

BALLYFASEY WIND FARM

Freshwater Pearl Mussel Survey



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Tait Business Centre, Dominic Street,
Limerick City, Ireland.

t. +353 61 313519, f. +353 61 414315

e. info@ecofact.ie

w. www.ecofact.ie



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1. INTRODUCTION

Ecofact Environmental Consultants Ltd. was commissioned by Tobin to undertake a Stage 1 Freshwater Pearl Mussel Survey (*Margaritifera margaritifera*) of watercourses affected by the proposed Ballyfasy Wind Farm in Co. Kilkenny. The purpose of the survey was to establish if Freshwater Pearl Mussels (FPMs) were present in the likely zone of influence of the proposed wind farm development.

The survey was undertaken in September 2024 under optimal environmental conditions. FPM surveys were conducted on all watercourses draining the site. The location of the proposed Ballyfasy Wind Farm site in Co. Kilkenny is shown in Figure 1.

The Freshwater Pearl Mussel is acknowledged to be one of the most demanding species of high water quality and high river bed quality in the world (Atkinson *et al*, 2024). Whilst Ireland supports a significant proportion of the *Margaritifera* populations remaining in Europe, these populations have been in dramatic decline in recent years, with an estimated decline of between 12.6% - 32.7 % between the 2007-2012 and 2013 – 2018 monitoring periods (NPWS, 2019). The species is on the IUCN Red List of Threatened Species and throughout the island of Ireland it is rated as critically endangered (Atkinson *et al*, 2024).

The Freshwater Pearl Mussel is afforded legal protection under the Wildlife Acts (1976 - 2023) in Ireland. The species was added to the fifth schedule of the Act under Statutory Instrument No. 112 of 1990. Therefore, under Section 23, it is an offence to injure or wilfully interfere with or destroy the breeding place or resting place of *Margaritifera*. The Wildlife Act affords protection to all *Margaritifera* populations within Ireland, regardless of whether they occur within or outside of an SAC (Atkinson *et al*, 2024). At a European level, *Margaritifera* is protected under the Habitats Directive and is listed under Annex II and Annex V of the Directive. The Habitats Directive has been transposed into Irish law via the European Communities Birds and Natural Habitats Regulations 2011 (S. I. No. 477 of 2011).

The Nore Pearl Mussel (*M. durrovensis*) is now considered to be an ecotype of the Freshwater Pearl Mussel (*M. margaritifera*) rather than a separate species (Geist *et al*, 2018). In this report the name Freshwater Pearl Mussel (*M. margaritifera*) is used to cover both *M. margaritifera* and the *M. durrovensis*. The National Parks and Wildlife Service (NPWS) Qualifying Interest list of the River Barrow and River Nore Special Area of Conservation (SAC) no longer includes *M. durrovensis*. The Qualifying Interest (QI) is now *Margaritifera margaritifera* (Freshwater Pearl Mussel) [1029].



Figure 1 Location of the proposed Ballyfasy Wind Farm site in Co. Kilkenny.



2. METHODOLOGY

2.1 Desk study

A desk-study was undertaken to identify existing records for the Freshwater Pearl Mussel from within the affected river catchments, and to identify the potential for this species to occur within the study area. A desk study review of the National Parks and Wildlife Service (NPWS) designations for this species relating to the affected rivers and the relevant legislation in place for the protection of this species was also undertaken.

2.2 Field surveys

Surveys of *Margaritifera* within a watercourse carry an inherent risk of damage to mussel beds and mussel habitats, and therefore a licence is required under Sections 9, 23 and 34 of the Wildlife Act to undertake surveys of the species.

Therefore, the current survey was carried out under license (NPWS Licence No. C131/2024). The methodology employed followed the NPWS guidance '*Margaritifera margaritifera* Stage 1 and Stage 2 survey guidelines' (Anon, 2004). The surveys undertaken were to establish whether FPMs were present in the subject river channels, employing a wading / bathyscope survey. The objective of a Stage 1 FPM survey is to establish whether adult *Margaritifera margaritifera* are present or not in a river.

All watercourses were surveyed in detail to 1km downstream of the proposed wind farm site boundary. This area is shown in Figure 2. Only small 1st order watercourses are present in this area. They were all surveyed visually and no snorkelling was required. This was the survey area for the contract and all channels in this area were fully evaluated. A further general overview survey was then undertaken to 5km downstream of the proposed wind farm site (See Figure 3). The surveys in this area were general overview surveys as per the contract. Detailed assessments were also carried out at 14 selected sites (also shown in Figure 3).

2.2.1 FPM habitat assessment

Habitat has a key influence on the presence/absence and density of mussels in a river. The habitat requirements for Freshwater Pearl Mussels are outlined in Skinner *et al.* (2003). These mussels require pristine freshwater ecosystems to survive and reproduce. They inhabit medium-to-large streams or rivers with moderate to steep gradients, where fast-flowing, well-oxygenated water supports clean substrates of sand, gravel, and cobble. In Ireland, Freshwater Pearl Mussels are found in a variety of rivers, ranging from the main channels of large watercourses to small streams.

Freshwater Pearl Mussels are typically found in medium-to-large rivers and streams, particularly those classified as stream orders 2, 3, and 4 (Moorkens, 2000). These streams provide the appropriate size and flow conditions needed to support mussel populations. Gradients in these watercourses are moderate to steep, promoting fast-flowing water that ensures high levels of oxygenation. The riverbed substrata are critical, with mussels favouring small sand patches stabilized among larger stones or boulders. This type of substrate provides stability and minimizes the risk of smothering by fine sediments. Areas with significant sedimentation of silt are unsuitable, as such conditions can clog feeding structures and prevent successful juvenile recruitment. Mussel aggregations are often found in shaded areas, typically created by overhanging vegetation, which help moderate water temperatures. Substrate stability, governed by composition, flow extremes, and the gradient of the watercourse, is another crucial factor for suitable habitat. Bankside vegetation also plays an important role in mussel habitats by providing shade, stabilizing riverbanks, and reducing sediment input from erosion. These



ecological interactions highlight the dependence of Freshwater Pearl Mussels on a healthy and interconnected aquatic ecosystem.

High water quality is essential for Freshwater Pearl Mussels to survive and reproduce. They require high dissolved oxygen levels, typically exceeding 9 mg/L, and low concentrations of nutrients such as nitrogen and phosphorus. A stable pH range, generally between 6.5 and 8, is also critical. Consistent water clarity and low levels of fine sediments are necessary to avoid suffocation and habitat degradation. Cool water temperatures, typically below 20°C, are ideal for their physiological functioning. The absence of pollutants, including heavy metals, pesticides, and organic contaminants, is vital for the survival of both adult mussels and juveniles. Although older mussels can sometimes persist in areas with reduced water quality, healthy populations are strongly associated with unpolluted waters.

