.674	4.975	10.753	7.820	4.785
20	0.014496	2.656	4.157	6.250	3.770	3.527	4.264	4.564	9.947	7.202	4.428	3.320	5.197	7.813	4.712	4.409	5.330	5.705	12.433	9.003	5.534
21	0.014496	2.496	3.919	5.887	3.558	3.320	4.022	4.294	9.326	6.766	4.151	3.120	4.899	7.359	4.448	4.150	5.027	5.368	11.657	8.458	5.189

Table 10 – TMR for Scottish Government 0.005479 SIL Individual Turbine – Note red denotes the SIL limit is NOT met.

11. Appendix C – Reference Documents

Phase 1: ‘Seismic Vibration produced by wind turbines in the Eskdalemuir region Release 2.0 of Substantial Research Project’

Phase 2: ‘SGV_202_Tech_Report_v07’

Phase 3: ‘SGV 203 Technical report v12.pdf’

Phase4 (Refinement): ‘AIFCL-101-Phase4-Rev-v1:- Field audit of Selected sites within the EKA Consultation Zone to support Government Policy Decisions’

Phase 5 (Revision): ‘AIFCL-101-Phase5-Rev-v11’

Onshore wind – policy statement refresh 2021: consultative report

All publicly available documents can be downloaded [here](#)

Ravengill

Eskdalemuir Seismic Array Considerations

Seismic Budget and SIL Analysis



The Eskdalemuir Seismic Budget Calculation Tool was funded and produced by:



1 Introduction / Document Summary

To support the development of Ravengill Energy Park, this report is produced to provide insight into the feasibility of the proposals with regards to constraints imposed by being within the Eskdalemuir Consultation Zone (ECZ). The contained planning considerations and calculations also demonstrate to planning authorities and the Ministry of Defence (MoD) the applicants consideration and compliance in development of the proposals from the start.

This report assesses the seismic impact of the proposed Ravengill Energy Park, on the MoD Eskdalemuir Seismic Array (EKA), which is used to detect global nuclear testing. The site lies within the 50 km ECZ and must comply with strict vibration limits to protect the array's functionality.

The expected ground vibration ('seismic budget') was analysed and compared against both current MoD thresholds and the proposed Seismic Impact Limit (SIL) policy being developed by the Scottish Government and MoD. Development within the ECZ is only possible with revised policy including regulation around the SIL.

Computer models were used to predict the seismic noise produced by each of the proposed turbines at Ravengill.

Purpose – Summary of Key Points Examined:

1. What is the predicted seismic budget that will be consumed by Ravengill?
2. Do the turbines meet the Seismic Impact Limit?