The survival of Freshwater Pearl Mussels is closely linked to the presence of suitable host fish, such as juvenile salmonids (*Salmo salar* and *Salmo trutta*). These fish are essential for the glochidia, the larval stage of mussels, which attach to the gills of the fish to develop. In Ireland, the hosts for glochidia are young native salmonids, typically within their first three years of life. A healthy population of juvenile salmonids is crucial, as the chances of glochidia attaching successfully are very low; most glochidia are swept downstream and die.

A general assessment of the habitat suitability and condition of the receiving watercourses was carried out at 14 selected sites. These sites are shown in Figure 3 and listed in Table 1. These sites were selected during the general survey of the wider area. These were locations which were considered to have suitable potential habitats. The habitat assessments were based on the known requirements of this species as outlined above. The surveys at these sites also had regard to the environmental parameters set out in the Fourth Schedule of the EC Environmental Objectives (Freshwater Pearl Mussel) Regulations (S.I. 296 of 2009).

2.2.2 Personnel and limitations

The surveys were completed by licenced surveyor Dr. William O'Connor, with assistance from Grace Walsh M.Sc. and Eoin McMahon. The surveys were completed during ideal conditions (dry, bright and normal water levels) during September 2024. Strict biosecurity measures were implemented between sites, including disinfecting all equipment using Virkon Aquatic. No significant limitations to the survey were identified.



Table 1 Location of the 14 sites selected for general habitat suitability and condition assessments.

Site Number	River	Segment Code	EPA Code	X	Y
A1	Arrigle	15_1470	15A02	662282	626764
A2	Arrigle	15_276	15A02	662509	629084
A3	Arrigle	15_502	15A02	662119	630104
A4	Arrigle	15_503	15A02	660647	632248
A5	Arrigle	15_90	15A02	660176	633190
A6	Arrigle	15_92	15A02	660375	635079
A7	Arrigle	15_93	15A02	660743	638230
G1	Glenmore River	16_1485	16B73	659678	624618
S1	Smartscastle (Stream)	16_1485	16B73	658011	624044
S2	Smartscastle (Stream)	16_3475	16S07	661214	621904
S3	Smartscastle (Stream)	16_3475	16S07	661255	620250
S4	Smartscastle (Stream)	16_3475	16S07	660984	619670
B1	Ballyknockbeg	16_3342	16S07	660451	617774
B2	Ballyknockbeg	15_2039	NA	665647	623522

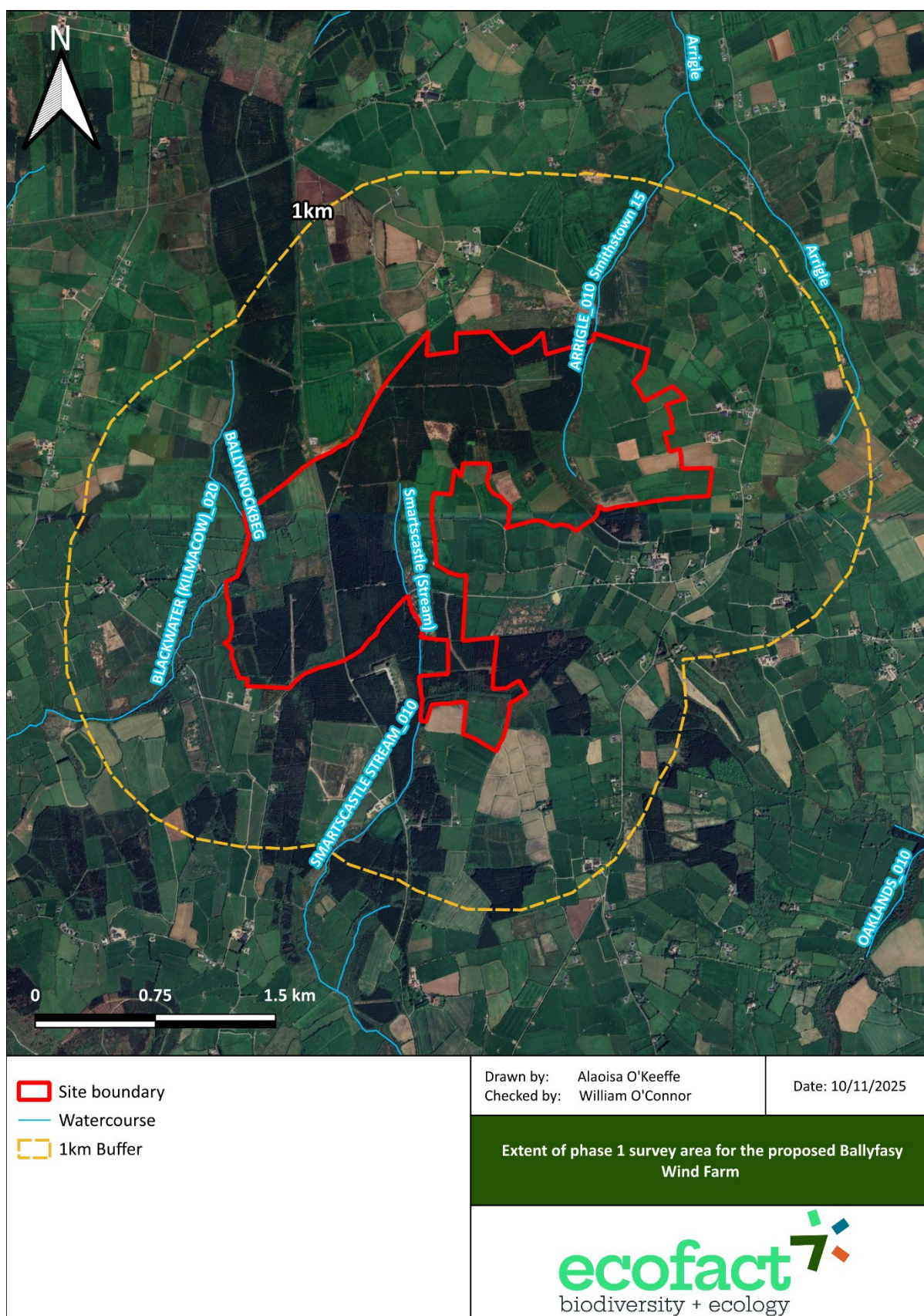


Figure 2 Extent of the Phase 1 survey of watercourses affected by the proposed Ballyfasy Wind Farm site in Co. Kilkenny.

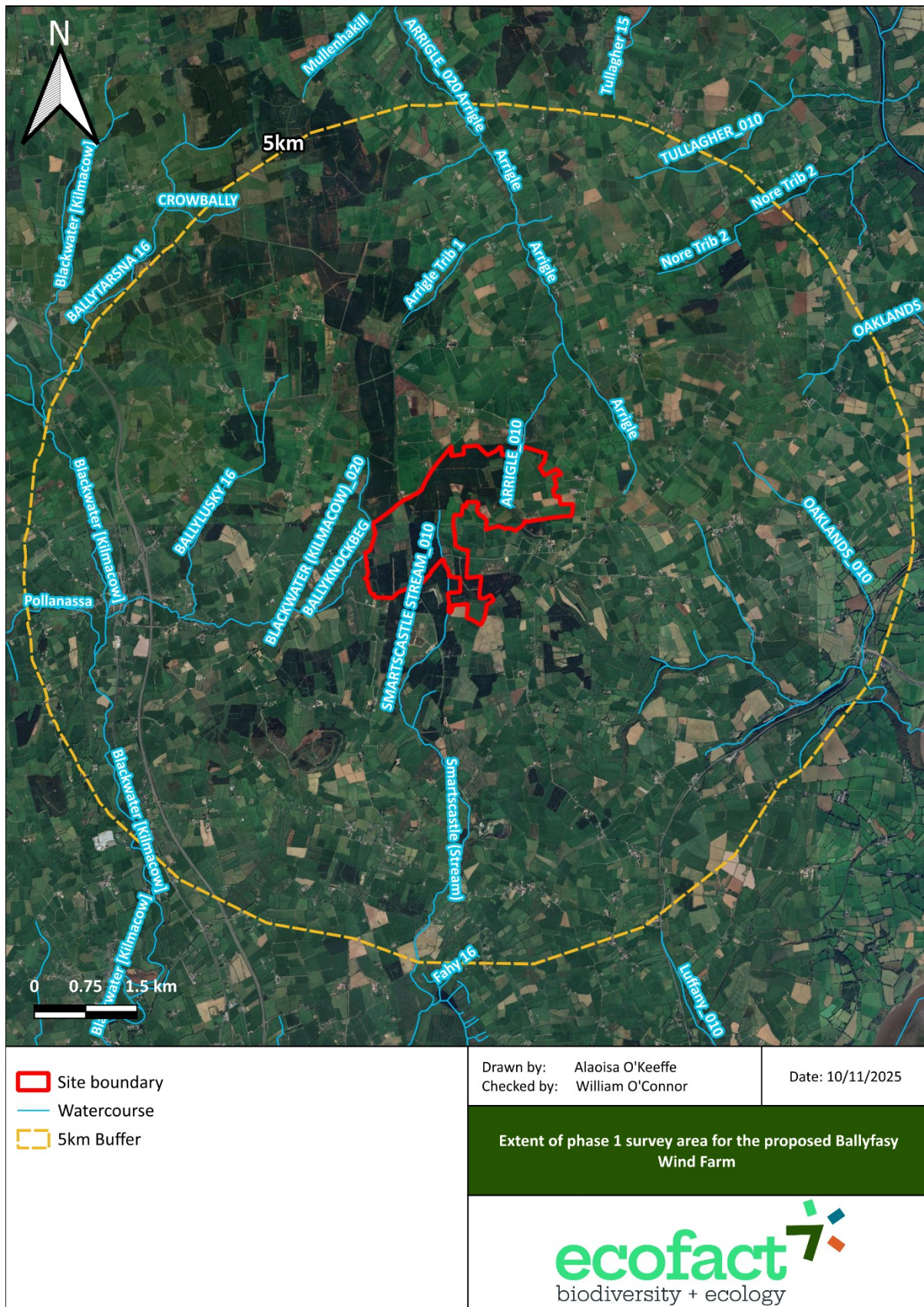


Figure 3 Extent of the general survey of watercourses affected by the proposed Ballyfasy Wind Farm site in Co. Kilkenny (5km radius).



3. RESULTS

3.1 Introduction

The location of Natura 2000 sites in relation to the proposed Ballyfasy Wind Farm site is shown in Figure 4. The proposed development is located upstream of the River Barrow and River Nore SAC (Site Code 002162) and the Lower River Suir SAC (Site Code 002137). Both of these Natura 2000 sites are designated for Freshwater Pearl Mussel [1029].

Three sub-catchments are affected by the proposed wind farm development; the Nore_SC_130 sub-catchment, the Nore_SC_140 sub-catchment, and the Blackwater[Kilmacow]_SC_010 sub-catchment. These catchments are indicated in Figure 5.

3.2 Nore_SC_130 sub-catchment

There is one watercourse within the boundary of the proposed wind farm site that is part of the Nore_SC_130 sub-catchment. This sub-catchment is shown in Figure 6. This is the Smithstown15 stream which is part of the headwaters of the River Arrigle. The Smithstown15 stream rises within the proposed development site and flows north to form the River Arrigle. The River Arrigle joins the River Nore upstream of Thomastown. The main channel of most of the River Arrigle is designated as part of the River barrow and River Nore Special Area of Conservation (SAC).

There is no suitable habitat for Freshwater Pearl Mussels in the Smithstown15 stream on the site. This watercourse is too small to support this species. The section of the River Arrigle from the Smithstown15 stream confluence downstream to the boundary of the SAC is also not considered to have any potential for Freshwater Pearl Mussels. The SAC boundary is at the R704 bridge and there is a lot of siltation at this point and there is no evidence of any mussels being present. Downstream of here the physical character of the river improves and from Ballyconnaught downstream the River Arrigle does have potential Freshwater Pearl Mussel habitats present. This area is >5km downstream of the proposed wind farm site.

The river was examined at four locations between the SAC boundary and the bridge at Ballyduff house just upstream from the River Nore. No evidence of mussels or dead shells were recorded during the spot checks completed at these locations.

There are no records of Freshwater Pearl Mussels in the River Arrigle. Moorkens *et al* (1992) reported that no live mussels were recorded in any tributaries of the River Nore. The River Arrigle was included in this survey and the survey extended over 4km of the river (which was estimated to be around 90% of the suitable habitat in the river).

This species has been confirmed absent in the areas surveyed within 1km of the wind farm site boundary. It is considered very unlikely that mussels are present in areas further downstream to the SAC boundary. No evidence of mussels or dead shells were recorded during the spot checks completed further downstream.

The River Nore main channel downstream of the River Arrigle confluence is not within the main known distribution of Freshwater Pearl Mussels in the River Nore.

The main mussel population is restricted to the section of main river channel from Poorman's Bridge to Lismaine Bridge, upstream of Ballyragget. However, the population has not successfully reproduced in the River Nore since 1970 and was considered to be on the edge of extinction in 2009 (NS 2, 2010).



The draft sub-basin management plan noted that the population in the River Nore was un-viable and on the verge of extinction (NS 2, 2010).

Water quality issues in the Nore catchment have hindered juvenile mussel recruitment, with heavy siltation and nutrient enrichment, and the timescale for such issues to be cleared is noted to be much longer than the lifespan of the last remaining mussels in the River Nore. Breeding programmes have been set up in the hope of creating self-sustaining populations that can be translocated to the Nore catchment (NS 2, 2010).

3.3 Nore_SC_140 sub-catchment

It can be seen from Figure 7 that this sub-catchment is only marginally within the red line boundary of the proposed wind farm development site. There does not seem to be any real likelihood that any drainage from the proposed development site will enter any watercourses in the catchment. There are no watercourses from the sub-catchment on or near the site. The nearest watercourse in this sub-catchment is the Parkstown Lower stream which flows into the Glenmore River. The Mullennahone stream is also located to the southeast of the red line boundary. This stream becomes the Glenmore River downstream of the Parkstown Lower stream catchment. The Glenmore River flows into the River Barrow estuary downstream of New Ross.

There are no records of Freshwater Pearl Mussels in the Nore_SC_140 sub-catchment. This species has been confirmed absent from the watercourses near the proposed wind farm site (Parkstown Lower and Mullennahone stream). The upper Glenmore River also has no potential for mussels. The Glenmore River was also inspected at Glenmore and this area was ruled out as a potential habitat for mussels. Freshwater Pearl Mussels would also not occur in the River Barrow estuary as the habitats here are unsuitable for this species.

Based on this current survey and absence of any records from this sub catchment the presence of Freshwater Pearl Mussels in the zone of influence of the proposed wind farm development is ruled out.

3.4 Blackwater [Kilmacow]_SC_010 sub-catchment

There are two watercourses within the boundary of the proposed wind farm site that are part of the Blackwater[Kilmacow]_SC_010 sub-catchment. This sub-catchment is shown in Figure 6. These are the Ballyknockbeg stream which runs along the western red line boundary of the proposed Ballyfasy Wind Farm site. This stream flows into the Ballylusky 16 stream, before joining the Blackwater [Kilmacow] River at Mullinvat. The other watercourse is the Smartcastle stream which rises on the site and flows directly south before eventually joining the tidal reaches of the Blackwater [Kilmacow] River just upstream of its confluence with the River Suir estuary.

There is no suitable habitat for Freshwater Pearl Mussels in either the Ballyknockbeg stream or Smartcastle stream on the site. These watercourses are too small, and do not have suitable gradient, to support this species. Both of these watercourses were surveyed up to 1km downstream of the proposed wind farm site boundary. It was again concluded that the habitats in these watercourses were unsuitable and no mussels were found during the survey. It is considered that these watercourses have no potential for this species within the Phase 1 survey area.

The Smartcastle stream was followed south to >5km downstream of the proposed wind farm site and again the presence of mussels was ruled out. This is a highly modified catchment that has been subjected to drainage works in the past. Water quality was also considered to be unsatisfactory with heavy siltation and growths or filamentous algae recorded. It is considered highly unlikely that mussels



are present in this watercourse. Similarly, the Ballyknockbeg stream was followed downstream as far as Mullinvat and was not considered to have any potential for mussels.

There are no Freshwater Pearl Mussel records from the Smartscastle (Stream) or Ballyknockbeg rivers. There is a single historical Freshwater Pearl Mussel record from the River Blackwater [Kilmacow] reported in Moorkens *et al* (1992). However, the species is now likely to be extinct in this catchment. Mussels have been confirmed absent in the areas surveyed within 1km of the wind farm site boundary. It was also considered very unlikely that mussels were present in areas further downstream. The general survey covered areas to >5km downstream and habitats were not considered to be suitable for this species. This is a highly modified catchment and extensive river engineering works have been undertaken in the past. Also, water quality is unsatisfactory.

The presence of Freshwater Pearl Mussels in the zone of influence of the proposed wind farm development is again ruled out.

Table 2 Evaluation of the watercourses affected by the proposed Ballyfasy Wind Farm site in relation to Freshwater Pearl Mussels.

Sub-catchment	River	Tributary	FPM Records	Suitable habitats within 1km	Suitable habitats within 5km	FPMs recorded
Nore_SC_130	Arrigle	Smithstown15	No	No	No	No
	Arrigle		No	No	No	No
Nore_SC_140	Glenmore River	Parkstown Lower*	No	No	No	No
	Glenmore River	Mullennahone	No	No	No	No
	Glenmore River		No	No	No	No
Blackwater[Kilmacow]_SC_010	Blackwater [Kilmacow]	Smartscastle (Stream)	No	No	No	No
		Ballyknockbeg	No	No	No	No

Table 3 Freshwater Pearl Mussel habitat assessments at the 14 selected sites.

Site Number	River	Description	Evaluation
A1	Arrigle	This site was located at a footbridge. The river at this location is highly modified as a result of forestry and agricultural activities. The river here is very low gradient, low flow, and is featureless. The substrate is heavily silted.	No potential mussel habitat present, presence of mussels is ruled out.
A2	Arrigle	The river at this site is larger than at Site A1 and has a rock/cobble substrate. This section has been drained and channelised in the past, with rock armouring present downstream of the bridge. Upstream of the bridge the banks are high with some bank erosion. There have been impacts as a result of encroachments by one-off house developments.	No potential mussel habitat present, presence of mussels is ruled out.
A3	Arrigle	This site was located at the R704 bridge. This section has been drained and channelised in the past. There was a lot of silt in the river at the time of the survey, and some of this appeared to	No potential mussel habitat present, presence of mussels is ruled out.



Site Number	River	Description	Evaluation
		have been recently deposited. The most likely source was considered to be nearby agricultural activities. Extensive macrophyte growth was also present.	
A4	Arrigle	The river is also modified in this area with evidence of historical flood works. The river was a similar size to Site A2 but the banks were lower. The river channel was impacted by agricultural pressures. The substrate was again comprised of rock/cobble substrate. However, it was rated as being unsuitable for mussels.	No potential mussel habitat present, presence of mussels is ruled out.
A5	Arrigle	This stretch of river was considered to have potentially suitable habitat for FPMs. The gradient was moderate, the substrate was dominated by cobbles, biological water quality was good, and the channel was unmodified with well development riparian woodland.	The areas around the bridge were checked and no mussels or dead shells were found. This was a rapid survey but this area was previously surveyed by Moorkens <i>et al</i> (1992) and no mussels were found.
A6	Arrigle	This stretch of river was accessed at a ford. This stretch had similar habitat to Site A5 and was considered to provide potential mussel habitat.	A 100m stretch at the ford was checked and no mussels or dead shells were found. This was a rapid survey but this area was previously surveyed by Moorkens <i>et al</i> (1992) and no mussels were found.
A7	Arrigle	This site was located at Ballyduff mill. This stretch of the river was again considered to be physically suitable for mussels. The river has a moderate gradient, stone/cobble substrate, and overhanging trees at this site. Water quality as considered to be satisfactory.	A 100m upstream from the bridge was checked with a rapid survey and no mussels or dead shells were found. This area was previously surveyed by Moorkens <i>et al</i> (1992) and no mussels were found.
G1	Glenmore River	This river was examined at Glenmore and upstream and is not considered to provide any potential habitat for Freshwater Pearl Mussels. Even at Glenmore this is a relatively small watercourse. The presence of mussel habitat upstream from here is ruled out.	No potential mussel habitat present, presence of mussels is ruled out. No real hydrological connectivity also between the proposed wind farm site and this catchment.
S1	Smartscastle (Stream)	This site is too small and does not have any physically suitable mussel habitat present.	No potential mussel habitat present, presence of mussels is ruled out.
S2	Smartscastle (Stream)	This stream has some physically suitable FPM habitat and the gradient and substrates are somewhat suitable. However, there is evidence of historical river modification and the site was heavily silt with excessive algae growth. A 100m section of the river was checked here and	Presence of mussels is ruled out.



Site Number	River	Description	Evaluation
		the presence of mussels was ruled out.	
S3	Smartscastle (Stream)	This site has been channelised and dredged in the past. This limits its suitability for mussels to be present. The site has some borderline physically suitable mussel habitat but there are no mussels here.	Not mussel habitat, previous drainage works and water quality issues, presence of mussels is ruled out.
S4	Smartscastle (Stream)	This section of the river has been subjected to drainage works in the past and the river bed was lowered with a rock cut. This was likely to have been done to drain the former Lough Cullin. Water quality was poor at this site with visible eutrophication.	No potential mussel habitat present, presence of mussels is ruled out.
B1	Ballyknockbeg	The Ballyknockbeg is a small stream and does not have any mussel potential.	No potential mussel habitat present, presence of mussels is ruled out.
B2	Ballyknockbeg	The Ballyknockbeg is a small stream and does not have any mussel potential.	No potential mussel habitat present, presence of mussels is ruled out.

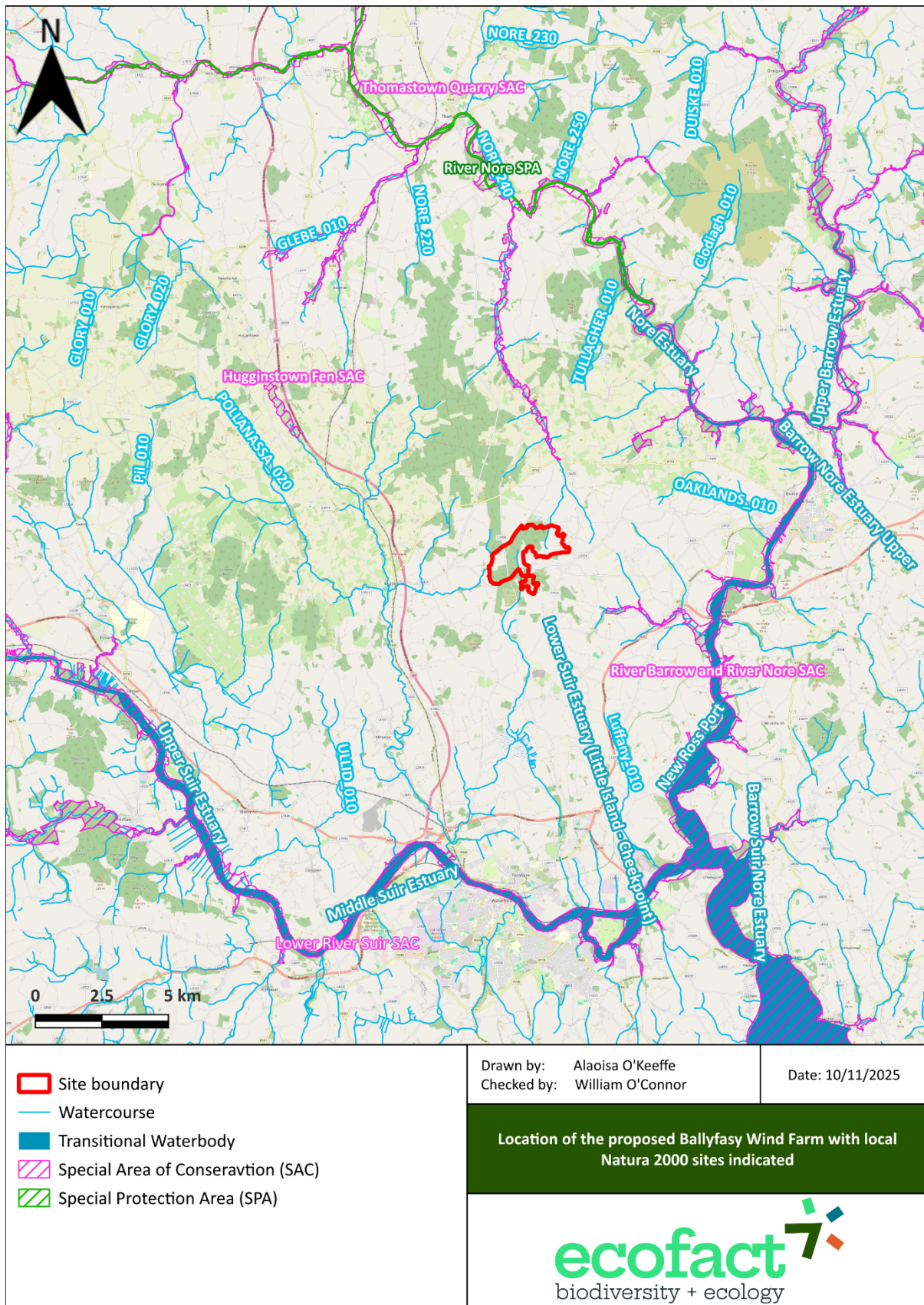


Figure 4 Location of Natura 2000 sites in relation to the proposed Ballyfasy Wind Farm site.

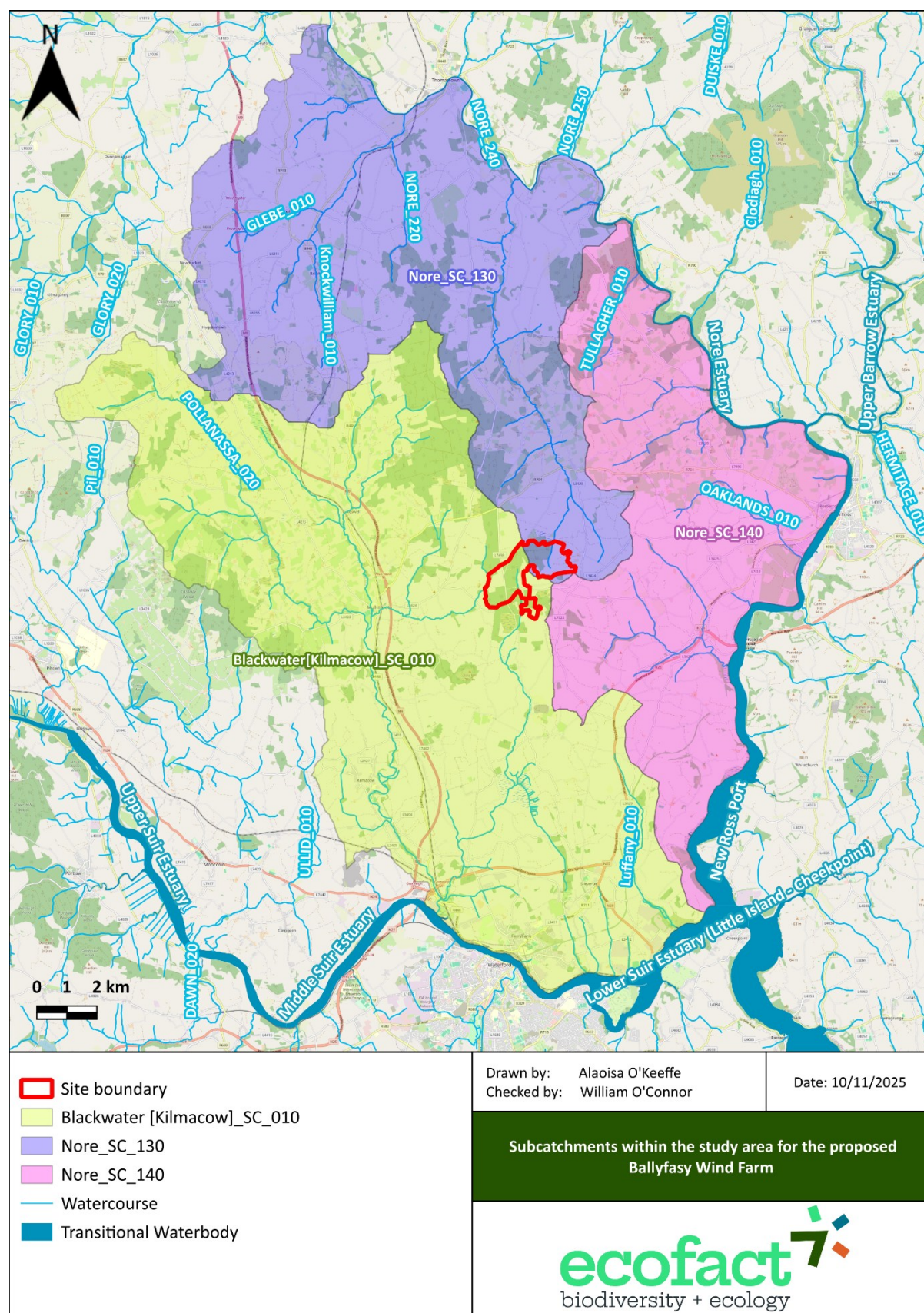


Figure 5 Sub-catchments affected by the proposed Ballyfasy Wind Farm site.

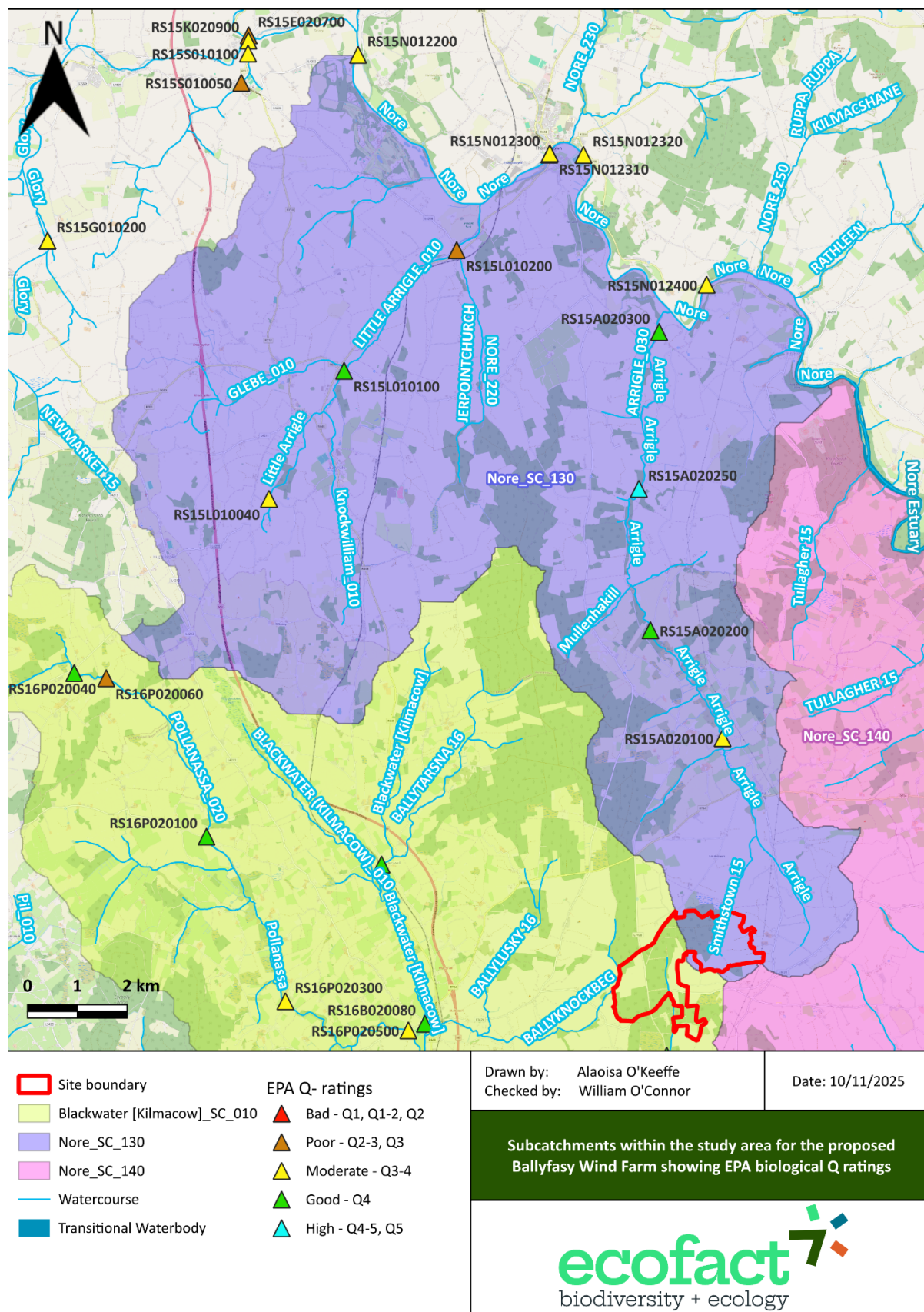


Figure 6 Location of the Nore_SC_130 sub-catchment in relation to the proposed Ballyfasy Wind Farm site.

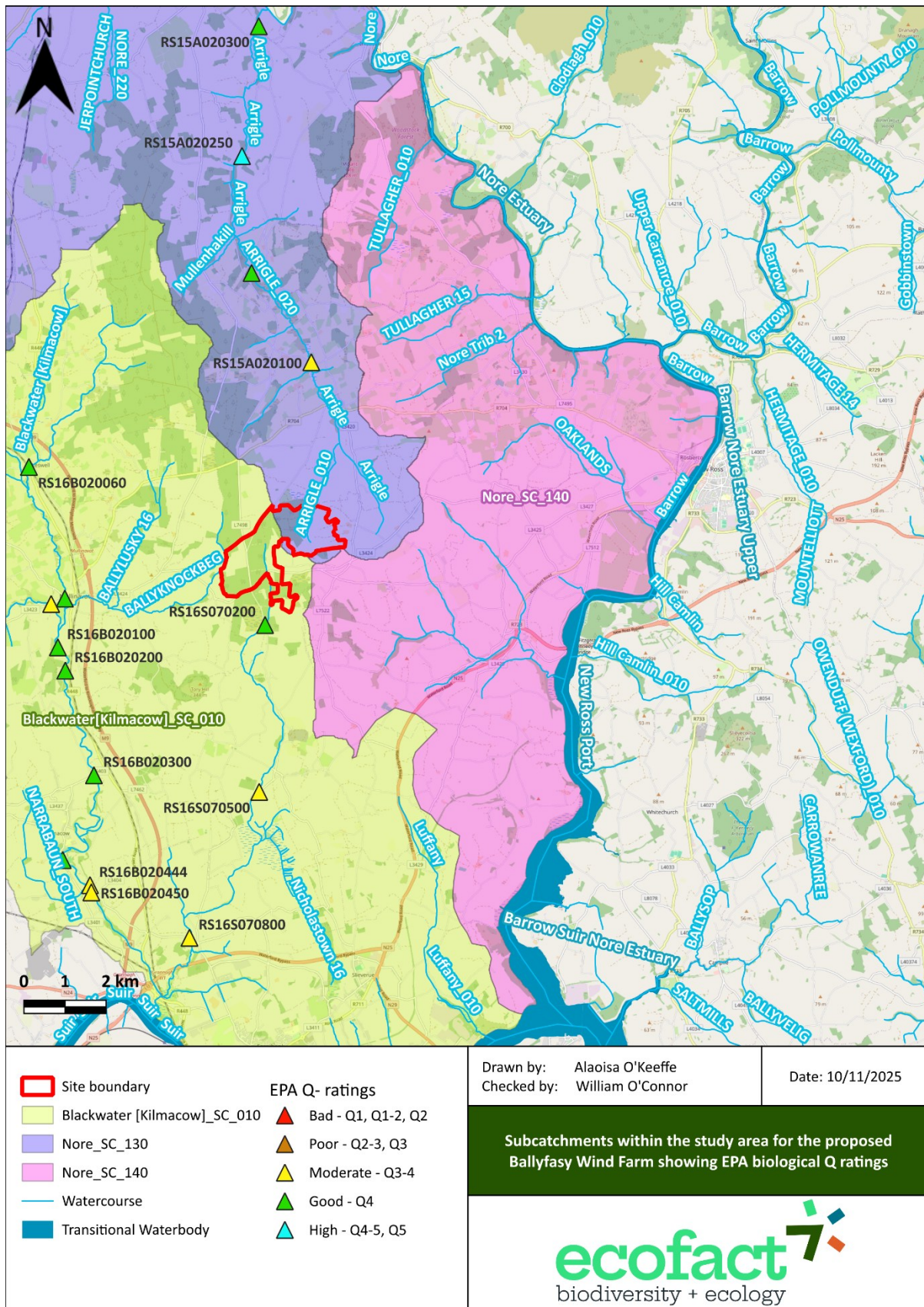
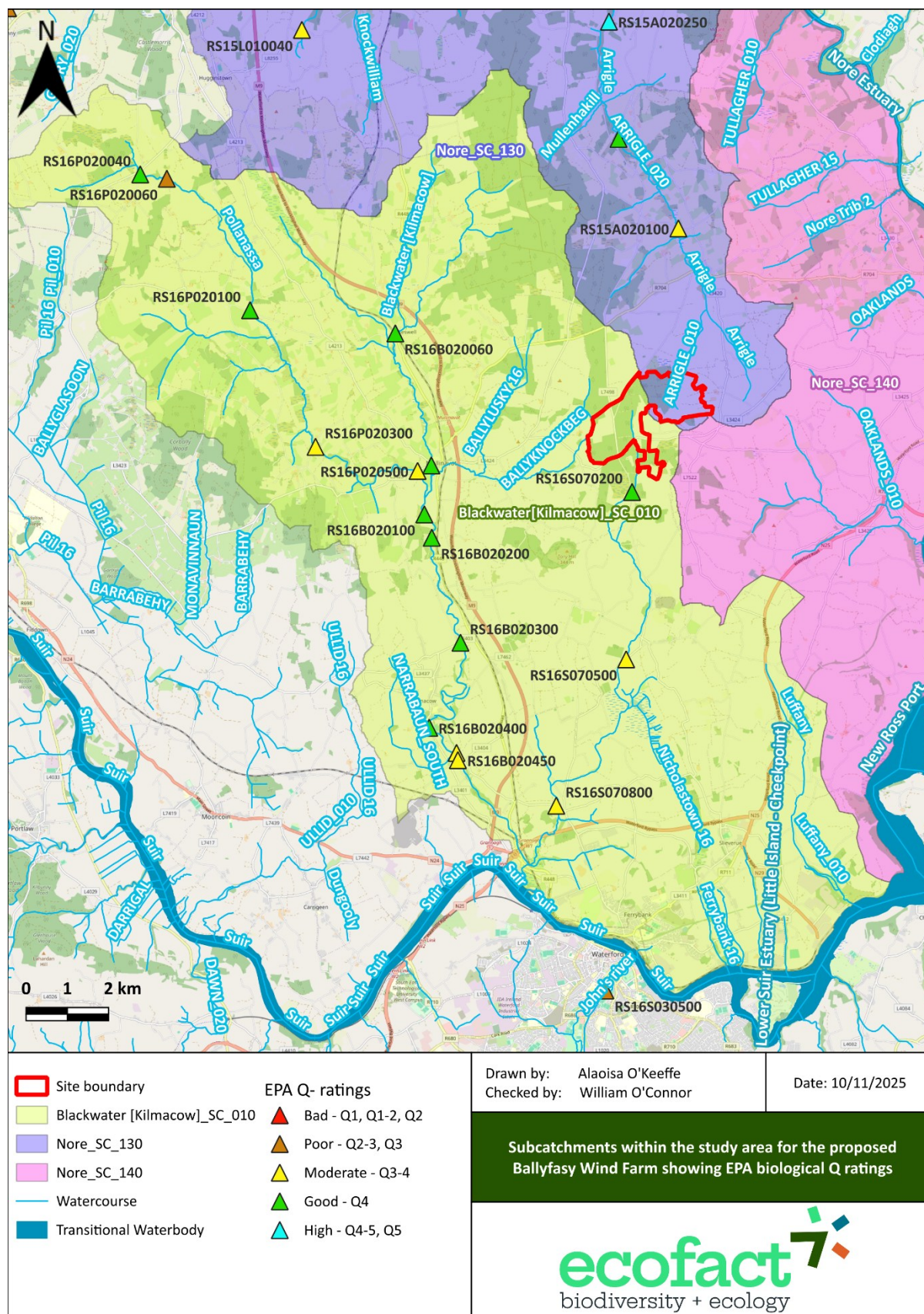


Figure 7 Location of the Nore_SC_140 sub-catchment in relation to the proposed Ballyfasy Wind Farm site.





4. SUMMARY AND CONCLUSIONS

The purpose of the survey was to determine whether Freshwater Pearl Mussels are present within the zone of influence of the proposed wind farm site. The current assessment included a detailed desk study followed by a field survey. The surveys were completed on all the watercourses on and draining from the proposed Ballyfasy wind farm site.

The desk study included a review of all existing records, NPWS designations, and relevant legislation pertaining to this protected species. A detailed assessment of watercourses on the site and to within 1km downstream of the site. A general survey was then completed on all the channels between a 1km and 5km radius of the proposed wind farm site. Further surveys were also completed at locations further downstream. The level of surveys completed was adequate to provide a full evaluation of Freshwater Pearl Mussels in the receiving waters of the proposed wind farm. The survey was conducted in September 2024 under optimal conditions.

The proposed wind farm is upstream of the River Barrow and River Nore SAC and Lower River Suir SAC which are both designated for Freshwater Pearl Mussel [1029]. Three sub-catchments were identified as relevant: Nore_SC_130, Nore_SC_140, and Blackwater[Kilmacow]_SC_010.

There are no records of Freshwater Pearl Mussels in the Nore_SC_130 sub-catchment, which includes the River Arrigle. Field surveys confirmed their absence within 1 km of the wind farm boundary, and no evidence such as dead shells was detected during spot checks further downstream. It was considered unlikely that mussels were present in the River Arrigle. No evidence of mussels or dead shells were recorded during the spot checks completed further downstream.

The River Nore main channel downstream of the River Arrigle confluence is not within the main known distribution of Freshwater Pearl Mussels in the River Nore.

In the Nore_SC_140 sub-catchment, the proposed development overlaps only marginally with this catchment area based on the GIS mapping completed for the current report. There are no existing records of Freshwater Pearl Mussels in this sub-catchment. Inspections of watercourses, including the Parkstown Lower and Mullennahone streams, and the Glenmore River, confirmed the unlikely presence of mussels. Furthermore, there is little likelihood that any drainage from the development site would impact watercourses in this area.

Within the Blackwater[Kilmacow]_SC_010 sub-catchment, two streams (Ballyknockbeg and Smartcastle) drain the proposed wind farm site. There are no existing records of Freshwater Pearl Mussels in this sub-catchment. Surveys conducted within 1 km of the site boundary confirmed their absence, and no evidence of mussels was found during downstream inspections.

It is concluded that Freshwater Pearl Mussels are likely to be absent from all three sub-catchments potentially affected by the proposed Ballyfasy Wind Farm. None of the watercourses draining the proposed wind farm site provide suitable habitat for the species, and their presence was ruled out in all areas surveyed. The River Nore channel downstream of the Arrigle confluence is not considered to be within the zone of influence of the proposed development, assuming effective water-quality protection and sediment-control mitigation measures are implemented. Mitigation required to protect Freshwater Pearl Mussels will need to comply with the Atkinson *et al.* (2024) guidelines.

PLATES



Plate 1 Coniferous plantation on the proposed wind farm site.



Plate 2 The upper reaches of the Smartcastle Stream within the proposed wind farm site.



Plate 3 The upper reaches of the Smartcastle Stream at Ballincrea upper.



Plate 4 The middle reaches of the Smartcastle Stream upstream of Gaulsmills.



Plate 5 The River Arrigle at the R704 bridge.



Plate 6 The middle reaches of the River Arrigle.



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